### Crop Rotation Calendar

<table>
<thead>
<tr>
<th></th>
<th>Dec / Jan / Feb</th>
<th>Mar / Apr / May</th>
<th>Jun / Jul / Aug</th>
<th>Sep / Oct / Nov</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perennial Forages</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summer Annuals</strong></td>
<td></td>
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<tr>
<td><strong>Spring Annuals</strong></td>
<td></td>
<td>Summer Annuals</td>
<td></td>
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</tr>
<tr>
<td><strong>Winter Annuals</strong></td>
<td>Winter Annuals</td>
<td></td>
<td>Winter Annuals</td>
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</tr>
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</table>

**Crops Grown Out of Their Natural Season**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Oats</th>
<th>Ann. Ryegrass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Ryegrass</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Perennials:** alfalfa, red & ladino clover, timothy, brome, orchard, tall & meadow fescue, perennial rye, reed canarygrass, chicory

**Summer Annuals:** BMR sorghum/sudan, sudangrass, teff, millet, cowpeas, soybean, buckwheat

**Spring Annuals:** oats, spring grains, field pea, brassicas (kale/radish/rape/swede), annual ryegrass, crimson clover, balansa clover

**Winter Annuals:** winter rye & winter grains, hairy vetch, crimson clover??, Austrian winter pea, balansa clover??
Strategies for extending the grazing season

Several strategies can be employed to supply forage into the fall or early winter and effectively extend the grazing season by 60 to 90 days, thus reducing the need for stored feeds. These strategies can be categorized into two major groups: 1) stockpiling (conserving cool-season forages in late summer for use in the fall and winter), or 2) utilizing forage crops that continue to grow in the fall and early winter.

STOCKPILING

Not all cool-season species are adapted to stockpiling. Most species reduce their growth in the fall because of shorter day lengths and/or they lose their leaves (quality) after being frosted. Tall fescue and birdsfoot trefoil are two forage species which are suited to stockpile management because they continue to grow in the fall and do not lose leaves as readily as other cool-season species do after frost.

Tall Fescue

Tall fescue is a deep-rooted, long-lived, sod-forming grass that spreads by short underground stems called rhizomes. It is drought resistant and will maintain itself under rather limited fertility conditions. Animals readily graze tall fescue during the fall, but show some reluctance to graze it during the summer months of July and August. Some of this reduced summer palatability, which results in poor animal performance, is associated with the presence of a fungus in the plant (endophytic). Endophyte-free varieties are now available and are recommended for new seedings. Tall fescue is the best adapted cool-season grass for stockpiling (Table 1).

Adapted Varieties

Numerous tall fescue varieties are being marketed in Pennsylvania, however, only endophyte-free varieties should be selected when seedings are to be grazed. ‘Johnstone,’ ‘Festorna,’ and ‘Barcel’ tall fescue varieties have performed well in Penn State studies. They are endophyte-free and of high quality.

Grazing Management

Tall fescue can be part of a forage program but should not be all of it. Legumes with tall fescue improve animal performance and increase forage production during the summer. Tall fescue will withstand closer grazing and more abuse than most cool-season grasses. But it can be overgrazed to the point that vigor and production are reduced. Don’t graze closer than three or four inches, and allow at least 30 days in mid-summer for the tall fescue to recover.

To stockpile tall fescue, don’t graze it from mid- or late August through mid-October. Cattle and sheep perform less than optimally on it during this period. Fertilize with 50 lb nitrogen/acre and allow the growth to accumulate for use in the fall or winter.

Stockpiling and nitrogen fertilizer allow accumulation of forage, however, this results in low tiller density, increased winter injury, and slow recovery in the spring (Table 2).

Table 1. Yield of grasses during three summer periods in Pennsylvania.

<table>
<thead>
<tr>
<th>Species</th>
<th>Early summer</th>
<th>Mid-summer</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tons/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall fescue</td>
<td>3.9</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Reed canarygrass</td>
<td>3.8</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>3.1</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Smooth bromegrass</td>
<td>3.5</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Timothy</td>
<td>3.8</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>2.5</td>
<td>0.4</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Table 2. Ground cover of five cool-season grasses harvested three, five, or eight times per year.

<table>
<thead>
<tr>
<th>N level</th>
<th>Harvests per yeara</th>
<th>KGB</th>
<th>TF</th>
<th>OG</th>
<th>SB</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>lb/yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>3</td>
<td>55</td>
<td>95</td>
<td>90</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>85</td>
<td>98</td>
<td>95</td>
<td>25</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>88</td>
<td>98</td>
<td>100</td>
<td>15</td>
<td>55</td>
</tr>
<tr>
<td>300</td>
<td>3</td>
<td>10</td>
<td>12</td>
<td>60</td>
<td>55</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>55</td>
<td>80</td>
<td>85</td>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>80</td>
<td>100</td>
<td>100</td>
<td>25</td>
<td>55</td>
</tr>
</tbody>
</table>

aThree harvests per year simulates a stockpile management system.
bKGB=Kentucky bluegrass, TF=tall fescue, OG=orchardgrass, SB=smooth bromegrass, T=timothy.
The most important thing to remember is that while stockpiling can provide large quantities of herbage for late fall and early winter grazing, it will also delay recovery in the spring. At modest rates of nitrogen fertilization, stands of tall fescue will not deteriorate as fast as other cool-season grasses under stockpiling.

For more information about tall fescue, refer to Tall Fescue, Penn State Agronomy Facts 28.

**Birdsfoot Trefoil**

Birdsfoot trefoil is a perennial legume adapted to production on poorly drained, low pH soils. It can reseed itself, is resistant to *Phytophthora* root rot and numerous alfalfa insects, responds well to fertilization, and does not cause bloat in animals. These characteristics have expanded its use in the northern United States and southern Canada where the production of other forage legumes is limited. Birdsfoot trefoil is well suited for stockpiling since it holds its leaves at maturity and after frost, thus maintaining a relatively high level of quality.

**Adapted Varieties**

About 25 varieties of birdsfoot trefoil are available in the United States and Canada. Birdsfoot trefoil varieties are generally characterized by growth habit into two types, Empire and European. Both types are referred to as "broadleaf" trefoils.

Empire-type birdsfoot trefoils are better adapted for grazing situations than the European types because they have fine stems, prostrate growth, and indeterminate growth habit. The Empire types grow slower during establishment and regrow more slowly following harvest than the European types. ‘Dawn’ and ‘Empire’ are high-yielding, Empire-type varieties that have performed well in Pennsylvania tests.

European-type birdsfoot trefoils are better adapted to hay production because they are more erect, establish faster, and regrow faster after harvest than the Empire type.

**Grazing Management**

To stockpile birdsfoot trefoil, avoid grazing between September 1 and the first killing frost. This period is needed to accumulate root reserves that improve winter survival and growth the following spring. The forage that accumulates during the stockpiling period can be grazed anytime after a killing frost.

Refer to Birdsfoot Trefoil, Penn State Agronomy Facts 20, for more information about production and management of this forage species.

**FALL GROWING FORAGE CROPS**

The growth of some forage species is not as adversely affected by cooler fall weather and shorter day lengths as are many cool-season forages. The species which seem to grow best in the fall are tall fescue, prairie grass, perennial ryegrass, and certain brassica crops. These species can provide a valuable feed supply for extending the grazing season.

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**Prairie Grass** *Bromus wildenovii*

Prairie grass is a tall growing perennial grass that is suited to well drained soils with medium to high fertility levels and a pH of 6.0 or greater. It is a type of bromegrass, but is different from smooth bromegrass in that it does not have rhizomes and it produces seed heads in each growth period, especially during the summer. Herbage and immature seedheads of prairie grass are highly palatable. It is an excellent grass for providing forage during droughts and for extending the grazing season well into the fall in Pennsylvania.

Fall harvesting (grazing) improves the winter persistence of prairie grass. It will persist for four to six years in Pennsylvania if properly managed. Forage quality of prairie grass compares well with other cool-season grasses but is more palatable.

