# Measurement of Time and Rate of Growth of Range Plants with Applications in Range Management

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It is generally recognized that rest from grazing is often the most economical way to restore a range to full productivity. However, in order for the rest to be effective it must be related to the seasonal growth habits of the forage species to be benefited. Benefits result from seed production, but primarily from the increased storage of carbohydrates in the roots. McCarty and Price (1942) showed how carbohydrate content in the roots is correlated seasonally with stages in the growth cycles of various grasses.

It is also generally recognized that returns are greatest from grazing grasses in their most active growth period. Sullivan and Garber (1947) in a review of chemical composition of pasture plants as it affects nutrition, concluded that the stage of growth is the most important factor. In early stages of growth, all grasses are succulent with high protein and low fiber content. In later stages of growth, the composition changes in the direction of a lower protein and phosphorus content with higher carbohydrate, fiber, and calcium content. Palatability and therefore intake also varies with the maturity or stages of growth in each species.

The foregoing considerations point to a need for more accurate local data on the time, rate and stages of growth of range plants.

## Procedure

Range plants were measured at weekly intervals in 1955 and 1956. The interval was extended to 2 weeks when the growth rate declined. Measurements also were made throughout the winter but at irregular intervals as weather permitted. Included in the study were over 100 plants in 1955 and over 300 in 1956. The height of each leaf tip, the green or live portion of each leaf, and the collar height of each was measured on all grasses in 1956 and on part of the grasses in 1955. The balance of the grasses in 1955 were measured for highest growth and height of the remaining green portion. These measurements were each recorded by individual bunches or individual shoots. The ground surface was the base or zero for all measurements. Approximately 50,000 measurements were recorded for the 1956 season.

Phenological data were also recorded both years. Portions of these data are consolidated for presentation here as three variables in the growth cycles of perennial grasses. They are total elongation, residual length and green length.

*Total elongation* will mean the total growth in length or height of all leaves and flowering stems to a certain date, whether or not still present on the plant. It is attained for each grass by adding the height measurements of all the leaves and flowering stems on a certain date.

*Residual length* will mean the remaining length or height of dead and live leaves and stems still attached to the plant at the time of measurement. Rabbits, insects, field mice and possibly other small animals sometimes ate the green leaves. It seemed they preferred the ones being measured. Wind, hail, snow and handling also broke off dry portions.

*Green length* will mean the observable green length on the leaves and stems at the time of measurement. Green length is of special interest because it largely governs grazing preferences by seasons.

The study was in an ungrazed area 3 miles south of North Platte, Nebraska, which is served by a first order Weather Bureau station with over a half century of meteorological data. Total precipitation in 1955 was .51 inch above normal and in 1956, .64 inch below normal. The soil of the area was mapped as a very fine sandy loam on loess parent material.

## Results

Data on three widely known range grasses, which are also important on the study area, are presented in Figure 1. These grasses are: Western wheatgrass *(Agropyron smithi)*, a grass evolved from northern ancestry; sideoats grama *(Bouteloua curtipendula)*, a grass with ancestry believed traceable to the Mexican Plateau and little bluestem *(Andropogon scoparius)*, a grass of tropical ancestry. The data show time and rate of elongation, and are not intended to show forage production (Fig. 1).

The three variables as shown in Figure 1 are averages from representative plants of each species. The months are divided into quarter months.

Visible fall growth on western wheatgrass started on October 3, 1955. Elongation as shown by the solid line was rather rapid until the last quarter of October. From the first quarter of November to the first quarter of March there was a very small amount of elongation. Some plants of western wheatgrass did not elongate during this period but others did. Spring growth was first evident the first quarter of March. Rapid

