The primary, cool season, perennial pasture grasses used in Kentucky are orchardgrass, bluegrass, and tall fescue. When not grazed or harvested, each of these passes through successive stages of growth in the spring: 1) leafy vegetative; 2) boot with seed heads enclosed in leaf sheath; 3) heading when the seed heads begin to show and, 4) bloom when pollination has occurred (Figure 2). Since fiber and lignin contents increase steadily beyond the vegetative stage, while percent protein and digestibility decrease, a major goal in grazing management is to maintain these grasses in the leafy, vegetative stage at all times. Once the spring season is past, these grasses do not go through this series of growth stages until the next spring. Therefore, the regrowth after each grazing period is leafy and high in quality.

The bottom leaves of the grasses, especially the tall-growing orchardgrass and tall fescue, die due to shading and diseases as the plants grow tall. Such tall growth also shades clover plants, making it difficult for them to compete or even survive. As leaves mature they decrease in quality and growth rate slows. Removal of these leaves by the grazing animal stimulates new tillers and increases the vigor of the plants if conditions are favorable for regrowth. Legumes, such as red clover, ladino clover, and alfalfa, also go from leafy to stemmy growth stages with the same lowering of quality as the grasses. Except for calcium, the mineral content in these forages decreases from the leafy to the stemmy growth stages.

Nonstructural carbohydrates and other energy reserves are produced when plants are growing. The excess nonstructural carbohydrates are stored in roots, rhizomes, stolons, and tillers. They provide energy and nutrients while plants are being grazed and as they make regrowth. Reserves provide energy for persistence during drought, periods of low or high temperatures, and for growth when conditions improve. Levels of nonstructural carbohydrates are reduced as they are utilized for rapid plant growth, particularly after the plants are grazed so short that little leaf area remains. As leaf area increases, nonstructural carbohydrate reserves also increase due to the positive balance between photosynthesis and respiration.
When leaf area on plants is low, such as after close grazing or hay making, there is not enough energy (sugars) being produced by photosynthesis to provide for both leaf and root development. To "stay alive" the plant uses all available energy for producing new leaves until there is excess for root development. If the leaf area, and indirectly the stored energy, is always low due to continuous overgrazing, the root system is small, weak, and shallow. The deprived root system cannot provide adequate water and nutrients which contributes to a weakening of the entire plant.

Maximum growth of forage plants generally occurs when there are enough leaves present to intercept 90 percent of the sunlight, with less than 10 percent falling on the soil surface below the plants. Additional leaves do not increase production due to shading and loss of efficiency of the older lower leaves. This is the optimum time to begin grazing.

Utilizing these principles, the goal of efficient grazing management, with the plant in mind, is to practice grazing management which results in plant persistence plus high yields and quality while maintaining adequate leaf area and levels of nonstructural carbohydrates for stored energy. This means removing a major portion of the leaves by grazing at a time when plant reserves are adequate, then allowing the plant enough time to produce leaf area sufficient to replace the reserves utilized in the process of making regrowth.

**Perennial Forage Species for Grazing**

Orchardgrass and tall fescue are tall growing, perennial, cool season grasses. Bluegrass is also a perennial, cool season grass which is shorter and has finer stems and leaves. Very close continuous grazing suppresses new growth of these grasses, but bluegrass is less affected than the two taller growing grasses. In addition to stored energy at the base of its tillers, bluegrass also has relatively high levels of nonstructural carbohydrates stored in its rhizomes which serve as sources of energy when it is grazed closely. Each of these cool season grasses, especially bluegrass, slows down dramatically in growth during the hot summer months.

The primary storage of nonstructural carbohydrates in orchardgrass is in the base of its tillers. Since it is also a tall grass compared to bluegrass, a large percentage of its tillers and their high levels of stored energy are susceptible to being removed by close grazing. Unlike bluegrass, orchardgrass has no rhizomes and tall fescue has only very short rhizomes for storage of energy.

Tall fescue is better able to withstand close, continuous grazing than orchardgrass. In addition to the nonstructural carbohydrate reserves in the base of its tillers, tall fescue has reserve energy stored in its short rhizomes. Tall fescue also has more leaves closer (semi-prostrate) to the ground. Based on these characteristics, bluegrass can be grazed
down to 1 inch, tall fescue to 2-3 inches, and orchardgrass to 3-4 inches without causing injury to the plants. However, each species benefits from recovery periods following grazing to allow accumulation of leaf area and nonstructural carbohydrate energy reserves. The cool season species benefit from longer rest periods and from not being grazed as closely during periods of stress such as drought or high temperatures.

Light grazing pressure results in orchardgrass and tall fescue dominating bluegrass and the clovers due primarily to shading by the two tall growing grasses. In tall fescue-orchardgrass pasture mixtures, tall fescue can be expected to overcome the orchardgrass. This is partly because tall fescue is adapted to a wider range of soil moisture, temperature, and soil fertility than orchardgrass. Another factor is that animals often overgraze the more palatable orchardgrass. Tall fescue also is better able to withstand close grazing due to its semi-prostrate tillers and leaves. In controlled grazing systems with adequate, but not extreme, grazing pressure, bluegrass can often be maintained with orchardgrass and even tall fescue if soils and climate are favorable for bluegrass.