**Adapted Varieties** *does not overwinter in NY*

‘Matua’ is the only cultivar of prairie grass that is currently sold in the United States. This variety was developed under New Zealand grazing conditions and has been very productive in Pennsylvania. Other prairie grass varieties are being evaluated for persistence and productivity by the USDA-Pasture Laboratory and Penn State; however, none of these varieties is marketed commercially in Pennsylvania at this time.

**Grazing Management**

Prairie grass is an ideal grass for grazing systems because of its potential for earlier spring grazing and its fall growth can effectively extend the grazing season by as much as two months over traditional cool-season grass species. Fall yields of nearly 3.5 tons/acre are possible. In addition, because seed heads are palatable, it is not necessary to mow them to maintain animal intake as may be needed with other grasses. Yields of nearly 7 tons/acre have been achieved when harvesting prairie grass for silage.

Prairie grass should not be cut or grazed below a 3-inch stubble height because regrowth energy reserves and buds for plant regrowth are contained in this portion of the plant.

In established prairie grass stands, delaying the first spring grazing will reduce recovery rate and lower the yield potential of the next cutting. Under normal weather conditions, about 25 to 30 days of regrowth is sufficient between harvests. This period is a good balance between yield and quality of prairie grass. Generally, during this time, new shoots have developed at the base of the plant and harvesting or grazing will allow more light to reach the shoots and to stimulate their growth. An approximate 50-day growth period in mid-summer will allow the prairie grass seed heads to mature and drop seed during August which, in turn, will thicken the stand the following year.

Prairie grass persists best when managed so that monthly harvests are made during the fall; spring yield and shoot density increase when multiple harvests are made in the fall. Harvesting only once in the fall (November) has caused 98 percent of the basal shoots (source for growth the
following spring) to winter kill. However, when prairie grass was harvested or grazed three times during the fall only 35 percent of the basal shoots were winter killed. Compromise is needed with regard to fall harvesting because late fall grazing reduces slightly prairie grass vigor the following spring and restricts early spring grazing.

Adequate nitrogen fertilization is essential for maximizing prairie grass growth in the fall. Nitrogen applications of 50 lb/acre are recommended after each harvest and in early fall.

For more information about the production and management of prairie grass, refer to Prairie Grass. Penn State Agronomy Facts 39.

**Forage Brassicas**

Brassicas are annual crops which continue to grow during the fall and into the winter. They are highly productive and digestible and contain relatively high levels of crude protein. They can be grazed 80 to 150 days after seeding, depending on the species and weather (Table 3). In addition, some varieties lend themselves to stockpiling.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Plant part consumed</th>
<th>Seeding to harvest days</th>
<th>Regrows after harvest</th>
<th>Seeding rate pounds/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kale</td>
<td>herbage</td>
<td>150 to 180³</td>
<td>no³</td>
<td>3.5 to 4</td>
</tr>
<tr>
<td>Rape</td>
<td>herbage</td>
<td>80 to 90</td>
<td>yes</td>
<td>3.5 to 4</td>
</tr>
<tr>
<td>Swede</td>
<td>herbage and root</td>
<td>150 to 180</td>
<td>no</td>
<td>1.5 to 2</td>
</tr>
<tr>
<td>Turnip</td>
<td>herbage and root</td>
<td>80 to 90</td>
<td>yes</td>
<td>1.5 to 2</td>
</tr>
</tbody>
</table>

³ An exception is the stemless variety ‘Premier’ which is ready for harvest 80 to 90 days after seeding and will regrow after harvest if not grazed below three to four inches.

**Species and Varieties**

Several brassica species can provide forage for grazing during the fall. These include:

**Kale**—The stemless variety ‘Premier’ has consistently survived winters in central Pennsylvania, whereas other varieties of kale usually have winter-killed in December.

**Rape**—Growth of rape slows or ceases at maturity until leaves senesce and die. Varieties differ in the time this occurs. For instance, ‘Rangi’ rape retains its leaves longer than most varieties, which makes it more suitable for stockpiling and winter grazing than other rape varieties.

**Swede**—The variety ‘Caldier’ has been cold hardy in central Pennsylvania and thus ideal for stockpiling for late-fall or early-winter grazing. However, in general, all swede varieties are recommended for late-fall grazing.

**Turnip or Turnip Hybrids**—Pennsylvania studies have shown that ‘Forage Star’ turnip is more cold tolerant and retains its leaves longer in the fall than other turnip varieties. Turnip can accumulate dry matter in October as fast as field corn does in August. Growing “out of season” (October and November) makes turnip a valuable crop for late fall grazing.

**Grazing Management**

Proper grazing management is important to optimize the true potential of these crops. Strip grazing small areas of brassicas provides the most efficient utilization.

Rape is more easily managed for multiple (generally more than two) grazings than are the other brassica species. Approximately six to ten inches of stubble should remain after the first grazing of rape; this practice promotes rapid regrowth. Regrowth of rape may be grazed at four-week intervals. On the final grazing, the plants should be grazed close to ground level.

When turnips are grazed twice, the first grazing should remove only their tops. Turnip regrowth is initiated at the top of the root, so this part of the plant should not be removed until the second and final grazing. Like rape, regrowth of turnips can be sufficient to graze within four weeks of the first grazing.

Diseases of brassicas are generally not a problem until the plants near maturity. Stockpiling should not be attempted in fields where brassicas have high levels of foliar disease at maturity. Research has shown yield reductions of 40 percent when disease infected brassica crops were stockpiled for 45 days. Generally, ‘Forage Star’ turnip and ‘Rangi’ rape are better suited for stockpiling than other varieties because of lower disease infestation. To reduce club root occurrence, brassicas should not be grown on the same field for more than two consecutive years.

**Yield and Nutritional Value**

Dry matter digestibility at maturity generally exceeds 90 percent for all plant parts except kale stems. Unlike perennial forage crops, the dry matter digestibility of brassicas does not decrease markedly with increasing plant
maturity. This characteristic makes them ideal for stockpiling. However, ruminant diets should not contain more than 75 percent brassica forage because the fiber content is too low for maintenance of proper rumen activity. With their high digestibility and low fiber content, brassicas actually should be considered as "concentrates" rather than "forage" in nutritional planning for livestock.

For more information about brassicas, refer to Use of Brassica Crops to Extend the Grazing Season, Penn State Agronomy Facts 33.

Small Grains
The use of winter cereal crops such as wheat, barley, rye, or triticale can provide fall 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 to be used for grazing, plant them three to four weeks earlier than for grain production. Increase the seeding rate to 3 bu/acre and apply nitrogen at the rate of 40 lb/acre at planting time.

If the small grains are being planted only for pasture (with no subsequent grain harvest), there may be some benefit to mixing small grains species. This has been beneficial in the southeast United States, where small grains pastures are quite common. Mixing species of rye, wheat, barley, or triticale can help extend the grazing period and reduce the tendency for a strong peak growth period in the spring.

Grazing Management
With adequate fall moisture, grazing should be available from October through December and then again in early spring. One acre of properly fertilized and managed small grains should support one animal unit (1,000 lb animal) on a limited grazing basis.

Stocking rate and time of grazing will be somewhat determined by the intended use of the crop. If you are planning to take a silage or grain harvest, grazing should only be moderate. Heavy grazing can reduce grain yields. Moderate grazing in the fall will not result in significant silage or grain losses provided that 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.

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 6). Small grains plants will be injured by grazing at any time after their growing points are above the ground.

Temporary electric fencing should provide a practical way to manage these pastures. Although small grains can be continuously grazed, a rotational or strip grazing practice may allow a higher carrying capacity (less wastage from trampling).

Small grains pasture is lush, high in protein, and low in fiber during most of the fall grazing period. Crude protein levels normally range from 15 percent to 34 percent of dry matter, making this forage an excellent protein supplement for many classes of livestock.