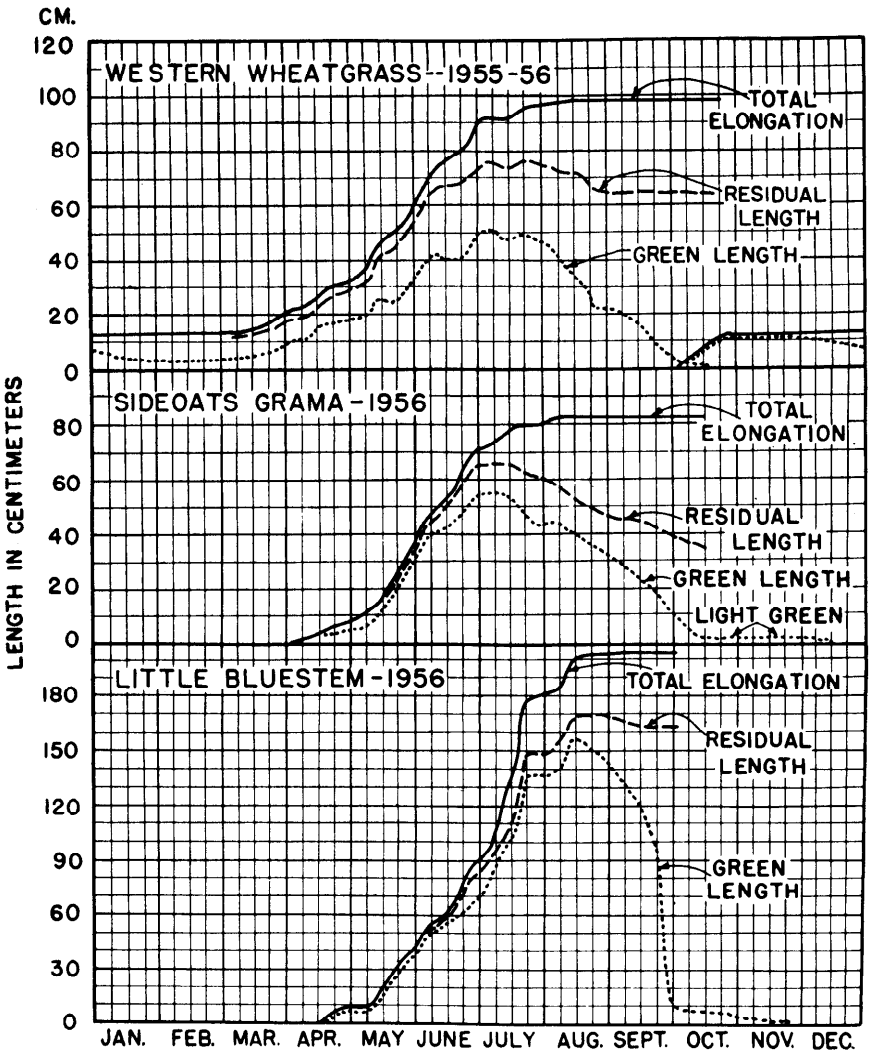


FIGURE 1. Graphs showing total elongation for time and rate of growth of three range grasses at North Platte, Nebraska, in 1956. Residual length and green length are also shown.

growth started the second quarter of May. Rate of growth declined the first quarter of July, and elongation essentially stopped by mid-August. The foliage loss as shown by difference between total elongation (solid line) and residual length (dashed line) in March, April and May was largely that which grew the previous fall. The loss increased the second quarter of June, but growth offset loss so that maximum residual length occurred in July. It declined during August, becoming rather stable by Sept. 1. This stability of residual length in western wheatgrass indicates its effectiveness in maintaining a mulch. Green length, indicated by the dotted line, was evident all winter. It reached the lowest point by the last quarter of January, remaining stable through February. Most plants which started elongation in the fall maintained some green length through the winter. The earliest or oldest leaves were damaged most by freezing weather. The newest or the rolled center leaf was rarely affected except for a gradual slow browning starting at the tip. Green length increased with the start of spring elongation. The maximum was attained the first quarter of July. Some continued into the third quarter of October, thus overlapping the time it started growth the previous fall. From this it could be said that western wheatgrass was green the year around.

Visible growth on sideoats grama started on April 1. The rapid elongation rate started the second quarter of May and subsided the first quarter of July. Maximum elongation was attained by the second quarter of August. The residual length shows very little foliage loss until the last of June. The leaves of sideoats grama are very brittle when brown and dry. Moreover, the majority of the leaves are relatively close to the ground so are subject to the extremes of the microclimate. Low freezing temperatures in the early growth period caused some brown on essentially all of the first spring leaves. Green length correlated closely with total elongation, the maximum occurring the first half of July. It declined at a rather uniform rate until the second quarter of October. A small amount remained into the winter, but by November it was a light green. Some green length may persist through the winter, since some greenness was measured April 1 on leaves which obviously grew the previous year. This possibility is being studied currently.

The first growth of little bluestem, visible out of small lower sheaths, was in the second quarter of April. Rapid elongation started the second quarter of May and declined the second quarter of August. The accelerated rate in mid-July was during jointing and the appearance of the inflorescenses. The tip of the uppermost lemma was measured on each raceme emerging from separate sheaths. Although the racemes and pedicels continued to grow, elongation was slower during the last quarter of July and the first quarter of August. Secondary racemes then appeared beside the first, out of the uppermost sheaths. The measurement of these produced

the apparent resumption of elongation in the second quarter of August. Elongation was completed by the last quarter of August. Residual length shows that the foliage loss was gradual until the last quarter of July, when a sizeable loss occurred. Residual length then paralleled elongation until the first quarter of September, when there was a little more loss. It then remained about the same, indicating that little bluestem is effective in maintaining a mulch. Green length shows that there was only a small amount of browning early in the growth period, indicating that little bluestem was affected less by low freezing temperatures than was sideoats grama. The greatest amount of green length occurred in the second quarter of August. It declined rapidly during September. The small amount remaining green on October 1 browned gradually, with a small amount remaining green until November 24. None was visible December 16.

