Elementary Morphology of Grass Growth and How It Affects Utilization[1]

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In grass, God in His wisdom gave the world a plant that is admirably adapted to withstand the grazing of animals and be an efficient forage producer.

Early in its life, the grass seedling has growth habits that enable it to survive in spite of grazing animals. J. E. Weaver (1930), in extensive studies of the development of grass roots, found that roots are sent deeply into the soil before much surface is exposed above the ground. He found that little bluestem, for example, sends roots 2 to 2.5 inches into the ground before the shoot appears above the ground. The root is much branched at the end of 3 days, and at the end of 2 weeks, has reached a depth of 6 inches, with a lateral spread of 2 to 3 inches. Thus, the seedling becomes firmly attached to the soil soon after germination, and is able to resist being pulled from the soil by a grazing animal.

Grasses as Efficient Forage Plants

There seem to be two primary reasons why grasses are such efficient forage producers: (1) the location of the meristematic tissue and growth habits of the plant, and (2) the ability of the plant to produce new shoots from buds at the nodes, the process known as "tillering."

Growth Habits of Grass

Let's examine the structure of a grass plant to see how the location of the meristematic tissue affects its utilization. The stem of a grass plant is made up of a series of nodes and internodes (Fig. 1). A sheath is attached at each node, with the leaf blade at the upper end of the sheath. The meristematic, or growth, tissue is located at the nodes in the stems, and at the base of the sheath and the blade. Growth is by the division, or multiplication, of the growth cells in the meristematic tissue. Thus, the internodes, sheaths and blades issue out of the meristematic region much as a pencil lead issues out of a mechanical pencil.

The grass stem has all its nodes and leaves in embryonic or rudimentary form when it emerges from the seed. Growth starts first in the basal node and leaf, pushing the rudimentary stalk upward. As that node and leaf approach full size, growth starts in the next node, then the next, and so on until the stem