Animal Health Precautions
Grass tetany can occur when small grains forage is grazed by cows about to calve or those which have recently calved. This usually occurs in the spring. It is recommended that animal diets be supplemented with a mineral mix containing magnesium. Lactating dairy cows that are grazing small grain pasture should receive an additional 1 ounce of magnesium oxide/cow/day.

There is a risk of nitrate poisoning if animals graze rapidly growing and recently fertilized small grains pasture. Avoid this situation by applying nitrogen fertilizer at planting time or well before the intended grazing period.

Although rare, bloat may also be a health risk when animals graze small grains. This most likely will occur when animals are first turned onto pasture in early spring and gorge themselves with the lush forage. Bloat can be prevented by feeding some stored forage just before turning the animals onto the pasture.
Extending grazing and reducing stored feed needs

Don Ball
Ed Ballard
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Garry Lacefield
Dan Undersander
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.

**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.
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...
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.

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.

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

![Graph showing stockpile yields at various nitrogen rates and application dates](image)

*aGeographical location will affect the suitability of various dates of application.

Source: Jim Gerrish, University of Missouri, 1997.
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 ½ 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 corn stalks 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.

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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.

<table>
<thead>
<tr>
<th>Item</th>
<th>Husk</th>
<th>Leaf</th>
<th>Stem</th>
<th>Cob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residue (% of total dry matter)</td>
<td>12</td>
<td>27</td>
<td>49</td>
<td>12</td>
</tr>
<tr>
<td>Crude protein (% by plant part)</td>
<td>3.6</td>
<td>7.8</td>
<td>4.5</td>
<td>2.2</td>
</tr>
<tr>
<td>In vitro dry matter disappearance (%)</td>
<td>67</td>
<td>47</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Palatability</td>
<td>high</td>
<td>high</td>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>

\[a\] Includes leaf sheath.

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

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.

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**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.

- 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.

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Crop residues can be an inexpensive source of nutrition.
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.

<table>
<thead>
<tr>
<th>Grazing systems</th>
<th>Continuous</th>
<th>Rotational</th>
<th>Change, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocking rate, cow-calf units/acre</td>
<td>0.50</td>
<td>0.69</td>
<td>+38</td>
</tr>
<tr>
<td>Calf weaning weight, lb</td>
<td>500</td>
<td>496</td>
<td>0</td>
</tr>
<tr>
<td>Total calf gain/acre, lb</td>
<td>248</td>
<td>340</td>
<td>+37</td>
</tr>
<tr>
<td>Cow pregnancy rate, %</td>
<td>96</td>
<td>95</td>
<td>0</td>
</tr>
<tr>
<td>Hay fed/cow, lb</td>
<td>2,570</td>
<td>1,750</td>
<td>−32</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Item</th>
<th>Hay</th>
<th>Cornstalks</th>
<th>Stockpiled tall fescue</th>
<th>Ryegrass + cereal rye</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/cow/day*a</td>
<td>100%</td>
<td>4%</td>
<td>23%</td>
<td>46%</td>
</tr>
<tr>
<td>Days of use</td>
<td>130 (hay)</td>
<td>60 (stalks)</td>
<td>90 (graze)</td>
<td>90 (graze)</td>
</tr>
<tr>
<td>70 (hay)</td>
<td>40 (hay)</td>
<td>40 (hay)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wintering cost*a</td>
<td>100%</td>
<td>71%</td>
<td>41%</td>
<td>63%</td>
</tr>
</tbody>
</table>

*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.

**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.)

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

**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.

- **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, carry-over 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.

**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
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.

<table>
<thead>
<tr>
<th></th>
<th>Lax management</th>
<th>Good management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incremental a</td>
<td>Additive b</td>
</tr>
<tr>
<td>Field curing</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Harvesting</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>Storage</td>
<td>35</td>
<td>58</td>
</tr>
<tr>
<td>Feeding</td>
<td>30</td>
<td>71</td>
</tr>
<tr>
<td><strong>Total loss</strong></td>
<td>—</td>
<td>71</td>
</tr>
</tbody>
</table>

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.
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.
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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*The USDA/NRCS is an equal opportunity provider and employer.*
Grazing Too Short in Fall and Winter Can Mean More Weeds in the Spring

Back in September of 2016, On Pasture readers were wondering if their fall and winter grazing might have an impact on the health of their pastures come spring. Turns out, it's always a good idea to leave enough grass so you don't add to your spring weed problems.

Results of a study by University of Wisconsin-Madison researchers show that if you graze shorter you're helping weed seeds get the light and resources they need to germinate well in the spring. Their study focused on burdock, but results could be similar for other weed species that germinate in early spring.

Agroecology Researcher Mark Renz and Marie Schmidt hypothesized that fewer burdocks would be established where more residual grass blocked sunlight from reaching the ground in March through early April when burdocks and other weeds begin growing. To test their idea, they clipped pasture plots to mimic grazing to five different heights: two inches, four inches, six inches, eight inches and unclipped. This November clipping was timed so it was as similar as possible to managed grazing pastures nearby.

Since burdock needs light to germinate, Renz and Schmidt went back to their plots in April to measure the amount of light being intercepted by foliage. As you’d guess, the shorter the foliage, the more light made it to the ground. The plots grazed to two and four inches at the Arlington farm intercepted 41% less light than the six and eight inch plots. At the Franbrook Farm the four inch plots intercepted 34% less light than the six and eight inch, and unclipped plots.
Though the differences in how much light was being intercepted diminished as the grass grew into May, the damage was already done. There was more burdock in the plots that were clipped shorter. At the Arlington Farm, researchers found that when only 30 percent of the light was intercepted, as it was in the two and four inch clipped plots, they could predict .46 burdock plants per square foot, or 20,000 per acre. With residual of 6 to 8 inches, 75 percent of the light was intercepted for .17 burdock per square foot or only about 7400 per acre.

It’s important to note that the researchers found differences in their plots between the two farms. Franbrook started with lower weed densities than the Arlington Farm, and also had a greater diversity of pasture plants. Overall there were fewer burdock at Franbrook, even in plots clipped to two and four inches.

**What Can You Expect?**

Renz and Schmidt’s study shows that retaining a six to eight inch residual height through the fall and into the start of the next grazing season can reduce burdock establishment by an average of 82 percent. They expect that other biennial pasture weeds such as bull thistle and common mullein may react similarly. They also pointed out that your results may vary because animals don’t graze each plant to the exact same height, and some may even graze burdock.

### Some Biennial Weeds

(Rosette in year one and flowers in year two and only spread from seed)

<table>
<thead>
<tr>
<th>Blueweed</th>
<th>Musk Thistle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdock</td>
<td>Mustards</td>
</tr>
<tr>
<td>Bull Thistle</td>
<td>Plumeless thistle</td>
</tr>
<tr>
<td>Buttercup</td>
<td>Prickly lettuce</td>
</tr>
<tr>
<td>Common Mullein</td>
<td>Rough Cinquefoil</td>
</tr>
<tr>
<td>Damask violet</td>
<td>Scotch thistle</td>
</tr>
<tr>
<td>Diffuse knapweed</td>
<td>Spotted Knapweed</td>
</tr>
<tr>
<td>Evening Primrose</td>
<td>Spotted Water Hemlock</td>
</tr>
<tr>
<td>Garlic mustard</td>
<td>Teasel</td>
</tr>
<tr>
<td>Houndstongue</td>
<td>Wild Carrot</td>
</tr>
<tr>
<td>Mallow</td>
<td>Wild Parsnip</td>
</tr>
<tr>
<td>Mares Tail</td>
<td>Yellow Salsify</td>
</tr>
</tbody>
</table>

### Can’t Beat It? Eat It!

Burdock is actually a quite palatable weed, high in nutritional value for both livestock and humans. While it’s fallen out of favor in European cuisine, the taproot is still harvested and eaten as a vegetable in Japan. Cut the stalks before they flower, peel them and boil them in water and you have a vegetable that tastes like an artichoke (to which burdock is related).

