How Pasture Plants Grow

To make good pasture management decisions, you need to understand the growth and development of grasses and legumes. Pasture use and production can be improved by carefully managing forage plant grazing. Making grazing decisions based on plant growth may seem unappealing, but it is the key to successful grazing management.

Structure of the grass plant

The structure of grass plants is similar among the many species of grasses (Figure 1). A grass plant is a collection of tillers or shoots that grow from buds at the base of the plant. Each tiller is composed of a series of repeating units consisting of a leaf, stem node, stem internode, and a bud. Each leaf is attached to the stem at a node, with an associated dormant bud. Early in the development of a grass tiller, the distance between nodes (internodes) on the stem is very short and the stem remains compact at the base of the plant. At the top of the stem is the growing point where new stem and leaves originate. As long as this growing point remains intact, it is capable of producing new leaves. Later in the development of the tiller, the growing point undergoes a change. It stops producing leaves and begins to form the immature seedhead of the plant. After this, the growing point on this tiller is no longer capable of producing any more new leaves, and grazing or clipping it off has no impact on further new leaf numbers. Once this transition occurs, some of the upper internodes begin to elongate and eventually raise the seedhead to the top of the tiller. New tillers emerge from the plant crown as regrowth.

How grasses develop

Grass develops through a sequence of stages. There are three primary developmental stages in grasses that you should be able to recognize for grazing management (Figure 2):
(1) vegetative;
(2) elongation; and
(3) reproductive.

The vegetative growth period is the growth of leaves. The stem, with its growing point, remains compact near the soil line. Once a critical number of leaves has formed on a tiller, the older and lowermost leaves generally die at approximately the rate of new leaf growth, and the number of leaves on a tiller remains relatively constant.

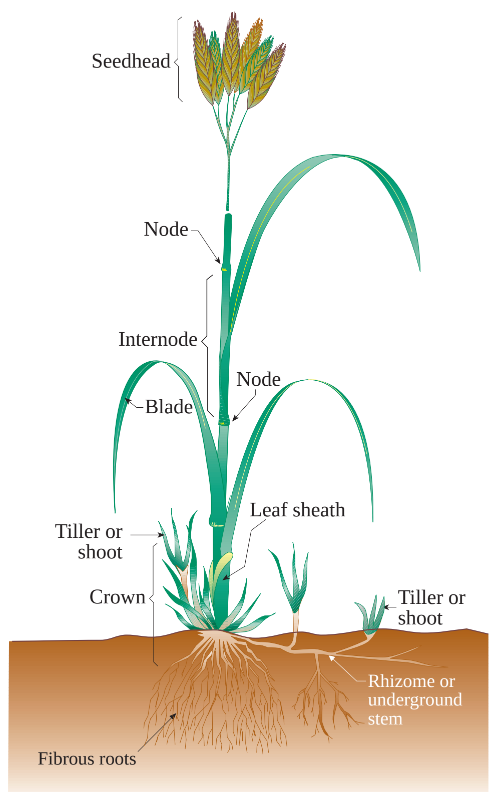

Figure 1. The parts of a grass plant. (Not all grasses have rhizomes.)

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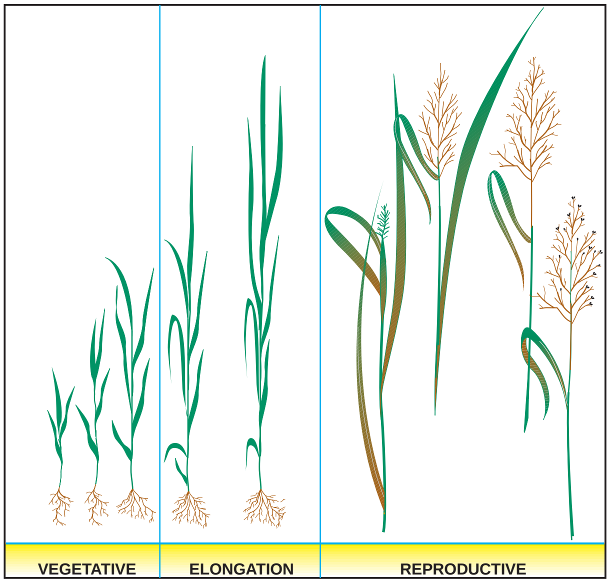

Figure 2. Developmental stages of grass growth.