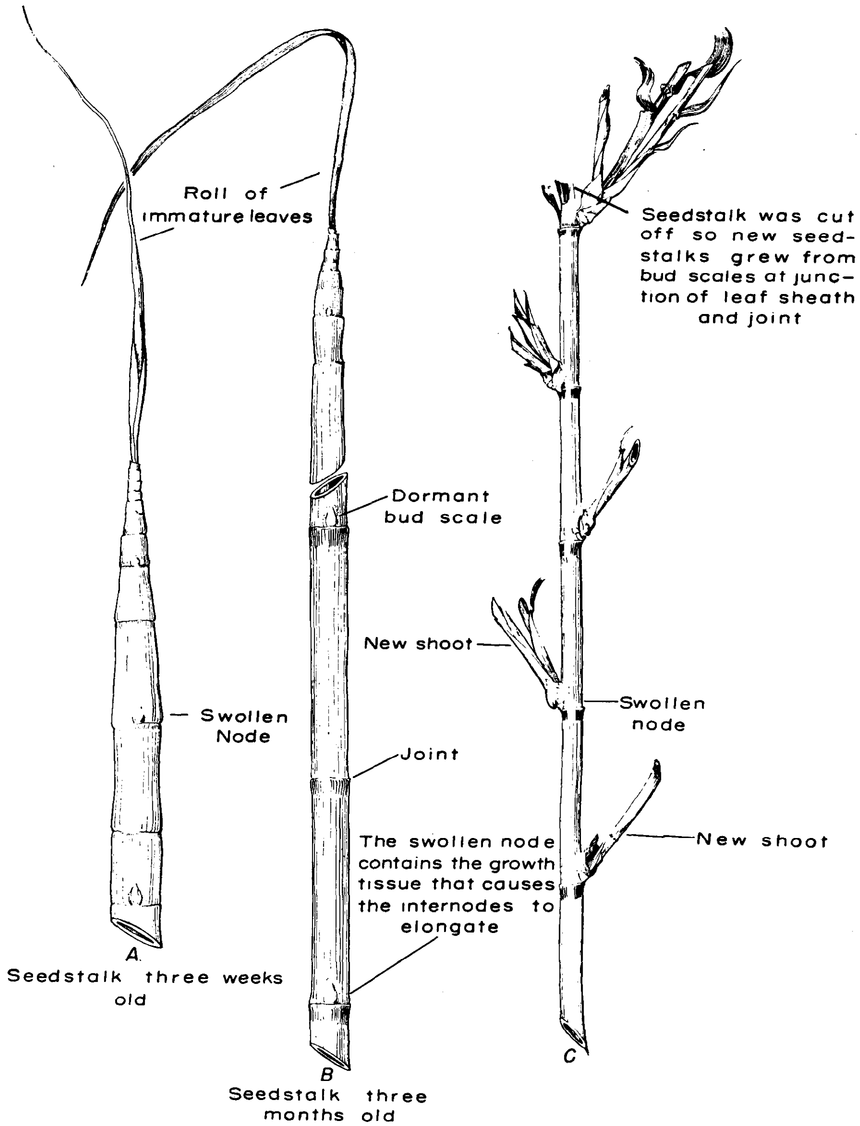

FIGURE 1. Defoliated seedstalks of giantreed (*Arundo donax*) show how a grass grows from the active tissue at the swollen node. A. Telescoping of joints of a young plant; B. Elongated stem of an older plant that is still growing as noted by the telescoping of joints toward the tip; C. Top of growing grass was cut off and new stems grew from the dormant buds at the joints.

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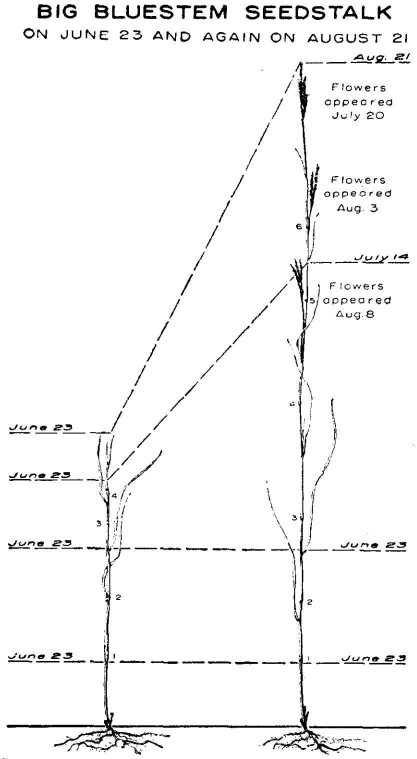

FIGURE 2. Development of big bluestem seedstalk on June 23 and on August 21. Four lower joints remained about the same length during the observation but the plant more than doubled in size from the fourth joint upward.

reaches its full length (Fig. 2).

The basal nodes of perennial grasses are very short. The sheaths and blades of these nodes are thrust upward, well ahead of the embryonic stem, or growing point. The sheaths and blades of the basal nodes overlap each other, forming a bundle or tube, the older more mature leaves on the outside, providing a protective cover for the immature leaves and the growing stem on the inside (Fig. 3). In some grasses, there may be 8 to 10 very short basal nodes, and the growing stem is not thrust above the ground and exposed to grazing until considerable growth has occurred.

An animal may graze off the leaves that are above the ground, without removing the meristematic tissue at the base of the leaves, or the growing point. Thus, a plant can continue its growth, except for a temporary slowing down of the growth due to the reduction of food-manufacturing leaves.

Herein lies one fundamental difference between grasses and the broad-leaved plants which makes grasses the more efficient forage producer. Unlike the grasses, the growing cells of the broad-leaved plants are found in the growing, or terminal bud. Upon germination, the terminal bud is immediately thrust upward, and within reach of a grazing animal. If removed before a leaf-joint is formed, there will be no further growth. If the terminal bud is removed above a leaf joint, many plants have the ability to start growth from a new bud formed at the leaf joint.

There are differences in grass species, themselves, in how they respond to grazing. J. E. Weaver and W. W. Hansen (1941) have made extensive studies of the origin, composition and degeneration of pastures in the Midwest. Palatability, nutritive value and other factors cause livestock to select some grasses more readily than others, and if too heavily used, even to graze some out of pastures.

Farrel A. Branson (1953) found, however, that differences in the physical structure of grasses may also be important in how grasses respond to grazing. Species of grasses vary in the number of short basal nodes, and also in the number of fruiting stems to vegetative stems.