*Let us know how your grazing goes, both by livestock and in your own kitchen!*

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Thanks to the National Grazing Lands Coalition for making this article possible.

NatGLC’s The 7th National Grazing Lands Conference is coming up in December 2 – 5 in Reno. It’s one of On Pasture’s favorites because folks just like you are the speakers, sharing their great experiences. Register before October 16 to get the best price. It’s just $395 for you and you can bring a friend or spouse for $175 more. On Pasture will be there. Come see us!

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FALL GROWING FORAGE: Brassicas

Brassicas are annual crops which continue to grow during the fall and into the winter. They are highly productive and digestible and contain relatively high levels of crude protein. They can be grazed 80 to 150 days after seeding, depending on the species and weather (Table 3). In addition, some varieties lend themselves to stockpiling.

Species and Varieties

Several brassica species can provide forage for grazing during the fall. These include:

**Kale** - The stemless variety `Premier' has consistently survived winters in central Pennsylvania, whereas other varieties of kale usually have winter-killed in December.

**Rape** - Growth of rape slows or ceases at maturity until leaves senesce and die. Varieties differ in the time this occurs. For instance, `Rangi' rape retains its leaves longer than most varieties, which makes it more suitable for stockpiling and winter grazing than other rape varieties.

**Swede** - The variety `Calder' has been cold hardy in central Pennsylvania and thus ideal for stockpiling for late-fall or early-winter grazing. However, in general, all swede varieties are recommended for late-fall grazing.

**Turnip or Turnip Hybrids** - Pennsylvania studies have shown that `Forage Star' turnip is more cold tolerant and retains its leaves longer in the fall than other turnip varieties. Turnip can accumulate dry matter in October as fast as field corn does in August. Growing "out of season" (October and November) makes turnip a valuable crop for late fall grazing.

Grazing Management

Proper grazing management is important to optimize the true potential of these crops. Strip grazing small areas of brassicas provides the most efficient utilization.

Rape is more easily managed for multiple (generally more than two) grazings than are the other brassica species. Approximately six to ten inches of stubble should remain after the first grazing of rape; this practice promotes
rapid regrowth. Regrowth of rape may be grazed at four-week intervals. On the final grazing, the plants should be grazed close to ground level.

When turnips are grazed twice, the first grazing should remove only their tops. Turnip regrowth is initiated at the top of the root, so this part of the plant should not be removed until the second and final grazing. Like rape, regrowth of turnips can be sufficient to graze within four weeks of the first grazing.

Diseases of brassicas are generally not a problem until the plants near maturity. Stockpiling should not be attempted in fields where brassicas have high levels of foliar disease at maturity. Research has shown yield reductions of 40 percent when disease infected brassica crops were stockpiled for 45 days. Generally, `Forage Star' turnip and `Rangi' rape are better suited for stockpiling than other varieties because of lower disease infestation. To reduce club root rot occurrence, brassicas should not be grown on the same field for more than two consecutive years.

**Yield and Nutritional Value**

Dry matter digestibility at maturity generally exceeds 90 percent for all plant parts except kale stems. Unlike perennial forage crops, the dry matter digestibility of brassicas does not decrease markedly with increasing plant maturity. This characteristic makes them ideal for stockpiling. However, ruminant diets should not contain more than 75 percent brassica forage because the fiber content is too low for maintenance of proper rumen activity. With their high digestibility and low fiber content, brassicas actually should be considered as "concentrates" rather than "forage" in nutritional planning for livestock.
Characteristics & Adaptation of Brassica Crops

Cool-season perennial grass and grass-legume pastures typically become less productive as the grazing season advances from June to November. Forage brassica crops such as turnip, swede, rape, and kale can be spring-seeded to supplement the perennial cool-season pastures in August and September or summer-seeded to extend the grazing season in November and December. Brassicas are annual crops which are highly productive and digestible and can be grazed 80 to 150 days after seeding, depending on the species. In addition, crude protein levels are high, varying from 15 to 25 percent in the herbage and 8 to 15 percent in the roots depending on the level of nitrogen fertilization and weather conditions.

Adapted Brassica Species & Varieties

Kale (Brassica oleracea L.)

Varieties of kale differ markedly in rate of establishment, stem development, time required to reach maturity, and in winterhardiness. The stemless type kale (e.g. Premier) has a faster rate of establishment than varieties which produce stems. Crop height of the stemless type is approximately 25 inches, whereas that of marrow stem kale is 60 inches with primary stems often 2 inches in diameter. Stemless kale attains maturity in approximately 90 days, allowing two crops/year, whereas varieties that develop stems require 150 to 180 days to attain maximum production (Table 1). Premier has consistently survived winters in central Pennsylvania, whereas other varieties of kale usually are winter-killed in December.

Rape (Brassica napus L.)

Mature forage rape is one of the best crops available for fattening lambs and flushing ewes. Rape is a multistemmed crop with fibrous roots. The stems vary in length, diameter, and in palatability to livestock. Forage yields of spring-planted rape increase until plants become physiologically mature. Growth slows or ceases at maturity and yields plateau until leaves senesce and die. Varieties differ in when this occurs, however, Rangi rape retains its leaves longer than most varieties. Generally, yields of rape varieties in Pennsylvania are maximized with two, 90-day growth periods (Table 1). However, performance of Emerald and Winfred rape varieties, is best with one 180-day growth period, and yields of rape hybrids were greatest with 60 days of growth before the first harvest and a 30-day growth period before the second harvest.
Swede (Brassica napus L.)

Like turnip, swedes produce a large edible root. Yields are higher than those of turnip, but they grow slower and require 150 to 180 days to reach maximum production. Swedes usually produce a short stem (neck), but can have stems 2 1/2 feet long when grown with tall crops which shade the swede. Unfortunately, stem elongation is at the expense of root development. The variety Calder was found to be cold hardy in central Pennsylvania and thus ideal for stockpiling and late fall or early winter grazing (Table 1). In general, all swede varieties are recommended for late fall grazing.

Turnip (Brassica rapa L.) or Turnip Hybrids

These crops grow very fast, reaching near maximum production levels in 80 to 90 days (Table 1). Studies in southwestern Pennsylvania showed that turnip can accumulate dry matter in October as fast as field corn does in August. Growing "out of season" (October/November) makes turnip a valuable crop for late fall grazing.

The proportions of tops and roots varies markedly depending on variety, crop age, and planting date. Research by the USDA Pasture Laboratory showed that turnip crops can vary from 90 percent tops/10 percent roots to 15 percent tops/85 percent roots. Some hybrids have fibrous roots which will not be readily grazed by livestock. All varieties produce primarily tops during the first 45 days of growth. Sixty to 90 days after seeding, turnip varieties such as Savannah and All Top continue to produce a high proportion of tops. During the same period, other turnip varieties have nearly equal top and root production and Purple Top has a greater root than top production. The significance in the proportion of tops and roots is that the crude protein concentration (8 to 10%) of roots is approximately one-half of that in turnip tops. Therefore, greater root production tends to reduce the crude protein yield of the total crop. On the other hand, stockpiled tops appear to be more vulnerable to weather and pest damage than roots. Varieties differ in resistance to diseases, but this often is not evident until the crop is more than 80 days of age and the plants are reaching full production.

Other Forage Brassicas

Several hybrids of brassica species are also used as forage crops, however, there is limited research information on the production and management of these hybrids. The more common hybrids include a cross between Chinese cabbage (Brassica campesteris sensulato L.) and rape (Perko), turnip (Tyfon, Buko), and swede (Wairangi).
Brassica Crop Establishment

All brassica crops require good soil drainage and a soil pH between 5.3 and 6.8 for optimum production. Good stands can be established by planting 3.5 to 4 pounds per acre of kale or rape, or 1.5 to 2 pounds per acre of swede or turnip. The higher seeding rates are recommended for spring plantings. The seeds should be planted in rows 6 to 8 inches apart and not more than one-half inch deep. However, brassica seed can also be broadcast and incorporated into tilled seedbeds by cultipacking. When preparing a tilled seedbed for brassica planting, plow the ground several weeks before planting to allow weed seeds to germinate before secondary tillage is completed to form a firm and fine seedbed that is free of weeds. In addition, the preplant incorporated herbicide, Treflan (Trifluralin), is labeled at 0.5 to 1.0 pint active ingredient per acre for control of annual grass and small seeded broadleaf weeds in brassicas.

