Avoiding Insidious Effects of Errant Grazing on Rangeland

Patrick E. Reece, Professor & Extension Rangeland Ecologist
University of Nebraska
Panhandle Research & Extension Center
308-632-1242
preece@unl.edu

Beef Production Convention
Torrington, WY
November 21, 2006

Introduction

An acre of semi-arid rangeland may contain more than a million grass tillers, most of which will die by the end of the growing season in October. A tiller is the smallest stand-alone-unit of a grass. Basic components of a tiller include a shoot, a crown, and roots (Fig. 1). Knowledge of the annual processes of repopulation and seasonal growth patterns of co-dominant rangeland grasses will help you avoid errant grazing. Cumulative effects of grazing and drought stress can be minimized when knowledge of grass growth is used to make wise year-to-year changes in pasture-use sequences. These practices optimize the vigor and forage production potential of rangeland grasses in pre-drought years, which is "Phase I" of every effective drought plan. When drought occurs, critical dates for reducing stocking rates correspond to rapid-growth windows, 30-day intervals during which co-dominant grasses normally grow most rapidly. There is little hope of measurable yield response to rainfall after severe drought has continued into the mid-point of these rapid-growth windows. The best ways to enhance plant vigor are to (1) avoid grazing key species during their rapid-growth windows in consecutive years and (2) to provide full growing-season deferment to each pasture once in every three years. Skillful grazing managers use their knowledge of plant growth to improve the profitability and longevity of their range livestock enterprises.

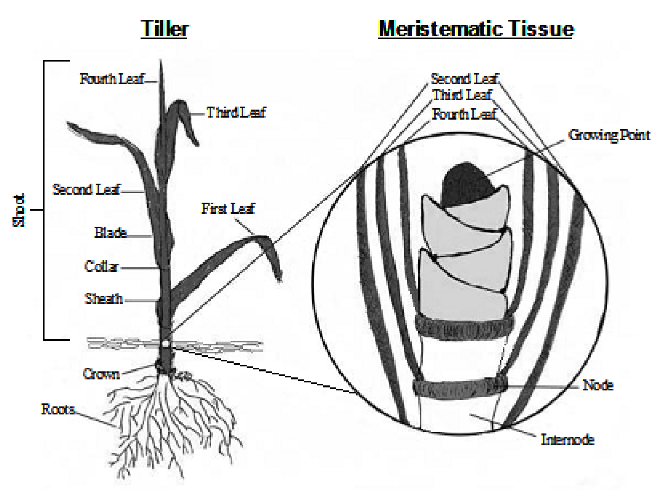

Figure 1. Form and structure of grass tillers (modified from Manske 2004)

Repopulation

Grass seed production on semi-arid rangeland is limited by timing or quantity of precipitation in most years. When viable seed is produced, much of it is consumed by birds, small mammals, or invertebrates like ants or beetles. Consequently, year-to-year replacement of grass tillers primarily depends on the production and survival of vegetative buds located on crowns, rhizomes, or stolons. Bud production and survival are highest in vigorous plants. Additionally, roots and carbohydrates produced by previously established "parent" tillers greatly enhance survival and growth of new tillers from vegetative buds compared to seedlings. Few perennial grasses become established from seed on rangeland.

Season of Growth

Rangeland plant communities are composed of mixtures of species that grow at different times during the spring, summer, or fall. Grasses are classified as cool-season or warm-season species generally based on their growth response to air temperature. Maximum growth rates of most cool-season species occur when air temperatures are 65° to 75°F compared to 90° to 95°F for many warm-season grasses. Within each season-of-growth category, there is variation among species. In the mixed-grass prairie of western Nebraska, sedges, grass-like cool-season species, are the first to grow in the spring. They are followed by prairie junegrass and needlegrasses which are followed by western wheatgrass (Fig. 2). Peak levels of current-year standing herbage for these species are staggered from April through June. Peak levels of standing herbage for warm-season grass species are staggered from July to September. In the sandhills of Nebraska, prairie sandreed is the earliest developing warm-season grass, followed by bluestems, switchgrass and grama grasses (Fig. 3).