The five species producing the bulk of the forage in the area are western wheatgrass, sideoats grama, prairie sandreed *(Calamovilfa longifolia)*, needleandthread *(Stipa comata)*, and little bluestem. The grand period of growth for a species is the period of most rapid elongation or the time in which the bulk of its foliage is produced. The date of the maximum green length and the grand period of growth for five grasses are shown in Table 1.

In Table 1 the grasses are listed in the order in which they successively attained maximum green length. Western wheatgrass and sideoats grama did this on July 9. These were followed by prairie sandreed July 22, needleandthread July 28, and little bluestem August 14.

Although the phenology of these species is quite different, it is highly significant in range management that the time of beginning of the grand period of growth varied but little. It occurred the second quarter of May for each of the five species. The duration of the grand period of growth varied from 1¾ months for western wheatgrass and sideoats grama to 3 months for little bluestem.

If these five species were arranged in the order in which they began visible growth in the spring, the order would be: western wheatgrass, needleandthread, sideoats grama, little bluestem and prairie sandreed, with very little difference between the last two. All five attained their maximum elongation in August.

**Table 1. Date of maximum green length and the grand period of growth (period of most rapid elongation) for five major range grasses on the silty range site at North Platte, Nebraska.**

| Species | Maximum Green Length *Date* | Grand Period of Growth (Most rapid elongation) *Month and Quarter* |
|---|---|---|
| Western wheatgrass | July 9 | May 2nd. Q—July 1st. Q |
| Sideoats grama | July 9 | May 2nd. Q—July 1st. Q |
| Prairie sandreed | July 22 | May 2nd. Q—July 4th. Q |
| Needleandthread | July 28 | May 2nd. Q—July 1st. Q |
| Little bluestem | Aug. 14 | May 2nd. Q—Aug. 2nd. Q |

## Discussion

Measurement of the highest growth only, as was made on many plants in 1955, does not reflect all the growth activity. Plains muhly *(Muhlenbergia cuspidata)* is an unpretentious appearing grass with a much branched stem. Often two stem branches with leaves grew from one node in a single sheath. Its tallest growth was only 22 centimeters, but the maximum elongation averaged 238 centimeters.

Certain species may appear brown and dormant throughout the winter. New growth is not discernible by green color at the base of shoots, as such winter increments are frozen and become brown as they are added. In such cases, measurements of total length revealed an increase, even though the shoot appeared brown at two successive measurements. The term "pseudodormancy" is suggested for this condition.

It is recognized that amount, and to a lesser degree, time of rainfall have an effect on grass growth. However, the weather is never the same, at least in Nebraska, so variations are normal. Total precipitation in 1955 was .51 inch above normal, with May and June 74 percent above normal and July and August 84 percent below normal. The 1956 precipitation, which was .64 inch below normal showed a deficiency of 56 percent in May. In June it exceeded normal by 79 percent, but in September it was 98 percent below normal. Moreover, no precipitation was received in October until the 24th. The amount of precipitation received during the different months varied widely between the two years. Even so, the total elongation each year for prairie sandreed and western wheatgrass showed a marked correlation in time and rate of growth. Elongation was greatest in 1955 for both species.

## Conclusions

Western wheatgrass and needleandthread, which start new growth in the fall, are in a state of pseudodormancy through the winter.

The time of beginning the grand period of growth is essentially the same for five phenologically different but major grasses on the site. They are western wheatgrass, needleandthread, sideoats grama, little bluestem and prairie sandreed. Little bluestem had the longest grand period of growth, which was 3 months.

Maximum elongation was attained by all five species at essentially the same time, that is, the fourth quarter of August in 1956.

Differences in the time and amount of precipitation in 1955 and 1956 had little influence on the grand period of growth. The major percentage of forage was produced in essentially the same relatively short period of both years.

Species varied in their effectiveness in maintaining a mulch. These data make possible more accurate timing of periods of rest or grazing to accomplish desired objectives, whether for strengthening or increasing certain species, or for maximum rate of livestock gains.

## LITERATURE CITED

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