Structural (morphological) changes occur in the grass plant during its development. These changes are very conspicuous and coincide with certain physiological or chemical changes that are impossible to see. Consequently, morphological characteristics are very useful when making grazing management decisions.

THE GRASS TILLER

The grass tiller (shoot) is composed of a growing point (apical) meristem which may turn into a seedhead), a stem, leaves, roots, nodes (joints) and dormant buds. (Fig. 4 & 5). Buds are located at the nodes which are at the base of the shoot (basal buds), on the stem (axillary buds) and at the nodes on the stolons or rhizomes. The dormant or inactive buds have potential to produce a new tiller (shoot) with a new growing point. The supply of buds accounts for new tillers (shoots) when the growing point is removed and is the basis for perennial plants to live from year to year. These buds not only account for new growth during the growing season, but those that remain dormant must survive the winter and produce next year's tillers. A spring tiller developing from a dormant bud can be compared to an annual plant developing from seed.

In effect, the tillers of perennial grasses act as annuals or in some grasses as biennial plants. The original tiller survives one or parts of two seasons and must produce sufficient buds for growth and next year's tillers. In the case of indiangrass, tillers develop in late summer and early fall, die back at frost, and are next year's shoots.

REMEMBER: If highly productive perennial grasses are to live from year to year they must be allowed to manufacture and store sufficient energy to develop buds that are vigorous enough to survive the winter and begin growing next spring. Otherwise, the producer must resort to plants that "manage themselves" or use annual forages.

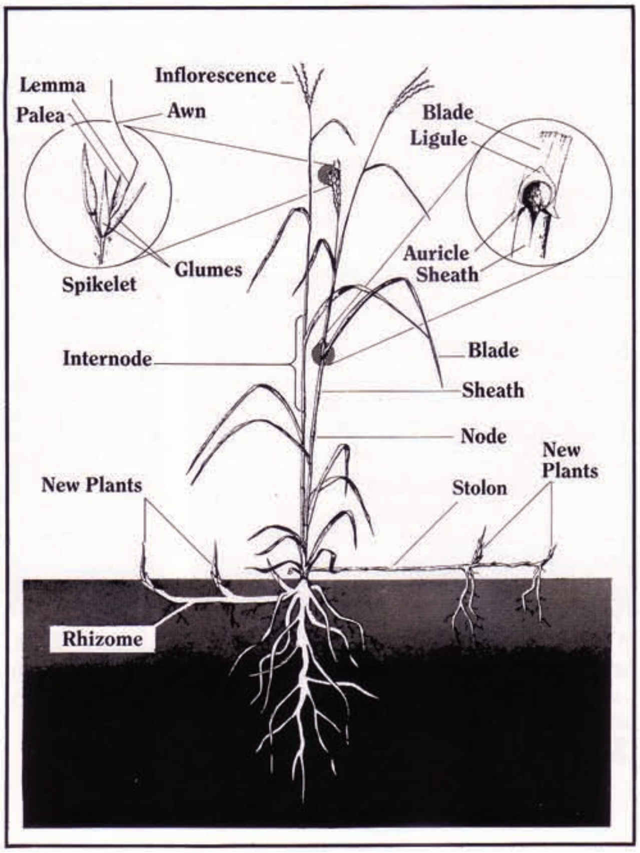

FIG. 4 Hypothetical grass plant.

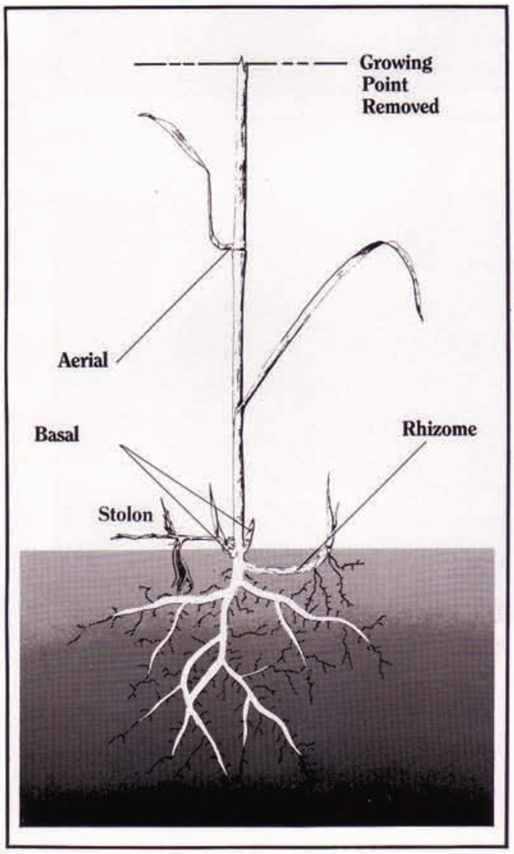

FIG. 5 Hypothetical grass showing basal, rhizome, stolon and aerial tillers.