Ladino and white Dutch clover are the same (*Trifolium repens*) except for size. Ladino is a giant type while white Dutch is much smaller. These perennial legumes have shallow root systems which make them susceptible to drought injury. They spread by stolons which are actually stems laying on the soil surface producing roots and leaves at each node. Since the stem (stolon) is on the soil surface rather than upright, grazing animals remove only leaves. This is a primary reason for the high quality of these plants and their ability to withstand close grazing.

Red clover is a perennial legume that generally persists for only one and half to three years in Kentucky due to crown and root diseases (common seed – 1 to 1 ½ yrs, improved varieties 2 to 3 years). It has excellent seedling vigor and develops a strong taproot. Red clover can tolerate close grazing even on a continuous basis. Regrowth is initiated from buds in the crown. It is an excellent companion legume with orchardgrass and tall fescue because it grows tall enough to compete with them. It adds to the quality and productivity of pasture and is also well suited for grazing and for hay or silage.

When properly managed, alfalfa and alfalfa-orchardgrass mixtures provide high-quality, high-yielding forage throughout the grazing season. Its large tap root enables alfalfa to obtain water during dry periods when more shallow rooted plants slow down in growth or dry up. Alfalfa needs a rest period following grazing. There are several unique considerations when grazing alfalfa though. Do not allow livestock to remain on the field more than 7 days (to avoid regrazing young shoots). Since plants should be at a late bud to early bloom stage before grazing, rotational grazing is essential for stand survival and productivity. Some producers prefer grazing alfalfa before the bloom stage for maximum quality. It is essential though to give alfalfa a sufficient rest period before regrazing because it stores carbohydrates (starches and sugars) in its large taproot and then uses these carbohydrates for regrowth following grazing (Note: alfalfa typically
reaches the late bud to early bloom stage in 28 to 35 days). See Figure 1 for an overview of root regrowth and root carbohydrate storage in alfalfa.

Managing alfalfa based on root carbohydrates is an important consideration during the fall. Alfalfa stands should not be grazed during the critical fall period to allow sufficient root carbohydrate storage before winter. This critical period is 6 weeks before the first killing frost (normally defined in alfalfa as 24°F or below). In Kentucky this period is considered September 15 to November 1, although it will vary somewhat from north to south and from one year to the next. Therefore, the last grazing for the summer should occur before September 15th, and then a final grazing can occur after November 1. Killing frosts do not always occur on or before November 1st, but the cooler soil temperatures during November generally prevent enough regrowth to allow carbohydrate depletion before winter.

There are exceptions to every rule and when forage it is short supply you may decide to take a risk and graze during the critical fall period. The following considerations may aid in making your decision concerning fall grazing timing: 1) Older stands have a greater chance of winter injury than younger stands; 2) If killing frosts normally occur earlier or later than November 1 in your area then shift your critical fall period earlier or later; and 3) Livestock producers will break the critical period rule when the need for high quality pasture is critical and enough to offset the risk of winter injury.

If you would like early or more frequent grazing to be an option, then it is essential that you choose a grazing tolerant variety (see KY variety test reports to choose adapted grazing type varieties, www.uky.edu/Ag/Forage. These varieties have been developed specifically for grazing are often able to withstand closer grazing and require less recovery period than the traditional hay varieties. To ensure persistence and high yields, grazing tolerant alfalfa varieties should be grazed to 3-4 inches within five days, then given at least 21 days for recovery growth before being grazed again.
Managing mixed stand – favor alfalfa

For many hay and pasture stands of alfalfa, mixtures with grass species such as orchardgrass is preferred. The grass adds to the nutritional balance, improves hay curing, and help provides a sod for hoof traffic. The common rule of thumb when managing a legume/grass mixture is to manage for the legume. For example, with an alfalfa/orchardgrass mixture you want the alfalfa to reach the late bud to early bloom stage before cutting or grazing. If the grass starts to dominate the stand then closer cutting or grazing will benefit the alfalfa since it’s regrowth energy comes from root carbohydrates (Figure 2). If the alfalfa starts to dominate the stand then and higher cutting or grazing height (3 to 4”, even 5”) benefits the grass since it retains sufficient green leaf area for continued photosynthesis.
Figure 2. Alfalfa/orchardgrass stand at two grazing heights.

The two figures shown above can be found in Roy Blaser's classic “Forage Animal Management Systems” available at http://www.caf.wvu.edu/~forage/books/fams/index.htm. Another excellent publication is the “Alfalfa Management Guide” by Undersander and others available at http://www.asa-cssa-sssa.org/publications/pdf/alfalfa_guide_production.pdf. The University of Kentucky’s forage website also contain a tremendous amount of forage management information at www.uky.edu/Ag/Forage.