Brassica stands can also be established by no-till planting in grass sod that is suppressed with paraquat or glyphosate herbicides. Read pesticide labels and precautions before using either of these herbicides. Ideally, the grass sod should be grazed through June with the grazing prior to brassica seeding being very close. Approximately two weeks before planting the herbicide should be applied to the grass sod. Another option for no-till establishment would be to apply a manure slurry to the sod, which will burn the sod back, and then no-till seed the brassicas seeds through the slurry. In addition to reduced erosion concerns with no-till planting, there are generally fewer insect problems than with conventionally seeded brassicas. The following recommendations will improve the chances of successful brassica establishment.

1. Attempt establishment only on well drained soils.
2. Do not seed deeper than one-half inch.
3. When seeding into a sod, suppress the sod long enough (2 to 3 weeks) to allow the brassicas to establish.

4. Apply 75 pounds of nitrogen at seeding to stimulate establishment and growth.

As previously mentioned, forage brassicas can be grown to supplement perennial cool-season pastures in August and September or to extend the grazing season in November and December. In the first instance, brassicas would be planted in May or early June when spring rains will help assure production for August and September grazing (Figure 1). Turnip, rape, or stemless kale could be used for this purpose. In the second instance, swede or kale would be planted in spring, or rape, turnip and turnip hybrids would be planted in late July or early August, and growth allowed to accumulate until November or December.

Figure 1. Planting and grazing sequence for forage brassicas.
Grazing Opportunities with Cereal Rye

**Cattle Producers**
Cereal rye is commonly used in cow-calf production to extend the grazing season, provide early spring forage, or as an emergency area for spring calving during inclement weather. Cattle producers can utilize cereal rye in other ways as well – to develop replacement heifers, to graze stocker cattle, or to provide a soft-surfaced, dust-free area for incoming calves that will eventually move to a feedlot.

**Crop Producers**
Cereal rye is grown to provide green manure, but also to improve organic matter and soil structure. Crop producers may add value to cereal rye by (1) harvesting and selling stored feed, (2) leasing these acres to a cattle producer to graze, or (3) temporarily grazing stocker cattle themselves. Stocker cattle grazing can be a good fit for crop producers as it requires minimal investment in fencing, facilities, and time. Electric fencing and portable corral systems can be easily erected and taken down. But, the biggest advantage with stocker cattle grazing is short-term ownership. It is easy to “get in” and “get out” of cattle production and to quickly capture increases in market price.

**Grazing of Cereal Rye by Stocker Cattle**
Successfully grazing cereal rye with stocker cattle involves the following best management practices:

1. **Be aware of grazing restrictions**
   Herbicides used earlier in the growing season may have restrictions on when the cereal rye may be planted after application.

2. **Start with the right animal**
   Ideally, the animal should have normal fill and be pre-conditioned (pre-weaned, vaccinated, and treated for external and internal parasites). It is suggested that calves weigh a minimum of 350 pounds and be at least 160 days of age. However, the heavier the calf, the more forage the calf can consume as the rumen is larger.

3. **Determine the nutrient content of the cereal rye**
   Data concerning the nutritional content of cereal rye forage is limited and varies with the maturity of the forage. Table 1 lists previously reported analyses. For best results, sample and get an analysis of the cereal rye that is to be grazed.
Table 1. Nutrient analysis and yield of cereal rye forage at various stage of maturity

<table>
<thead>
<tr>
<th>Stage of Maturity</th>
<th>DM (%)</th>
<th>CP (%)</th>
<th>TDN (%)</th>
<th>RFV</th>
<th>Yield (T/Ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetative¹</td>
<td>14</td>
<td>27</td>
<td>71</td>
<td>185</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Boot to full head (ryelage)²</td>
<td>21-23</td>
<td>Avg. 27</td>
<td>8-13</td>
<td>Avg. 61</td>
<td>71-121</td>
</tr>
<tr>
<td>Straw³</td>
<td>89</td>
<td>4</td>
<td>44</td>
<td>60</td>
<td>NA</td>
</tr>
</tbody>
</table>

¹ Preliminary data. April 19, 2016. Enhancing the value of cover crops through utilization by beef stocker cattle. Iowa State University Extension and Outreach.

4. Match the cereal rye analysis to the animal’s nutrient requirements

Nutritional requirements of stocker cattle (Table 2) depend on the animal’s frame, weight, and desired gain. While crude protein requirements are easily met with vegetative cereal rye, the protein is highly soluble. To meet the requirements for un-degraded intake protein, it may be necessary to supplement with a bypass protein, such as distillers grains. Total digestible nutrients (TDN) requirements can be met for gains of 1-2 pounds, providing the animal consumes sufficient dry matter.

Table 2. Diet nutrient density for growing steer and heifer calves¹

<table>
<thead>
<tr>
<th>Body Weight (lbs)</th>
<th>ADG (lbs)</th>
<th>DM Intake (lbs/day)</th>
<th>TDN (% DM)</th>
<th>CP (% DM)</th>
<th>DM Intake (lbs/day)</th>
<th>TDN (% DM)</th>
<th>CP (% DM)</th>
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</thead>
<tbody>
<tr>
<td>300</td>
<td>1.0</td>
<td>8.4</td>
<td>59</td>
<td>11.4</td>
<td>8.3</td>
<td>58</td>
<td>11.5</td>
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<td>64</td>
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<td>8.6</td>
<td>63</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>8.6</td>
<td>69</td>
<td>16.2</td>
<td>8.6</td>
<td>68</td>
<td>16.2</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>8.5</td>
<td>75</td>
<td>18.9</td>
<td>8.6</td>
<td>73</td>
<td>18.7</td>
</tr>
<tr>
<td>400</td>
<td>1.0</td>
<td>10.4</td>
<td>59</td>
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<td>58</td>
<td>10.4</td>
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<td>12.1</td>
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<tr>
<td>600</td>
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<td>9.4</td>
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<td>13.6</td>
<td>14.4</td>
<td>73</td>
<td>13.5</td>
</tr>
</tbody>
</table>

5. **Supplemental dry matter may be needed**
   The high moisture content of cereal rye makes it difficult to meet the dry matter requirements of grazing cattle. It may be necessary to offer dry, high quality forage or grain in addition to cereal rye.

6. **Provide palatable, free-choice mineral**
   Lush, fast-growing cereal rye may be high in potassium and low in magnesium. To prevent grass tetany in the grazing animal, additional magnesium should be provided in the mineral.

7. **Begin grazing when the plants are ready**
   Grazing should start when the plants have adequate root development and are a minimum of six inches in height. Root development can be determined by “plucking.” Using your thumb and first index finger, try to pull up the plant. If it comes up easily, the cereal rye is not ready to be grazed.

8. **Be willing to adjust the stocking rate**
   Typical spring stocking rates may range from 1-2 animals per acre. However, stocking rate is a function of plant growth, plant density, animal weight, and weather. Removal of the animals from the field during extremely wet weather may be necessary to prevent pugging of the soil.

9. **Be realistic about expected performance**
   Gains of stocker cattle grazing cereal rye typically range from 1-2 pounds per day and depend primarily on dry matter intake. Early in the grazing season, the dry matter content of cereal rye at turnout may be as low as 15 percent, but will increase with plant maturity. Until this occurs, it may be necessary to provide additional dry matter through supplementation.

Written by Beth Doran, beef specialist with Iowa State University Extension and Outreach. Reviewed by Dan Loy, director of the Iowa Beef Center, and Erika Lundy, program specialist with the Iowa Beef Center.

Photos by Beth Doran and Erika Lundy.