TILLER DEVELOPMENT

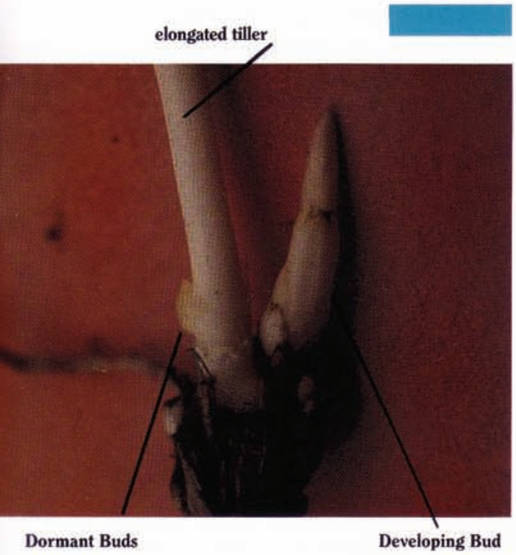

Photo of dormant bud, a bud developing into a tiller, and an elongated tiller (indiangrass).

All grass tillers begin growth with a growing point developing from a dormant bud at or below ground level until it is elevated and/or triggered to become reproductive. As long as the tiller is vegetative, it has the potential to produce an indefinite number of leaves (Fig. 6A). When the tiller is triggered to elevate or become reproductive, there is no further potential for new leaf initiation (Fig. 6B). When first elongated, a tiller appears to be vegetative since no seedhead is evident. In some grasses, tillers remain as elongated (jointed) vegetative tillers because the seedhead either never develops, or aborts (dies) at a very young stage. In many situations, elongation is a transitional stage between the vegetative and reproductive stages. If the tiller has become reproductive, a seedhead will emerge (Fig. 6C). *Removal of the growing point of an elongated tiller breaks the dormancy of the buds associated with that tiller.* New growth potentially could occur by the development of three different kinds of tillers from dormant buds (Fig. 5). The most rapid growth occurs from an intact growing point of the defoliated tiller. Then generally, the basal and rhizome buds are the next source of most rapid growth. Aerial tillers, although active on some grasses like switchgrass and reed canarygrass, are the least productive of the new tillers.

The timing of internode elongation (stem elongation) is very important due to the subsequent exposure of the growing point to grazing. Kentucky bluegrass, tall fescue and many other grasses have no internode elongation until about the time the growing point enters the reproductive phase. Such grasses maintain their growing point below or at ground level throughout most of the growing season and are resistant to continuous, close grazing. On the other hand, grasses such as smooth brome and switchgrass elevate their growing point early in their development due to the elongation of the internodes. Some grasses may have elongated growth (elevated growing point) without seedhead development (elongated vegetative shoots) at certain times of the year such as smooth brome, reed canarygrass, and western wheatgrass.

Early in the season, all grasses have their growing points close to or at ground level. Since grazing livestock cannot physically graze any closer than about an inch from

