Morphological Staging of Perennial Grasses

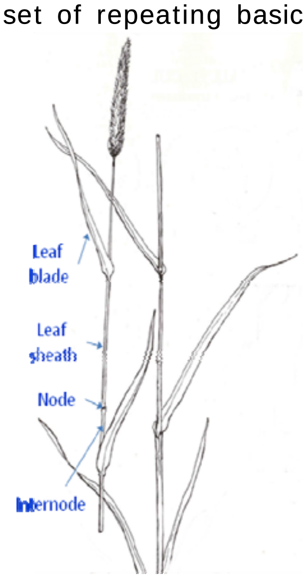
It is highly desirable to be able to estimate forage quality of perennial grasses. A relatively simple morphological staging method for grass plants could provide valuable information regarding forage quality and optimum harvest date. Several staging systems have been proposed for perennial grasses, most are relatively complicated.

Morphological staging of alfalfa is relatively easy, and alfalfa quality is closely linked with morphology. Simply knowing the height of the tallest stem in an alfalfa sample can result in reasonable predictions of alfalfa NDF (See Grass Information Sheet #22). Quantifying the morphology of perennial grasses is considerably more difficult.

Grass Stands are Variable

Grass cultivars are usually a mix of different genotypes, resulting in variation in maturity among individual plants. So a grass stand is a complex ever-changing population of tillers, which are at very different stages of maturity. Quality of grass forage should be related to the average maturity stage of tillers in a stand, but this requires analysis of many tillers.

An individual grass tiller can be considered a set of repeating basic units stacked on top of another, ending in an inflorescence. A basic unit includes a leaf blade and sheath, a node and internode, and the axillary bud associated with the node. Although not all tillers become reproductive, each tiller that does goes through four basic growth phases: vegetative, stem elongation (jointing), reproductive, and seed formation.



Georgia System

Ten stages from vegetative to ripe seed, were used to generate numerical mean stage values for tall fescue morphology based on both number of ranked tillers (MSC) and the weight of ranked tillers (MSW). The crude staging system was not sensitive enough to accurately detect differences in forage quality between young and old tillers. It was concluded that prediction equations based on climate data were more accurate for predicting forage quality than equations based on morphological staging.

Nebraska System

Moore and Moser described a modification of a developmental morphology system for small grains applied to perennial forages. Within each of the four growth phases, a number of substages were defined. These included the number of collared leaves, the number of palpable or visible nodes, stages of inflorescence development, and stages of seed development.

The coded stages are numerical so the result can be express numerically. Each tiller in a sample is evaluated for stage of growth, and an average stage of development is determined based on the number of tillers evaluated. The suggested number of tillers to measure is quite large (maybe 50 or more).

Italian System

Growth phases were used to generate a coded numerical index, but each phase was divided up based on length more than stage. Vegetative stages were based on tiller height, and elongation stages were based on inflorescence height. Inflorescence emergence was based on % of the head emerged, while flowering was based on the % of the head that was flowering. This system requires rating about 50 tillers per sample.

The coded mean stage in the Italian system did relate reasonably well to forage digestibility, within a narrow geographical range. Samples were collected from early vegetative to full flowering, however, the large range in maturity guarantees that a strong relationship will exist between maturity stage and quality. Whether or not this would work within the much smaller range in maturity leading up to harvest is not known.

A Simplified System

An attempt was made to simplify existing systems and also test whether the most mature tiller could be used to evaluate quality, as can be done with alfalfa. Parsons simplified the system to 20 stages (1-20), primarily focusing on number of collared leaves, and number of palpable or visible nodes (Table 1).

Table 1. Simplified grass maturity categories applied to the most mature tiller in a sample.

GMAXSTG Value	Stage Description
1-8	1-8 collared leaves
9-15	1-7 palpable/visible nodes
16	Inflorescence emerging
17	Inflorescence emerged
18	Peduncle elongated
19	Anthesis
20	Post anthesis

Besides evaluating the simplified stage of the most mature tiller (GMAXSTG), height of the tallest tiller and height of the grass canopy were also measured as possible predictors of grass NDF. None of these were very useful in developing equations to predict NDF content of grasses.

Grass Regrowth is More Variable

Some grass species do not have stem or reproductive development during regrowth, while others do. Other grasses, such as reed canarygrass, have stem elongation in regrowth, but generally do not develop a seed head. Summer regrowth occurs during a typically hotter and dryer season, such that dry conditions will significantly change growth and the rate of quality change in grasses. All this makes grass regrowth even more difficult to quantify or use for predictive purposes. Harvest is best estimated by days of regrowth, and assessing whether the regrowth environment was moist enough to allow sufficient dry matter accumulation for harvest.

Summary

It is possible to quantify average growth stage of a grass stand, but requires a large time investment. While such indexes can effectively describe tiller populations and quantify grass morphology, they have significant limitations when used to predict forage quality. Alfalfa height in a mixed stand can predict forage quality of grass in the stand better than any grass morphological staging system.

Additional Resources

- 2011 Cornell Guide for Integrated Field Crops Management. Electronically accessible at: http://ipmguidelines.org/Fieldcrops/.
- Parsons, D., Cherney, J. H., and Gauch, H. G., Jr. 2006. Estimation of Preharvest Fiber Content of Mixed Alfalfa–Grass Stands in New York. Agron. J. 98:1081-1089.
- Hill, N.S., M.L. Cabrera, and C.S. Agee. 1995. Morphological and Climatological Predictors of Forage Quality in Tall Fescue. Crop Sci. 35:541-549.
- Moore, K.J. and L.E. Moser. 1995. Quantifying Developmental Morphology of Perennial Grasses. Crop Sci. 35:37-43.
- Valente, M.E., G. Borreani, P.G. Peiretti, and E. Tabacco. 2000. Codified Morphological Stage for Predicting Digestibility of Italian Ryegrass during the Spring Cycle. Agron. J. 92:967-973.

Disclaimer

For more information

Cornell University Cooperative Extension

Grass Management Manual
http://forages.org

David Parsons, Jerry Cherney, Debbie J.R. Cherney

2011