This factsheet is funded by an Iowa Department of Agriculture and Land Stewardship (IDALS) Water Quality Initiative granted to Practical Farmers of Iowa. This project delivers on-farm data and practical information to farmers in order to spread knowledge and increase adoption of cover crops.
What can be stockpiled?
Nearly any grass or legume species can be stockpiled. Tall fescue has probably been used most frequently in stockpiling systems because of its good fall growth and persistence under grazing. Although the palatability of tall fescue is relatively low during the grazing season compared to other grasses, it maintains its quality when exposed to adverse autumn and winter weather. Endophyte fungus-free varieties of tall fescue are recommended over those containing endophyte. However, if you have endophyte-infected fescue in your pastures, it can still be used effectively in stockpile grazing systems. A few extra management practices such as seeding legumes into the pasture and clipping seedheads in early summer can minimize some of the undesirable traits associated with endophyte-infected fescue forage.

Smooth bromegrass and orchardgrass have slightly higher nutritive value than tall fescue, but may have less persistence in subsequent years following winter grazing. Legumes such as alfalfa and red clover increase the forage nutritive value and contribute nitrogen to associated grasses, but often live for a shorter period of time in mixed stands where winter stockpile grazing is practiced. Red clover has good seedling vigor and can be relatively easy to establish back into pasture stands by frost seeding in late winter or interseeding in the spring.

What is stockpiled forage?
Stockpiled forage is forage that is allowed to grow and accumulate for use at a later time or during a period of forage deficit. It is common practice to harvest and store (stockpile) forage as hay or silage, but the purposeful stockpiling of forage for grazing at a later time is a new concept for many livestock producers.

Why stockpiled forage for grazing?
The climate of the upper Midwest United States permits forage to grow during a seven- to eight-month period. During this period, grazed forage is the least form of forage for livestock. Beef cow herd and sheep flock records over the past few years show that winter feed costs are the single largest production expense, and that keeping the winter feeding costs low is a key to profitable production. Extending the grazing season by using stockpiled forage in late autumn and during the winter months has been shown to be a very economical way to maintain livestock profitability. Even an extra three to four weeks added to the grazing season is beneficial.
Length of the stockpiling period
The most common stockpiling practice is to allow the forage in the stockpile pasture to accumulate during the last 70-80 days of the growing season. This 70-day period can be achieved by terminating summer grazing or harvesting the last summer hay harvest by late July or early August to allow for uninterrupted growth during the stockpiling period. The forage that grows during this autumn period is leafy and high in nutritive value. Stockpile grazing research in southern Iowa and northern Missouri shows that about three fourths to one ton of forage dry matter per acre can be stockpiled over a 70-day period. Longer periods of stockpiling can increase forage yields, but forage nutritive value may reduced both in digestibility and crude protein.

Pasture fertilization
Nitrogen fertilization in grass pastures is necessary to maximize forage yield during the stockpiling period. Applying 40-50 pounds per acre of nitrogen in early August (at the start of the stockpiling period), will often boost the forage yield approximately 50 percent to about 1.5 tons of stockpiled forage dry matter. Nitrogen fertilization should be applied as early as possible in order to optimize the response of the forages. Fertilization in late September will have minimal effects on stockpiled forage yields. While legumes will provide nitrogen for grass growth in mixed pastures, modest nitrogen applications to mixed grass/legume pastures in the autumn may improve forage yields without adversely affecting long-term legume persistence in the pasture. Weather conditions will influence fertilizer benefits and accumulation of stockpiled forage. Late summer and autumn drought conditions cause the greatest disruption in stockpiling management. Lack of autumn rainfall will often greatly reduce forage growth and limit efficiency of fertilizer use.

Grazing system
Strip grazing of stockpiled forages extends forage quality more than continuous grazing. If given unrestricted access to a pasture, livestock will selectively graze plant parts with the highest digestibility and protein concentration first. If unmanaged, animals will have high-quality diets early in the stockpile grazing period, and will be left with forage composed of an increasingly higher proportion of stems and fiber, but of a decreasing nutritive quality. To minimize this effect, producers are encouraged to erect temporary fences and strip graze smaller areas of the stockpiled forage. This grazing management allows the manager to ration the forage, extend the grazing days further into the winter, and provide a more uniform forage nutritive quality.

Winter grazing can have its disadvantages too
Winter precipitation (rain, sleet and snow) leads to weathering loss or reduction in the nutritional value of stockpiled forages. Winter precipitation reduces both the digestibility of dry matter and protein content. Stockpiled forage maintains its nutritional value longer in dry years.

The physical effect of snow on grazing of stockpiled forages is not as great as might be expected. While snow will restrict access to forage, cows are willing to graze through relatively deep (up to 9 inches) snow for high-quality stockpiled forage. On the other hand, as little as one fourth inch of ice on top of snow or covering the forage may halt grazing. The extent and duration of the physical effects of winter precipitation will vary with location and yearly weather cycles. In one southern Iowa research study, cows were able to graze within a week after a 17-inch blizzard.

It is important to be flexible and be able to manage through adverse weather periods. In the event that livestock can’t graze due to ice or snow, be prepared to provide supplemental forage or feed as needed. Also consider that grazing on frozen soil causes minimal pasture damage, but grazing stockpiled pasture when soil conditions are muddy can lead to soil compaction and long-term damage to pasture sod. A stockpile management recommendation is to provide for a sacrifice pasture or dry lot feeding area during periods of winter and spring mud. To further minimize sod damage, storing bales in the pasture behind moveable electric fence can limit unnecessary tractor traffic.

Stockpile forage must fit into a grazing management system
August and September are generally considered to be pasture shortage months. It is not often convenient for most producers to set aside a portion of their summer pasture acres for stockpiling. Areas to be stockpiled need to be carefully considered. They may be those used in early summer as hay meadow or early summer pasture areas. The stockpiled pasture areas selected should be easily accessible in the winter for livestock handling and possible supplemental feeding, and have an adequate winter water supply. On farms where corn crop residues are also available for grazing, weathering losses and nutritional considerations indicate that the corn crop residue fields should be grazed first, followed by the stockpiled forage. During this time of the year, neither corn crop residues nor stockpiled forage may be suitable as a stand-alone ration. A sound supplemental feeding program should be developed to meet the nutritional needs of livestock without excessive winter feeding costs. With thoughtful planning, winter grazing may become an economically important part of your livestock enterprise.

Additional information on winter livestock management and stockpiled forage research results can be obtained from your local extension office. Prepared by Stephen K. Barnhart, extension agronomist. This fact sheet is funded, in part, by the USDA Natural Resources Conservation Service through cooperative agreement no. 74-6-11-7-3.

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Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gerald A. Miller, interim director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa. FM 1792 November 2010
Introduction

The concept of stockpiling is simple. Rather than cutting, drying, and storing hay to feed in winter, you grow pasture forage until frost and let the animals harvest their own feed as late into winter as weather conditions allow. Most classes of livestock can graze through up to 8 inches of snow and are comfortable in much colder temperatures than many people imagine. However, like everything in pasture management, it’s more complicated in practice. Successful stockpiling is a result of planning, timing, and luck.

There are two main reasons given for stockpiling. The first and most obvious one is that it replaces mechanically harvested, stored feed with the cheapest feed we can produce – pasture. It should save money.

The other reason is that it can improve pasture utilization the following season by staggering spring and early summer grass growth. Fifty percent or more of pasture growth occurs during the ‘spring flush’. Making hay off some acres is the most common way to deal with this overabundance. The idea behind stockpiling is that winter grazing of some paddocks can help stage paddocks to accumulate forage at different rates in spring.

Successful Stockpiling

There are three primary factors in stockpiling success: fall moisture, fall nitrogen availability, and winter weather conditions. Clearly, there is some risk involved, since we have no control over two of the three factors. In comparison, when you make hay for winter feeding, you have the greater cost of mechanical harvest, but somewhat less weather risk, especially if you can store the hay under cover.