The number of short basal nodes influences how soon the growing stem is thrust above the ground, and within reach of a grazing animal. Little bluestem, for example, was found to have 12 to 15 very short basal nodes, the whole aggregating no more than one inch in length (Fig. 4). Most of these short nodes are below ground level. Thus, the growing point is not pushed above ground until after the first 12 to 15 short nodes are mature, which may be mid-growing season. There are about 7 elongated nodes above ground.

Sideoats grama has 10 to 12 very short nodes, totalling little more than one-half inch in length. On the other hand, there are only 2 or 3 nodes above ground. Thus, the growing, or rudimentary, stem, is not pushed to within reach of a grazing animal until shortly before the seed head is produced.

The seed heads of little bluestem and sideoats grama are thus exposed to a grazing animal only for a short time. Sideoats grama, having only a few nodes above ground, produces seed heads quickly after the point emerges above the ground, and the chances of the head being removed by grazing are small. It can effectively resist heavy grazing.

On the other hand, some grasses as Indiangrass and switchgrass have only 2 to 4 short basal nodes (Fig. 5). The growing stem is elevated above ground soon after growth starts, and is within reach of a grazing animal. This fact, combined with the high palatability of these grasses in early growth stages, makes it highly probable that the growing stem will be removed, particularly under heavy use.

Production of New Grass Shoots

The second important characteristic of grasses that makes them efficient forage producers is their ability to produce new shoots at the nodes, as illustrated in Figure 1, (C.). Buds at the short basal nodes may develop new shoots, and these may again develop new shoots at their nodes, the process known

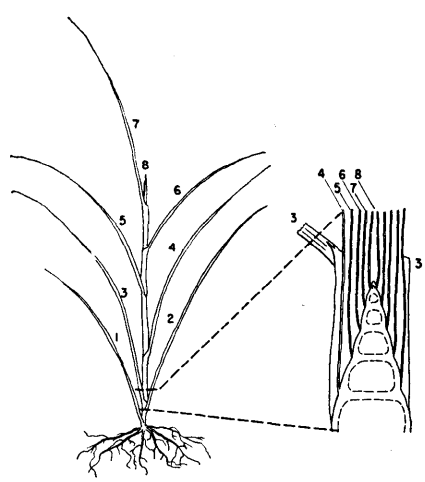

FIGURE 3. Young seedstalk of big bluestem with enlarged cross-section (*rt.*) showing growing point with enclosing sheaths.

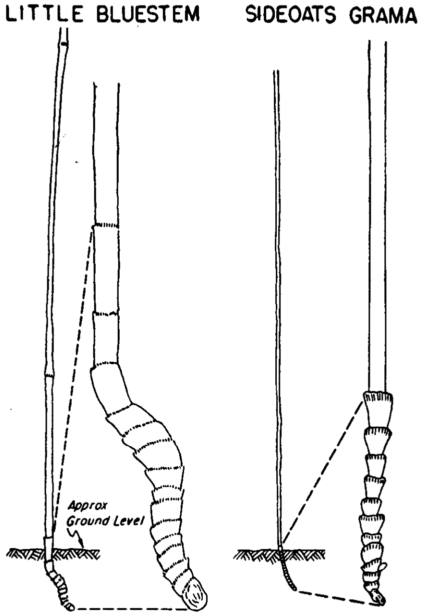

FIGURE 4. Seedstalks of little bluestem and sideoats grama with leaves and sheaths removed showing short basal nodes. Detail enlarged 5 times that of habit sketch.

as "tillering." Generally, growth hormones are produced in the new or growing buds, and the buds at the nodes do not develop. However, under the stimulation of removal of the growing stem, growth hormones are then produced in the bud scales at the nodes, which will begin growth.

Grasses having many short basal nodes, as sideoats grama and little bluestem, have many buds from which to "tiller." Adventitious roots are developed at the nodes to supply the needs of the newly-developed lateral branches into which the axillary buds develop.

Indiangrass and switchgrass, with fewer short basal needs, have only a few nodes from which buds can develop into new shoots. They are less able to spread or even maintain growth under intense grazing.

Branson (1953) found that the ratio of fruiting stems to vegetative stems in grasses has an influence on response to grazing. Sideoats grama, a grass tolerant of close-grazing, has a ratio of slightly more than 2 vegetative stems to one fruiting stem. Buffalograss and blue grama, both tolerant of heavy grazing, have ratios of about 6 vegetative stems to each stem producing a seed head. Switchgrass, a grass less tolerant to grazing, has a ratio of more than 2 fruiting stems to each vegetative stem. Branson concluded that those grasses producing a predominance of fruiting stems are less tolerant of grazing than those producing an abundance of vegetative stems.