Elongation is the stage during which stem internodes lengthen. This is sometimes called jointing. The elongation stage usually begins in response to changing length of days. During this stage only the upper internodes elongate. The lower internodes do not elongate and remain at the base of the plant. These lower nodes, internodes, and dormant buds, together with related tillers, form the crown of the plant. When the developing seedhead begins to push through the uppermost leaf sheath, the plant has reached 'boot stage,' the end of elongation. The reproductive stage is the period when the seedhead develops, pollination occurs, and seed develops.

Structure of legumes

Legumes are a special class of plants that can "fix" atmospheric nitrogen into their own plant-available nitrogen. Legume development differs from that of grasses. Stems begin to grow in length immediately with leaves arranged alternately on opposite sides of the stem (Figure 3). Legume stem length and amount of branching varies among species. Legumes can branch at leaf-stem junctions. Flowers can form on the main stem or on branches.

How legumes develop

Legumes develop as vegetative growth to an early stage of reproduction called bud stage. Buds are green, immature flowers that develop quickly to open bloom or flowering stage. Legumes also have many potential regrowth points. In addition to the buds at the stem tip and along the stem at each leaf-stem junction, most legume species also have dormant buds at the stem base, or crown, of the plant. These crown buds are the source of the first growth in the spring and can quickly produce new, leafy regrowth when growing stems are grazed or clipped.

An obvious difference among forage legume species is the type of growth habit. Alfalfa has an upright growth habit. Red clover and birdsfoot trefoil have an intermediate growth habit. White clover is a pasture legume that grows close to the ground. The stems of white clover (stolons) lie flat on the soil surface and spread by buds along the stem, forming stem branches.

Plant growth, growth rate, and growth cycles

Plants "capture" solar energy with their leaves and convert it to plant-usable carbohydrates during photosynthesis. Some of the energy is converted to proteins, fiber, oils, etc., as the plant develops new leaves, stems, and seeds. Much of the energy is used in respiration during the many plant growth and development processes. Unused carbohydrates accumulate or are stored in the roots and plant crown. The balance of these energy processes determines the health and vigor of each pasture plant.

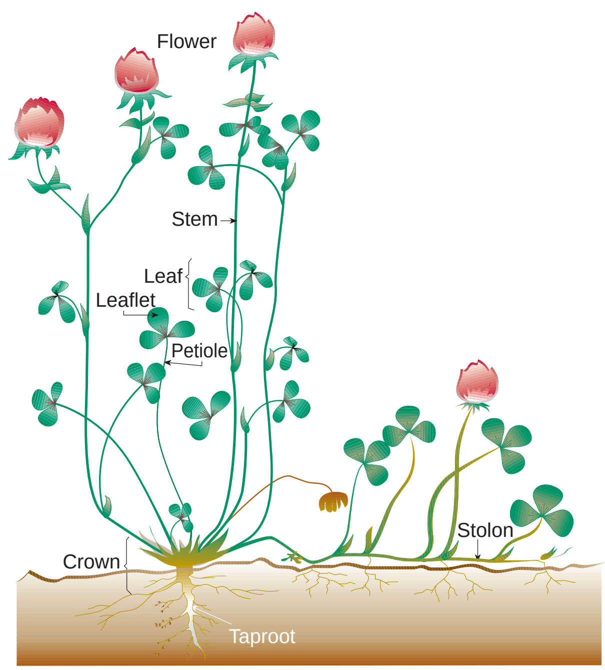

Figure 3. The parts of a legume plant. (Not all plant parts are present on all species.)