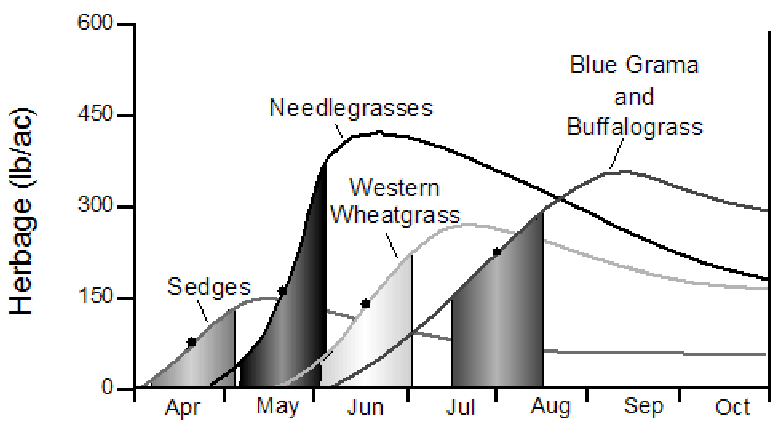

Figure 2. Seasonal distribution of plant growth (lines) and midpoints (●) of rapid-growth windows (shaded areas) for key species on a limy upland range site in western Nebraska or eastern Wyoming.

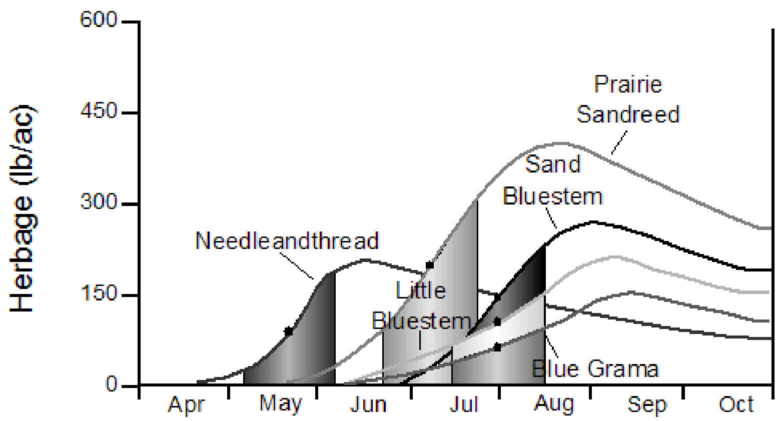

Figure 3. Seasonal distribution of plant growth (lines) and midpoints (●) of rapid-growth windows (shaded areas) for key species on a sands range site in western Nebraska or eastern Wyoming

Grazing and Drought Interactions

Overgrazing is a "root-mining" process. Cumulative effects of overgrazing are especially insidious in years when precipitation is above average, because progressive declines in the length of deep roots are not readily apparent when looking at above-ground plant growth. Under these conditions, subsequent-year herbage production of preferred grass species plummets when drought occurs.

In the absence of drought, heavy defoliation of sand bluestem in July, when herbage production is normally most rapid (Fig. 3), reduced total end-of-season root length by 32% compared to clipping dormant plants in October (Fig. 4). Clipping sand bluestem plants in June, before rapid plant growth occurred, had the least effect of summer defoliation on total root length. Multiple mid-month defoliation treatments during the growing season were devastating to root growth. Clipping plants in June and again in August after 60 days of deferment reduced end-of-season root length by 43% (Fig. 4). In contrast to measurable declines in root length, a single year of heavy defoliation had no effect on total current-year above-ground herbage production of sand bluestem.

When drought does not occur, cattle are unlikely to overgraze warm-season tallgrasses in pastures that are deferred until mid-August, because the tillers have aged and declined in palatability. Additionally, cattle will avoid grazing tillers with seed heads. Periodically deferring grazing until August will help maintain or improve vigor of most tallgrasses. Grazing sandhills pastures two or more times during June through August is likely to reduce the number of tillers that produce seed and increase the risk of heavy defoliation in the second grazing period.