Stolon and Rhizome Development

Certain grasses have the ability to produce stolons and rhizomes, another characteristic probably closely associated with the ability to tiller, making them tolerant to grazing. Buffalograss and curly-mesquite produce surface runners, or stolons, from the axillary buds on the nodes. The growing points of these grasses remain at or near the ground level, and they have a high ratio of vegetative stems to fruiting stems. They are very tolerant of grazing, even though quite palatable when growing.

Johnsongrass (Fig. 6), western wheatgrass, Kentucky bluegrass, and others produce underground

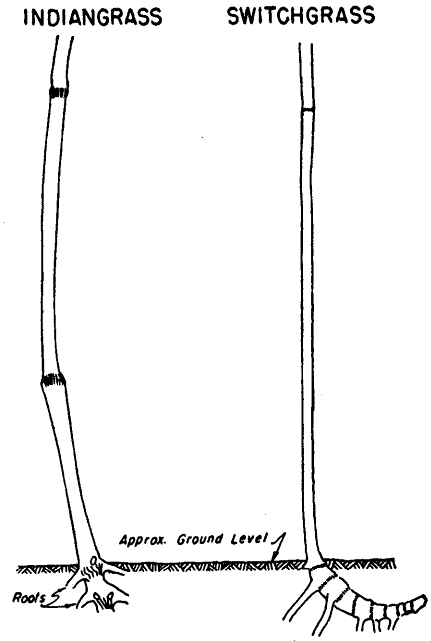

FIGURE 5. Seedstalks of Indiangrass and switchgrass with leaves and sheaths removed showing position of basal nodes.

stems, or rhizomes, by means of which they spread. These rhizomes are below the ground and, therefore, cannot be grazed. However, both Johnsongrass and western wheatgrass immediately elevate the

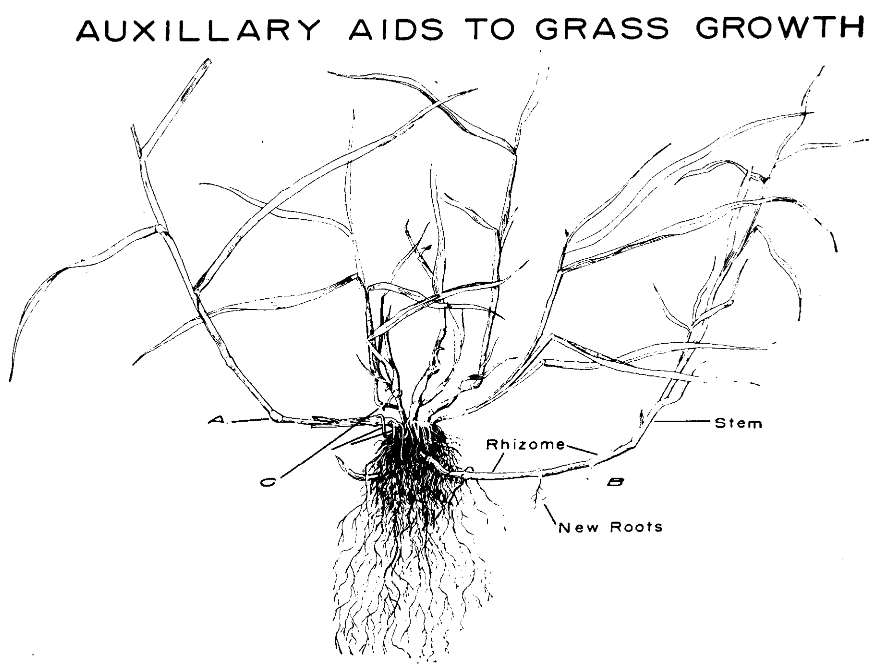

FIGURE 6. Axillary aids to grass growth. A. Lodged or bent-over stem showing geotropic reaction of growth tissue on lower side of node in forcing stem upward; B. Rhizome, new roots and stem; C. Developing holdfast or brace-roots.

growing point of the stem above ground upon emerging, and have a low ratio of vegetative stems to fruiting stems, making them less tolerant of grazing than the bluegrass, which has a high ratio and remains close to the ground.