The right amounts of nitrogen and moisture will maximize the amount and quality of stockpiled forage going into winter. A mid-August application of 50 pounds nitrogen per acre will satisfy the nitrogen requirement, but timely rainfall is equally important.
Under typical Wisconsin conditions an acre of stockpiled pasture will yield between one-half and one ton of forage after frost.

Once the forage has been stockpiled, its availability and quality depend on snow cover and temperature conditions throughout the winter. The longer it is out there in the field, the more quality and quantity will decline. Stockpiling for spring is a much more questionable proposition than for fall.

**What does the research tell us?**

Beyond these general principles, what else should we know? Luckily, we have a very comprehensive study conducted in 1996 and 1997 in Wisconsin at Arlington, Lancaster, and Marshfield. The study looked at seven grass species, three harvest dates, and four nitrogen treatments at three sites in Wisconsin. The seven grass species were late orchardgrass, early orchardgrass, quackgrass, reed canarygrass, smooth bromegrass, tall fescue, and timothy.

There were three harvest dates. The first harvest was taken just after the first killing frost (October). The second harvest was taken in early-winter (December). The third harvest was taken in early spring prior to the greenup (March).

There were four nitrogen treatments. The first two treatments were either 0 or 60 pounds nitrogen per acre on August 1. The third treatment was 90 pounds nitrogen per acre after first spring cut and 60 pounds nitrogen per acre on August 1. The fourth treatment was 40 pounds nitrogen per acre applied before spring cut, 50 pounds nitrogen per acre after spring cut, and 60 pounds nitrogen per acre on August 1.

**Harvest Dates**

The first sets of plots were harvested after the first killing frost in October. Across all sites and all species, the N-fertilized stockpiled pasture yielded 1.24 tons of dry matter per acre (t/a). The non-fertilized plots averaged a yield of 0.72 t/a.

Averaged across all sites, grass species, and nitrogen treatments, yields from stockpiled plots harvested in December (0.95 t/a) and March (0.80 t/a) were lower than the October harvest. Between October and March, there was an approximate 50% loss in dry matter through decomposition and leaching of carbohydrates.

**Nitrogen Effects**

Sixty pounds nitrogen per acre on August 1 increased fall yield of the stockpiled forage by nearly 75% over unfertilized plots at all sites averaged across harvest dates and grass species. Nitrogen treatments which included spring and summer nitrogen applications affected summer yields, but had no beneficial effect on fall forage regrowth. So, if you’re going to stockpile, nitrogen applied in August is essential for good fall growth.
Species Response to Stockpiling

Species rankings were generally the same across all harvest sites and dates. Either tall fescue or early-maturing orchardgrass ranked highest in yield at each harvest date and site. The late-maturing orchardgrass usually ranked third. Yields (t/a) ranged across the species as follows: tall fescue, 1.41; early orchardgrass, 1.35; late orchardgrass, 1.24; timothy, 1.17; reed canarygrass, 1.09; smooth bromegrass, 0.96; and quackgrass, 0.95. These are yields cut at grazing height (3 to 4 inches). Actual animal intake, of course, will vary with management, livestock type, and pasture composition.

Forage Quality

Forage quality levels for this research were significantly lower than what is observed by farmers who routinely stockpile pasture. Nitrogen application resulted in an average crude protein (CP) increase of one percent across all grass species, but did not affect digestibility (DG) of the forage significantly. October forage quality with added nitrogen averaged 11.6% CP and 73% DG. Crude protein levels declined up to 2 percentage points between October and December, but did not decline consistently between December and March. Digestibility values declined an average of 3 percentage points between October and December, and another 5 percentage points between December and March.

Several graziers who have tested stockpiled forage report quality levels similar to what they observe in spring and early summer, with protein levels in the upper teens and low twenties and reasonably good Relative Forage Quality (RFQ) values. It is unclear why the study values were so much lower, although one can speculate that management or weather conditions may have contributed.

Best Species

Which species performed best for stockpiling? Tall fescue was the best. It is remarkably well adapted for stockpiling because of its more uniform distribution of growth over the season. It accumulates biomass well in late summer and fall, and its stiff, waxy leaves seem to hold up better than average over the winter. Early orchardgrass was next highest in yield and was higher in CP and similar in DG to tall fescue. The late orchardgrass usually ranked third.

Timothy and reed canarygrass both had average yields and average levels of CP. However, the digestibility of timothy was among the highest, while reed canarygrass had among the lowest digestibility levels.

Smooth bromegrass and quackgrass had the lowest yields and higher than average protein levels. Digestibility of smooth bromegrass was relatively high, while quackgrass DG was uniformly low.
Staggering Spring Growth?

Many people talk about the role of stockpiling in managing the spring flush. The theory is that stockpiling rather than grazing in the fall allows the plants to store root reserves which will then contribute to faster greenup and growth in spring. Because the forage is grazed after growth has stopped in fall, root reserves should remain intact the following spring to contribute to more vigorous growth. Non-stockpiled paddocks should green up more slowly because they’ve gone into the winter with no root reserves. This makes intuitive sense and it may actually occur under some circumstances, but this study did not provide evidence to support these assumptions.

At the Arlington site, the stockpiled pastures did not accumulate more forage in early spring compared to non-stockpiled pastures. Early spring yields were similar between stockpiled/winter-grazed and fall-grazed/non-stockpiled pastures. At Lancaster, the stockpiled/winter-grazed forage had lower early spring yields than the fall-grazed/non-stockpiled plots. Treading injury during winter grazing might have damaged crowns and negatively impacted spring regrowth. In this case, the stockpiled/winter-grazed paddocks greened up more slowly than the fall-grazed/non-stockpiled paddocks. So, while the mechanism is different, we’ve still achieved the desired result--staggered spring growth of paddocks to improve pasture utilization.

Putting it all together

With a little bit of nitrogen and little additional cost, you can get at least an additional fall grazing by stockpiling some of your paddocks. While stockpiled forage in this study was of relatively low quality compared to fresh pasture, many experienced graziers have been able to obtain higher quality levels with a combination of nitrogen fertilizer, good management, and a little bit of luck. For many graziers, especially seasonal dairymen, extending the season into December is quite feasible and very practical. Because of the continuing decline in dry matter and quality and the logistical challenges of grazing through snow and ice, it is questionable whether we should pursue stockpiling for feeding beyond early winter as the primary forage source for lactating dairy cows.

Stockpiling is one of several tools we have to help manage the grass farm’s resource base. It is used most effectively on farms with more than one acre of pasture per animal unit (1 AU = 1000 pound of animal). How many additional acres do you need? A 1000 pound animal will need approximately 30 pounds of dry matter per day (3% of body weight) or about 900 pounds per month. For each additional month of grazing after frost, you’ll need about 0.4 acres for that animal (1.2 t/a x 2000 lb = 2400 lb; 900 lb/month ÷ 2400 = 0.375 acres). For a herd of 100 dry dairy cows, you’ll need about 50 additional acres. But, start small. As you learn what works with your system, on your soils, with your climate, you can expand your program. Would stockpiling work for you? There’s one way to find out!
Literature Cited


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Figuring Stockpile/Hay/Forage Requirements

By Kathy Voth / September 23, 2013 / Comments Off on Figuring Stockpile/Hay/Forage Requirements

Here’s a little calculator we put together to help you figure out how much stockpiled forage you have, or may need for the winter. If you’re not set up with a stockpile this season, you can also use it to figure out how much hay you’ll need for overwintering.

Download Our Xcel Spreadsheet Calculator Here!

I originally created this calculator to go along with the leasing pasture series from Meg Grzeskiewicz. Since we’ve gotten questions from folks on how much winter stockpile they might need, and how much their animals eat, we thought it was a good time to put it center stage on its own.

The calculator is really an Xcel spreadsheet. You plug numbers into the yellow boxes. The answers you’re looking for will show up in the dark green boxes. There are several different part to the calculator, depending on the questions you’re asking.