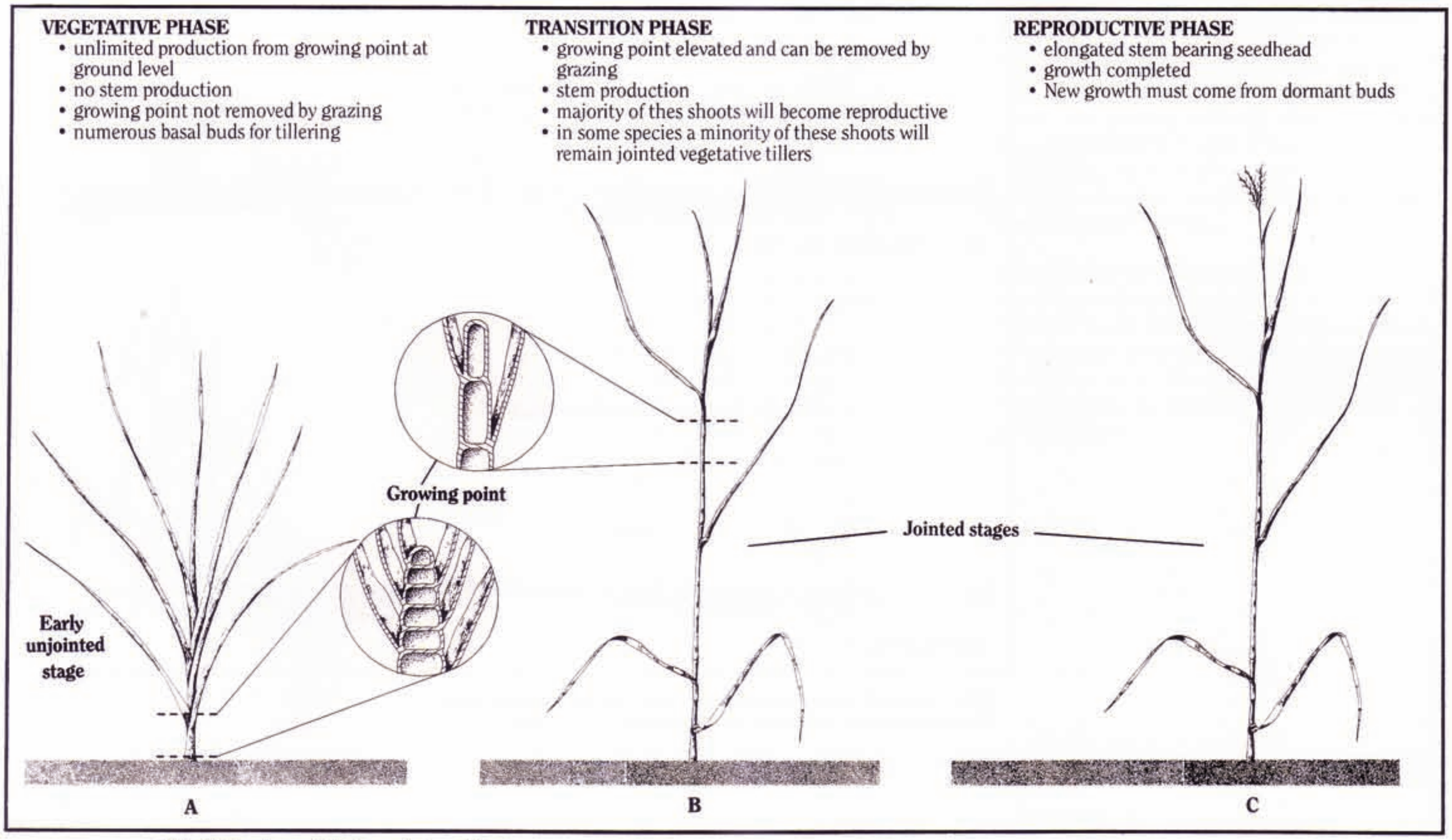

FIG. 6 Developmental phases of a grass tiller.

the ground, there is no danger of removing the growing point at this time. Although the plants are grazed, each grazed tiller can continue to produce new leaf material. On the other hand, if internode elongation has occurred and the *growing point* is removed, new leaf material must come from dormant buds.

Since a bud that is developing into a new tiller has no leaves, it must depend on energy provided by either residual leaf material or energy from carbohydrate storage organs. If severe defoliation has occurred as with cutting for hay, the only source of energy for new tillers is stored carbohydrates. On the other hand, if severe defoliation does not occur and some residual leaf material remains, new tiller growth can receive energy manufactured by the remaining leaf material and there is no depletion of carbohydrate reserves.

As the new tiller develops it draws upon the carbohydrate reserves. If sufficient time is allowed for new leaf material to develop and replenish the carbohydrate reserves (positive carbohydrate balance), no harm is done. However, if severe defoliation is repeated before the new tiller has an opportunity to achieve a positive carbohydrate balance, great harm will come to the plant.

REMEMBER: Grasses that elevate their growing point early in the growth cycle must be managed differently than grasses that elevate their growing point late in the growth cycle.

