Manipulating Grass Plant Growth Can Enhance Forage Production

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Understanding grass development and grass plant response to grazing can help producers implement effective grazing management strategies, according to a North Dakota State University range scientist.

"Grasses have developed specialized growth characteristics and biological processes in response to a long history of grazing," says Lee Manske, range scientist at NDSU's Dickinson Research Extension Center. "Producers can manipulate these processes to enhance grass herbage production and reduce pasture and forage costs."

Unlike plants such as trees, shrubs, and forbs, which grow with the youngest cells at the shoot tips, grass plants have the oldest cells at the leaf tip. Therefore, grazing animals can remove portions of a grass leaf without stopping the growth of the shoot. Leaves may continue to grow from existing buds and from new leaf buds developed in the shoot's apical meristem, or growing point. The apical meristem remains close to the ground and below the reach of the grazing animal when the shoot is in the vegetative, or non-flowering, phase. This growth structure makes grasses well adapted to grazing, Manske notes.

Grass plants consist of tillers, which have shoots and roots. Each shoot is made up of units with four parts:

- a leaf, consisting of a blade and sheath, with a collar separating the two structures;
- a node, the point of leaf attachment to the stem;
- an internode, the length of stem between two nodes; and
- an axillary bud, the area of tissue that can develop into a new shoot.

The crown of a grass plant is the lower portion of a shoot and has at least two nodes that can produce roots. Before flower development, the shoot consists of several closely spaced nodes. The node at the top, or apex, of the stem is the location of the shoot's apical meristem, an area of new cell formation. The cells in this area can develop into either leaf buds or flower buds, depending on the stage of the shoot. Leaves form on alternating sides of the shoot so that the oldest leaf is outermost and each new leaf grows upward, protected by the surrounding sheaths of the lower leaves. The leaf grows as the cells' size and weight increase, beginning with cells at the tip of the blade.

Even with this specialized form, grass plants can be damaged if too much material is removed by grazing or if grazing occurs too early or too late in the season. Grazing that deprives the shoot of sufficient leaf area to support itself or that removes leaf buds or the apical meristem has the potential to stop the growth of the shoot and limit herbage production for the season, Manske emphasizes.

He also stresses that the grass shoot's production of three to three and a half new leaves during the growing season is important. When the shoot reaches the third-leaf stage, the apical meristem begins to produce flower buds rather than leaf buds, although formed leaf buds continue to grow and develop. Defoliation of leaf material before the shoot has reached this stage can disrupt the formation of leaf buds and leaves for the shoot, weaken the plant and diminish the plant's ability to produce herbage, Manske stresses.

Most native cool-season grasses reach the third-leaf stage around early June, and most native warm-season grasses follow in about two weeks. On strategies that begin grazing before the third-leaf stage, such as early spring grazing started in mid May, 45 to 60 percent of the potential herbage biomass will not be produced.

Defoliation of the shoot that has reached the third-leaf stage can stimulate the natural biological processes grass plants have developed in response to grazing. These processes include stimulation of vegetative reproduction, the growth of new tillers from the grazed shoot's axillary buds. Properly timed grazing that removes only a small

portion of the leaf activates beneficial processes that can result in a 30 to 45 percent increase in herbage production, Manske says.

Changes in day length trigger the shoot to begin sexual reproduction, or flowering. The first external sign of flower stalk development is the swelling of the sheath that encloses the flower head. This stage of grass plant development, occasionally referred to as the "boot" stage, marks the shoot's transition from the vegetative to the reproductive stage. Most cool-season plants enter the reproductive stage before June 21, the longest day of the year, and most warm-season plants enter the reproductive stage after June 21, Manske observes. Flowering, fertilization, and the formation of seed heads soon follow.

Strategies that delay grazing until after seeds have developed are neither biologically nor economically sound, Manske emphasizes. Plants need not produce viable seed each year for a grassland to remain healthy. In North American prairies, the primary form of grass reproduction is vegetative, and defoliation management designed to enhance sexual reproduction through seed production does little to improve the prairie ecosystem and increase herbage production, Manske notes.

Delaying grazing to allow seed production decreases livestock returns. The nutritional quality of the grass diminishes sharply after the flowering stage. On pastures managed to produce grass seed, the growth of secondary tillers has not been stimulated by grazing between the third-leaf and the flowering stage, so the quantity and quality of herbage produced are lower than the quantity and quality of herbage produced on rotation pastures. Manske says that the energy and resources directed toward sexual propagation could be better directed into vegetative tiller production.

Implementing grazing management strategies that start after the third-leaf stage and coordinate rotation grazing periods with grass growth stages can activate beneficial plant processes that result in increased herbage production and in turn reduce pasture and forage costs, Manske emphasizes.