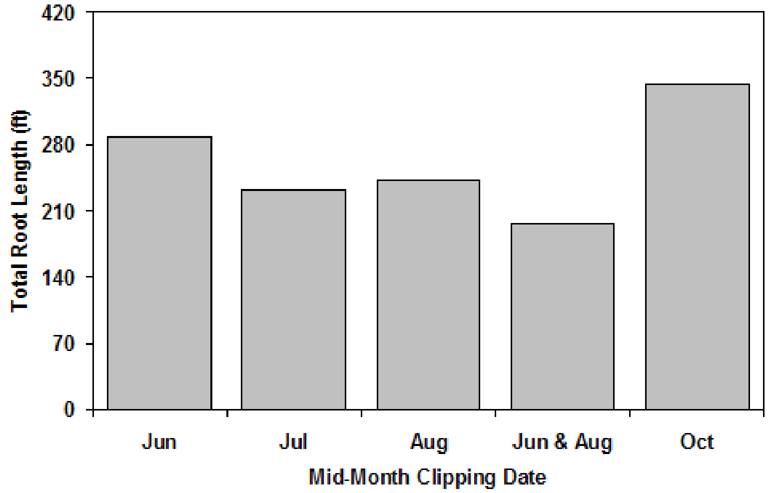

Figure 4. End-of-season total length of sand bluestem roots after mid-month clipping treatments to a stubble height of about 3 inches (Engel et al. 1998)

Rapid growth occurs in grasses when air temperatures and soil water are simultaneously favorable. Rapid rates of herbage production are associated with stem elongation. Optimum air temperatures differ among species (Figs. 2,3). Fifty to 80% of the annual herbage production of most species occurs during a 30-day time period for mid- and tallgrasses on semi-arid rangeland. These rapid-growth windows are best defined by growing degree days. Species sequences are the same each year; however, initiation of rapid growth may change by one to weeks as cumulative degree days change from year to year.

Drought Management

Knowledge of seasonal growth patterns is critical for implementing timely drought management decisions. When drought persists into the rapid-growth windows of co-dominant species, forage production potential is seriously impaired for the rest of the "summer" grazing season. Failure to reduce grazing pressure before or during these windows will result in the combined stresses of overgrazing and drought that are likely to cause long-term declines in forage production potential.

About 50% of the annual forage resource on limy upland and silty range sites in western Nebraska and eastern Wyoming is produced by sedges and needlegrasses (Fig. 2). Consequently, 50% reductions in carrying capacity are likely to occur on these sites when severe drought persists into mid-May. Continuation of drought into mid-June will negatively affect about 75% of the annual forage production potential because of drought stress on sedges, needlegrasses, and western wheatgrass.

Vegetation in good to excellent range condition on sands or sandy range sites in the semi-arid region of the northern Great Plains is often dominated by warm-season tallgrasses (Fig. 3). The combination of cool-season species and the earliest developing warm-season grass, prairie sandreed, generally account for half of the annual forage supply. Productivity of these species is seriously impaired when drought persists into mid-May and early July, respectively (Fig. 3). Persistence of drought through late July will cause measurable reductions in forage production of the entire plant community. There is little hope of measurable yield responses to rainfall after severe drought has continued into the mid-point of these rapid-growth windows.

Moisture accumulated between killing frost of the preceding year and spring green-up of the current year results in greater yield per inch of water than summer precipitation. Little or no accumulation of soil water during the dormant season increases the need for timely destocking to avoid damaging rangeland vegetation.

Grazing Systems

Seasonal changes in the botanical composition of livestock diets on rangeland correspond to seasonal patterns of plant growth. Cattle are selective grazers. They select immature tillers over mature tillers, and leaves over stems. Consequently, livestock use of each species tends to be highest when tillers are vegetative, predominantly leaves, and progressively lower as tillers age or transition into reproductive tillers. Defoliation of grazed mid- and tallgrass tillers will likely be 50% or higher early in the growing season when tillers are vegetative.