Growth rate is how fast the plant adds new dry weight over a period of time. Figure 4 shows the typical pattern of growth rate and yield. When a plant is short with minimal leaf area, its daily growth rate is slow. As the plant accumulates increasingly more leaf area, its ability to capture sunlight increases rapidly and its growth rate per day reaches its highest level in the late vegetative phase. As stems develop to flowering and seed production, few new leaves form and the lower, older leaves die, growth rate slows, and yield levels off. During reproduction, the dry weight of the plant is not increasing but is being redistributed within the plant as stems mature and seeds develop.

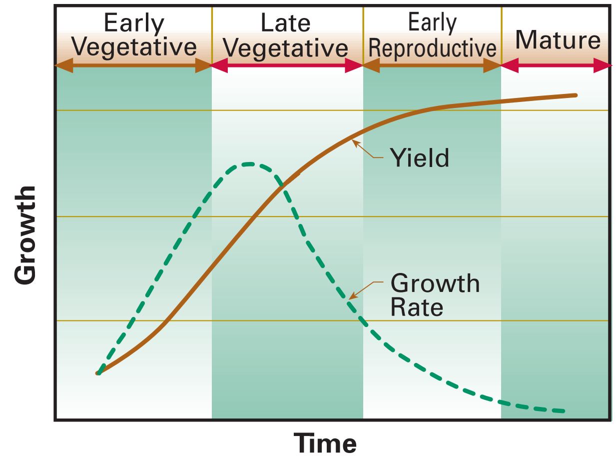

Figure 4. Growth rate changes during a growth cycle

Each pasture plant begins its growth in the spring from dormant crown buds, using carbohydrates stored in the roots and crown the previous growing season. The plant's early spring growth rate, though relatively slow, is strong as long as there is an ample supply of stored energy. Spring growth can be as much as two weeks earlier when plants are vigorous.

When stored energy levels are low because of overgrazing the previous year, regrowth and the production of new leaves proceeds at a very slow rate. As plants grow and leaf area increases, growth rate and plant development can proceed rapidly and restore the level of stored carbohydrates.

Seasonal growth and pasture production

Productivity of forage plants in pastures varies throughout the growing season. An important classification of pasture grasses is whether they have their highest growth rates during the cool portion of the growing season (cool-season grasses), or whether their growth rates are greatest during the warmer days of the growing season (warm-season grasses). Figure 5 shows that cool-season grasses, such as Kentucky bluegrass, orchardgrass, and bromegrass, produce most of their seasonal yield in the cooler spring and autumn months, whereas warm-season grasses (switchgrass, big bluestem, sudangrass) are most productive during the warm summer months. Legumes, such as alfalfa, clovers, and birdsfoot trefoil, generally are less influenced by seasonal temperature than grasses and produce growth more uniformly throughout the growing season. Legumes, however, still grow most rapidly during the spring months.

The growth patterns shown are the idealized pattern where nothing interferes with a plant as it grows. The productivity of the pasture at any time during the grazing season is determined primarily by the types of pasture plants, weather, and soil conditions. This productivity is also influenced by grazing management, leaf area, rest periods, and the vigor of the pasture plants.

Grazing and growing points

In the spring, the leaves of grasses grow from an active growing point near the soil surface. Grazing will remove only leaf tips without greatly interfering with the activity of the growing point. As changes in length of days and temperature cause the elongation of the seed stem, the growing point is elevated and can be removed by grazing or harvest (Figure 6). If the active growing point is removed, leafy tiller growth develops from dormant basal buds as new tillers. Most pasture grasses produce seedstems