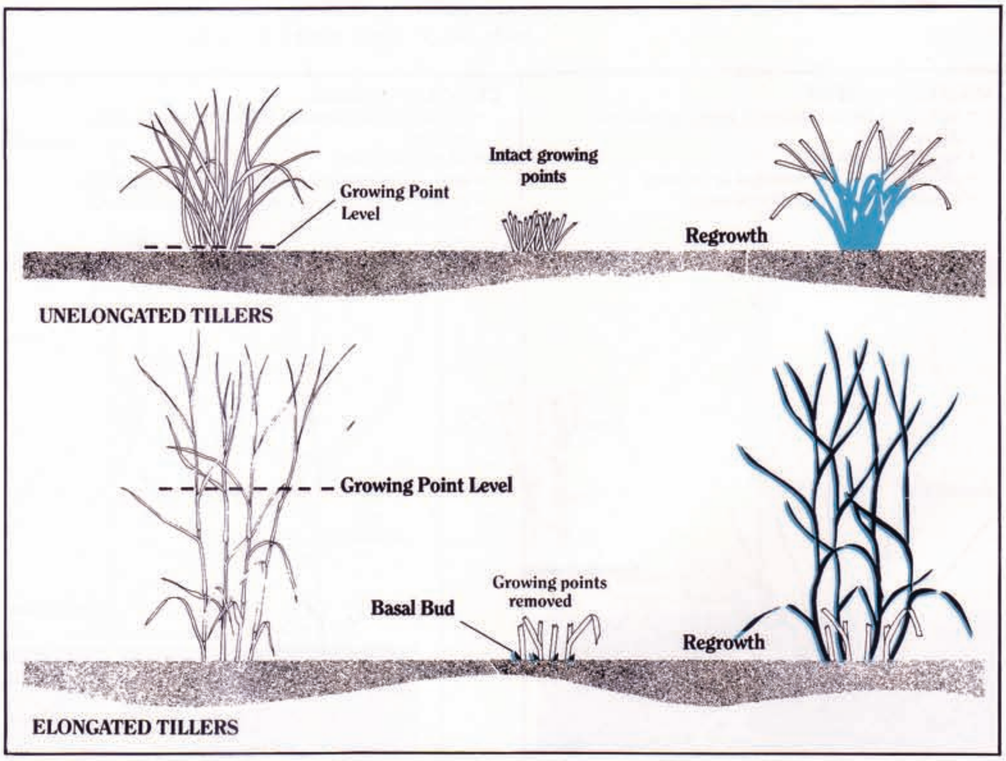

FIG. 7 **Regrowth of a grass growing from intact growing points (e.g. Kentucky bluegrass) compared to regrowth from basal buds, e.g. switchgrass).**

If initial grazing of tall grasses is begun at the above-growth stage they must be intensively grazed-otherwise the grass will get ahead of the cattle. (photo courtesy of Dick Brown-S.C.S.)

Growth can occur from intact, active growing points when defoliation occurs above the growing point, or it can originate from dormant buds (Fig. 7). If growth occurs from intact growing points during the growing season, remaining leaf area (factory) is generally more important in providing energy than stored carbohydrates (warehouse). However, carbohydrate reserves are the only source of energy for initiation of spring growth. Late summer and fall management of grasses not only influences winter survival, but it also has an impact on bud initiation. In many situations, the lack of "spring vigor of a grass stand" is caused by a lack of development of tiller buds the previous year due to low carbohydrates. The same phenomenon happens when a peach tree produces a heavy crop of peaches. The developing peaches consume nearly all of the carbohydrate produced by the tree in mid- and late summer. As a result, there are few buds initiated which would produce next year's blossoms. Consequently, the tree does not produce any fruit the following year. Severe defoliation late in the season not only has a negative effect on stored carbohydrate, it also removes nearly all of the insulation. Therefore, crown buds or newly developed tillers are not insulated or protected from cold winter temperatures.

The proportion of reproductive to vegetative shoots is a very important management tool. From a grazing standpoint, there are three critical issues:

1. seed stems are generally low in forage quality and often avoided by livestock;
2. the appearance of seedheads means that there will be no more vegetative growth from that shoot,
3. removal of an elevated growing point on a seed stem can stimulate new vegetative growth from basal buds assuming plant vigor and environmental conditions are adequate for growth.

Switchgrass and smooth brome are grasses characterized by a high proportion of reproductive shoots that elevate early in the season. Grazing tolerance has been defined as relatively low for such plants if grazed continuously; however, just as certain kinds, classes and breeds of livestock are suited to certain management practices, so are grasses. The livestock producer should understand the growth process of such plants to take full advantage of the vegetative growth potential. Plants such as switchgrass and smooth brome are well suited to mechanical harvest or rotational grazing. Grazing which is designed to remove the growing point followed by a period of non-use to allow the development of new tillers that can be grazed will generally be more productive over time than continuous grazing during the growing season.

The process of specific management for specific plants is relatively easy in a monoculture (single species stand); however, it can be very difficult in mixed stands. The producer must identify the key plants for which he wants to manage and develop a grazing program based on their needs. There will be plants that the management will not favor and there are grazing resistant plants such as Kentucky bluegrass, blue grama, tall fescue and white clover which would survive almost any cattle grazing program. Mismanagement of a grazing unit will always favor the grazing resistant plants. Proper management is a practical alternative that will provide optimum forage production from the managed species.

REMEMBER: Livestock producers must develop skills and knowledge that allow them to make appropriate decisions about which types of livestock are best suited to their operation. Producers must also make such judgments concerning the forages they produce.