The percentage of tillers grazed in a pasture increases as grazing pressure increases. Averaged over the entire pasture, grazing pressure is relatively low under continuous summer grazing. However, allowing cattle to graze plant species they most prefer throughout the summer for years results in overgrazed areas near stock tanks and on level to gently rolling areas. Even at low to moderate stocking rates, range condition in these overgrazed areas can not be improved under season-long continuous summer grazing.

Range condition can be improved by alternating summer and dormant-season grazing or by using rotation grazing with an appropriate number of pastures during the summer grazing season. Shifting from continuous summer grazing to a two-pasture deferred-rotation system is counterproductive. Using one or both pastures more than once during the summer increases the risk of preferred species being heavily defoliated several times each growing season in consecutive years. When each pasture is grazed only once, movement of cattle from the first to the second pasture often occurs during the rapid-growth window of one or more key grass species. For example, splitting the summer grazing season on limy upland range sites (Fig. 2) between two pastures will likely result in a late June to early July move. This will double the grazing pressure on western wheatgrass during its rapid-growth window in both pastures in consecutive years. Movement of cattle on sands range sites (Fig. 9) is likely to occur during July, doubling grazing pressure during the rapid-growth windows of prairie sandreed and sand bluestem in consecutive years.

The risk of overgrazing preferred species in consecutive years can be resolved by using four or more pastures for rotation grazing. Progressively shifting the first-grazed pasture by one in the numerical sequence of pasture use, changes the time of grazing over years. However, this clock-work approach may result in overgrazing of a key species in two consecutive years in each four-year cycle between the first and second, or second and third pastures in the sequence. When "summer" grazing seasons are five to six months long, the pasture grazed last in the preceding year should be the one grazed during the rapid-growth window of key species in the current year. Adding one or two additional pastures to rotation systems will make it easier to change pasture-use sequences and avoid consecutive years of heavy use of key grass species during their rapid-growth windows. The highest levels of forage production and sustainable stocking rates on sandhills rangeland in western Nebraska have been accomplished with deferred-rotation grazing systems, in which every pasture receives a full growing-season deferment from spring green-up to killing frost every third year. Clearly, this management scheme is most feasible with cow-calf enterprises where cows are on the ranch all year and season of grazing can be rotated among pastures. Practices that improve the vigor and productivity of preferred grass species are also likely to increase populations of highly palatable forbs such as stiff sunflower and reduce populations of unpalatable forbs such as western ragweed.

Summary

Understanding how grasses grow and how semi-arid environmental constraints affect plant growth is critical for long-term success in ranching. Grasses grow rapidly only when air temperature and soil water are simultaneously favorable. Optimum air temperatures differ among most species. Fifty to 80% of the annual herbage production of each species occurs during a 30-day rapid-growth window, for mid- and tallgrasses on semi-arid rangelands. When severe drought persists into the rapid-growth window of a given species, forage production potential of that species is seriously impaired for the rest of the year. Failure to reduce grazing pressure before or during the rapid-growth windows of co-dominant grasses will result in the combined stresses of overgrazing and drought that are likely to cause long-term declines in forage production potential. Little or no accumulation of soil water during the preceding dormant season increases the need for timely destocking to avoid damaging rangeland vegetation. Maintaining healthy diverse plant communities provides a buffer against irregular distribution of precipitation and drought that are common to semi-arid rangelands.

Overgrazing is a "root-mining" process. Cumulative effects of overgrazing are insidious in years when precipitation is above average because declines in root length are not readily apparent when looking at above-ground growth on mixed-grass or sandhills prairie.

Excellent rangeland stewardship can be best accomplished by using moderate stocking rates. When feasible, use deferred-rotation grazing systems with four or more pastures or rest-rotation systems with five or more pastures to reduce the likelihood of overgrazing key species in consecutive years. Avoid using summer grazing seasons shorter than four months, because grazing pressure is concentrated during the rapid-growth windows of key forage species. Providing each pasture with a full growing-season deferment from spring green-up to killing frost once in every three years greatly enhances subsequent-year forage production potential.