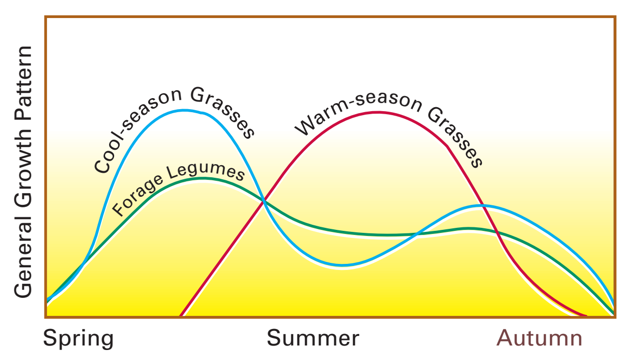

Figure 5. Different types of pasture plants are productive during different parts of the grazing season.

only in the spring. After an initial grazing or hay harvest in late spring removes the seedstems, only leafy vegetative growth is present for the remainder of the grazing season. Warm-season grasses, such as switchgrass, undergo the same basic developmental stages and recovery responses, only a month or two later, during the warmer summer months.

For legumes, the location of growing points helps determine the response to grazing. The growing point for alfalfa is near the tip of the growing stem and is easily removed by grazing. The growing points of red clover and birdsfoot trefoil are lower on the plant and less susceptible to removal by grazing. Alfalfa, red clover, and birdsfoot trefoil will quickly produce new, leafy regrowth from dormant crown buds and lower stem branches when the growing stems are grazed or cut. The growing points of white clover are at the soil surface on trailing stolons and are virtually resistant to removal by grazing, but can be damaged by hooves.

Grazing and leaf area management

If grazing animals remove only a small amount of the active green leaf area, photosynthesis can proceed and the plant can replenish carbohydrate stores while top and root growth is progressing. But if grazing animals remove most of the available leaf area every few days, the plant allocates nearly all growth energy to new leaf growth, the root system diminishes, and less energy is stored. This frequent leaf removal without adequate time for the plant to restore its vigor is the physiological basis of overgrazing. Overgrazed pastures produce far below their potential, maintaining only a low stand density and poor vigor.

The amount of rest that a grazed plant requires to recover its vigor and replenish an effective leaf area is influenced by the period in the growing season and the amount of active leaf area remaining following the grazing period. A cool-season grass

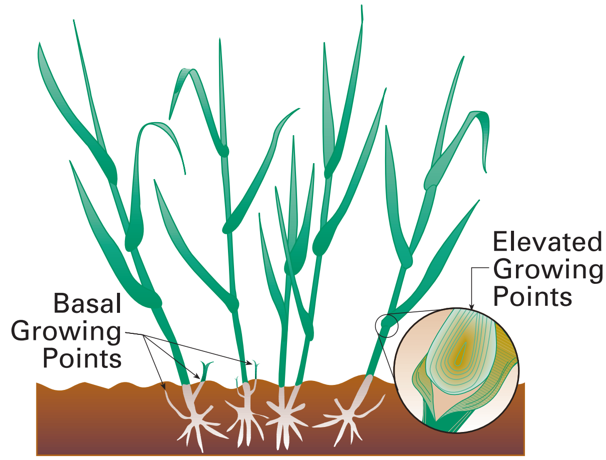

Figure 6. Elevated growing points are vulnerable to removal by grazing.

can recover in two to three weeks during its ideal spring and autumn growing periods, but may require six weeks or more to recover during the more stressful months of July and August. Warm-season grasses, on the other hand, grow very slowly during the cool months of spring and autumn, but recover quickly following four to six weeks of rest during their ideal summer growing period. The rest (or recovery) period can be shortened somewhat by leaving a taller leaf area remaining following grazing. This residual leaf area can contribute photosynthesis energy quickly, supplementing stored energy reserves to aid in a much faster recovery. Cool-season grasses and mixed cool-season grasses and legumes should have 3 to 4 inches of residual leaf area for rapid recovery; leave about 4 to 8 inches of leaf area on warm-season grasses following grazing.

Prepared by Stephen K. Barnhart, extension agronomist.

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