The first section (shown below) was designed to help you figure out how much forage you have during the spring/summer grazing season. The “Total Forage Available” answer it gives you assumes that you’ll be leaving at least 50% behind to prevent overgrazing. If you use this answer as you consider how much winter stockpile you have, note that once the grass is dormant, you can graze shorter because the plant is not actively growing.
The next section of the calculator helps you figure out how much forage your animals eat. The first thing you’ll notice is that it uses a measurement called “AUMs.” This stands for Animal Unit month. This is a measurement that is more often used in the west where government agencies lease rangeland. One AUM is the amount of forage required for one cow/calf pair, because that was what was most common on rangelands. All you have to do is enter the number of animals you have in each category. You’ll get answers for how much that group eats, and then figures for daily and monthly rates for the whole herd.

We included a tool to help you estimate your carrying capacity. First you enter your rotation length. This is the amount of time you anticipate it will take for the forage to completely recover. (If you’re using this to figure out how long your stockpile will last, your rotation will be the amount of time before you have new spring growth.) The calculator divides your rotation length by the total forage you have available from the first section. You can use the chart of daily forage requirements to enter the amount of food one animal eats so that the calculator can tell you how many animals you can feed.
Now, how much forage do your animals need over the winter? Well, it depends. In this spreadsheet we’ve given you two options based on how different people prefer to manage their animals. Option 1 includes feeding 50% of your livestock’s Dry Matter requirements. Some folks do this because they want to speed up spring green up. You can use Option 2 if you don’t have stockpile and will only be feeding hay, or if you don’t feed hay with your stockpiled pasture. For either option you’ll need to fill in the number of days you’ll feed livestock, how many of those days will be covered by stockpile, daily forage requirements, and how many animals you anticipate overwintering. (Meg G. provides a little more background on stockpile grazing in this article.)

### How Much Hay Do I Need For Over-Wintering?

Depending on your location and operation management style, you may or may not have stockpile to feed livestock over the winter. You might also feed hay along with your stockpiled forage to speed up spring green up. Choose the calculator option that works best for your operation. Experiment with different scenarios to see how they might affect your profitability. Plan to adjust your hay purchase up to cover unforeseen situations.

**Calculator Option 1:**
I have stockpile, I feed 50% of my livestock's Dry Matter needs while on stockpile to help with spring green up.

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<th>Number of Days I'll Feed</th>
<th>Number of days Grazing Stockpile</th>
<th>Daily Pounds of Forage 1 Animal Requires</th>
<th>Number of Animals to Overwinter</th>
<th>DM Required While Grazing Stockpile</th>
<th>DM Required When Not Grazing Stockpile</th>
<th>Total Hay Required In Tons (Assuming 85% DM/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>75</td>
<td>26.7</td>
<td>10</td>
<td>10012.5</td>
<td>6675</td>
<td>9.48</td>
</tr>
</tbody>
</table>

**Calculator Option 2:**
I don’t have stockpile, or I don’t feed hay along with my stockpiled forage.

<table>
<thead>
<tr>
<th>Number of Days I'll Feed</th>
<th>Number of days Grazing Stockpile</th>
<th>Daily Pounds of Forage 1 Animal Requires</th>
<th>Number of Animals to Overwinter</th>
<th>Hay Required When Not Grazing Stockpile</th>
<th>Total Hay Required In Tons (Assuming 85% DM/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>75</td>
<td>26.7</td>
<td>10</td>
<td>6675</td>
<td>3.79</td>
</tr>
</tbody>
</table>

Keep in mind that this calculator is somewhat generic because we wanted it to work for as many people as possible. All the numbers you get from it are estimates and you’ll have to use your
experience and that of the extension specialists and Natural Resources Conservation professionals in your area if you have questions.

ABOUT THE AUTHOR

Kathy Voth
Publisher, Editor and Author

Kathy worked with the Bureau of Land Management for 12 years before founding Livestock for Landscapes in 2004. Her twelve years at the agency allowed her to pursue her goal of helping communities find ways to live profitably AND sustainably in their environment. She has been researching and working with livestock as a land management tool for over a decade. When she's not helping farmers, ranchers and land managers on-site, she writes articles, and books, and edits videos to help others turn their livestock into landscape managers.
Grazing your herd through the winter on standing forages in pasture is one way to reduce costs and improve your bottom line. It avoids the expense of baling, moving feed and then feeding. But is the feed giving your livestock what they need to survive and thrive? Here’s some data from a variety of locations to help you with the answer.

**Standing Pasture**

In his series of articles walking readers with him through his 2014-2015 grazing season, our resident Grass Whisperer, Troy Bishopp, went the extra mile to give his fellow graziers information that would help them to make the transition to winter grazing. He even tested his standing forage so that they would have an idea of what to expect. Here’s what he learned:

“The Paddock 10 forage sample came back. This may not represent the quality of the green forage that they’re eating because I took a sample with green, brown and seedheads mixed together. I chose this sample because the cows will eventually go back and clean-up after they’ve grazed off the best stuff in the first 8 hours. But as Kathy Voth points out, it’s possible that my green forage is quite high in protein and they are balancing their diet by adding the older, browner forage to balance the high protein.

“According to the nutritional needs of an early to mid gestation 850lb heifer, this feed just meets their daily requirement. The energy should be 60 ME, and we’re at 56. However since they can eat all they want they tend to get what they need.

“Penn State’s Craig Williams and Virginia Ishler, and Cornell’s April Wright Lucas and Larry Chase helped me calculate the value of this feed. Based on the cost of the ingredients, they say my pasture is worth between $53 and $62 dollars per ton. Meanwhile, This forage displaces $150/ton hay (delivered). This is a key factor for reducing feed costs by planning out your grazing, letting the animals harvest it themselves and getting the fertility transfer not to mention you have rested plants going into nest grazing season.” (Are you wondering, like I am why they pasture that is
Troy’s experience is similar to results of three years of forage testing in southwestern Manitoba. According to their testing, total digestible nutrients (TDN) in stockpiled forage decline over winter. Fifty per cent TDN is sufficient to feed a dry cow in early to mid gestation. All of the stockpiled grasses tested retained more than 50 per cent TDN over winter and spring. However, energy levels in stockpiled alfalfa dropped significantly between October and December. By early December, testing showed alfalfa did not have adequate TDN to maintain a dry cow.

As the graph above shows, many of the grasses meet the needs of dry cows. However, after November in Manitoba, stockpiled grasses don’t contain adequate energy to support lactating cows that require 60 per cent to 65 per cent TDN to maintain milk production, or of young, growing stock that need 65 per cent to 70 per cent TDN to gain 2 pounds per day. Their forage tests for Crude Protein and Relative Feed
Value, below, tell a similar story. But as you look at these graphs, keep in mind that your forage values may decline at different rates, depending on your latitude and climate. Discussion with your local forage extension specialist or NRCS or Conservation District staff can help you calibrate this information to your area.

**Standing Annual Forages**

Karla H. Jenkins, Aaron Berger and Gary Herbert of University of Nebraska-Lincoln conducted research on behalf of farmers and ranchers planting annual forages in pasture who want to graze them through the winter. Those producers wanted to know if these annual forages would provide adequate nutrition through these colder months.

For the study researchers planted annual forages after irrigated wheat was harvested, and some additional water was applied to the forage crop. (The total tonnage and the quality produced would likely vary if the forage was planted earlier in the summer and on dryland acres.) Then they tested them through the winter season. Interestingly, as you can see from the table below, quality changed very little over the winter.
“While some nutrient loss did occur, all forages studied in both years maintained enough quality to support rumen function without additional protein. The available nutrients would also support about 1-1.5 lb/d gain on weaned calves if quantity was adequate,” said Karla Jenkins.

She also noted that the severe drought in the first year of the study raised nitrate levels about the recommended 1600 ppm for safe grazing when they harvested just prior to the frost, but that nitrate dissipated over the winter until forage was safe to graze in March. She cautions producers to sample forages for nitrates and nutrient content before beginning grazing.