Still other grasses, like Bermudagrass, have both stolons and rhizomes. Bermudagrass remains close to the ground and can tolerate intense grazing.

Another feature adding somewhat to the value of grasses for grazing is their ability to withstand trampling. The plant is able to tiller if the shoot is removed by grazing or trampling. The meristematic tissue at the nodes also retains its ability to resume limited growth. If the shoot is knocked down accidentally, the tissue on the lower side of the stem resumes growth. The cells on the lower side of the stem are the collection point in such cases of growth hormones, stimulating the cells to elongate, thus elevating the stem again to a vertical position, where normal production of the seed head can proceed.

Thus we can see in grasses a type of plant that is adapted to withstand grazing and to be an efficient producer of forage for grazing animals. Perhaps ages of grazing have left only those plants in the plains and prairie regions that were able to withstand grazing —an application, to a degree at least, of the law of the survival of the fittest.

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Effects of Seed Treatments Upon the Germination of Certain Browse Species of Colorado

Abstract of thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Range Management, Colorado A. and M. College, 1954.

Attempts to restore browse cover on depleted big game winter ranges by artificial reseeding have generally failed. Successful reseeding of browse plants has been handicapped by a lack of information concerning methods of treating browse seeds which will induce satisfactory germination.

A study was undertaken to compare the relative effectiveness of two seed treatments, stratification and acid scarification, in inducing germination of three shrubs: antelope bitterbrush (*Purshia tridentata*), mountain mahogany (*Cercocarpus montanus*) and fourwing saltbush (*Atriplex canescens*). Potential germination of these seeds was also determined for comparative purposes by staining embryos with tetrazolium chloride by the topographic method.

Stratification was accomplished by placing seed in moist acid peat at temperatures of 31° F. to 41° F. Samples were removed at weekly intervals to determine the optimum period of stratification.

Acid scarification was accomplished by placing seed in a copper-screen basket and suspending in concentrated sulfuric acid for ten minute intervals up to 90 minutes. The seed were then washed and planted in flats of vermiculite in four replications of 50 seeds each for germination at temperatures of 62° to 77° F.

The best period of stratification for bitterbrush was 49 to 70 days. After 49 days in stratification a few of the seeds began to sprout. The germination of seed stratified for 70 days was 82.5 percent, while non-treated seed germinated 1 percent. Acid treatment of bitterbrush for a period of 50 minutes resulted in a germination of 83.5 percent.

The best period of stratification for mountain mahogany was four weeks or longer. At the end of nine weeks stratification, however, a large portion of the seed began to sprout. The germination of seed stratified for 70 days was 71 percent, while non-treated seed germinated 1 percent.

Mountain mahogany seed soaked in acid for 60 minutes had the highest germination, 51.5 percent. This figure is significantly higher than the control, but is also significantly lower than the germination resulting from stratification. Nevertheless, acid scarification removes the hairy styles from the seed which would permit the seed to pass readily through a seed drill for more rapid and effective planting.

Fourwing saltbush seed does not require stratification so only acid treatment was used on these seeds. The germination of seed soaked for 60 minutes was 15.5 percent, while the control lot germinated 10.5 percent.

Staining of the embryos by use of 2,3,5-triphenyltetrazolium chloride proved inconclusive in indicating germination capacity for bitterbrush and mountain mahogany. Fourwing saltbush, however, reacted favorably to the stain. The average potential germination of fourwing saltbush as indicated by staining was 41 percent, while the average germination of acid treated seed was 14.75 percent.

These studies show that acid scarification of bitterbrush is as effective as stratification in inducing better germination. Acid scarification may be accomplished in less time than stratification, and the treatment is advantageous in instances where seed must be treated and planted in a minimum of time.

While stratification induces better germination of mountain mahogany than acid scarification, the latter treatment removed the hairy styles so that seed may be planted with drills. In view of the known advantages of drilling in planting seed more uniformly in the soil, acid scarification of mountain mahogany seed is to be preferred wherever drilling of seed may be effective.

Acid scarification removes the wings of fourwing saltbush seed so that it may be drilled.—*Raymond John Boyd,* 2090 Leyden Street, Denver, Colorado.