Dry Matter Accumulation of Four Warm Season Grasses in the Nebraska Sandhills

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Abstract

Grass development and seasonal growth patterns are used in making range management decisions. Plant development and dry matter accumulation of four warm-season grasses were studied in the Nebraska Sandhills. Development of the grasses were slowed during 1974 due to low precipitation. Plant, leaf blade, and stem dry matter accumulation per shoot increased with successive harvests and were considerably greater both years for the tall grasses, sand bluestem [*Andropogon hallii* Hack.] and switchgrass [*Panicum virgatum* L.], than for the mid-grasses, little bluestem [*Schizachyrium scoparium* (Michx.) Nash.] and sand lovegrass [*Eragrostis trichodes* (Nutt.) Wood]. Leaf blade to stem ratios decreased with successive harvests for all grasses. Dry matter accumulation of the tall grasses was affected more by the low rainfall in 1974 than that of the mid-grasses. At the last harvest, decrease in stem dry matter accumulation was considerably greater than the decrease in leaf blade dry matter accumulation in 1974 as compared to 1973.

Knowledge of development and seasonal growth patterns of grasses is used in making management decisions for proper range use. Development of plants can be altered by many climatic and management factors.

Time and height of growing point elevation of grasses is important in determining the reaction of shoots to herbage removal. The growing point remains below the soil surface during early vegetative growth and is elevated later in the growing season with internode elongation. If the growing point is removed after elevation, normal shoot development is arrested, and any further growth can only come from axillary buds at the shoot base (Cook and Stoddart 1953; Rechenthin 1956; Booysen et al. 1963; Hyder 1972).

Dry matter accumulation in grasses results from the interaction of the genetic constitution of the plant and environmental factors. Available soil moisture is probably the most important environmental factor influencing growth and development of grasses. High correlations have been found between available soil moisture and forage production (Cable 1971; Shiflet and Dietz 1974). Temperature affects precipitation effectiveness, as higher temperatures are associated with greater evapotranspiration losses.

Dry matter accumulation of a plant, when plotted, is generally represented by a sigmoid curve. The sigmoid curve can be separated into three growth periods: (1) early period of slow growth, (2) middle period of rapid growth, and (3) final period of slow growth (Stubbendieck and Burzlaff 1971). Early above-ground growth is primarily leaf material. Stem material is added later as the shoot and inflorescence develop during the middle period of rapid growth. In the last phase, dry matter accumulation continues, but at a slower rate (Sims et al. 1971; Sims et al. 1973; Pieper et al. 1974).

Four abundant grasses found in the Nebraska Sandhills are little bluestem [*Schizachyrium scoparium* (Michx.) Nash.], sand bluestem [*Andropogon hallii* Hack.], and sand lovegrass [*Eragrostis trichodes* (Nutt.) Wood], and switchgrass [*Panicum virgatum L.*]. They are important for soil stability and forage production. All four grasses are native, warm season, perennials. Sand bluestem and switchgrass are rhizomatous tall grasses, while little bluestem and sand lovegrass are mid-grasses and grow in bunches.

Objectives of this study were to examine stages of development and time of growing point elevation and to measure plant, leaf blade, and stem dry matter accumulation during two consecutive growing seasons.

Materials and Methods

The study was located in the Nebraska Sandhills near Halsey. The study area had a gently rolling topography and was classified as a sands range site. Range condition was excellent. Soil was a Valentine fine sand. Native tall and mid-grasses and forbs composed the dominant vegetation. No domestic livestock grazing had occurred since about 1935. About 70% of the annual precipitation falls within the April through September growing season.

In March, 1973 and 1974, 110 plants each of little bluestem, sand bluestem, sand lovegrass, and switchgrass were selected randomly throughout a 5-ha area. Dry matter accumulation was determined by harvesting the plants at weekly intervals beginning June 4, 1973, and May 27, 1974, and continued for 11 consecutive weeks. Stage of development was recorded at each harvest. Growing point height was measured in cm from the soil surface to the top of the shoot apex. Different plants were harvested each week with a minimum of 10 shoots per plant randomly clipped to a 2.5 cm height. Harvested shoots were separated into leaf blades and remaining topgrowth, hereafter referred to as stems. Forage was oven-dried at 70° C until a constant weight was obtained.

The study was conducted in a completely randomized design with ten replications. A factorial arrangement was used. Factors were years, grasses, and harvests with 2, 4, and 11 levels, respectively. An analysis of variance was computed for each variable. The treatment sum of squares was partitioned into years, grasses, and harvests, and their interactions. Years were considered a random effect and grasses and harvests fixed effects. Duncan's multiple range test was used to compare treatment means.

Results and Discussion

Annual and growing season precipitation were considerably lower in 1974 than in 1973. Between April 1 and July 31,

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This report is a contribution of the Nebraska Agricultural Experiment Station as Technical Paper Number 5328.

Manuscript received May 15, 1977.

precipitation was 28.6 cm in 1973 and 22.6 cm in 1974. Average air temperatures were higher in 1974 than in 1973. Average air temperatures during July were 3° C higher in 1974 than in 1973.

The grasses were at the 3- and 4-leaf stage of development at first harvest both years. At last harvest in early to mid August, little bluestem and sand bluestem inflorescences were beginning to emerge, sand lovegrass inflorescences were partially emerged, and switchgrass inflorescences were fully emerged. Sand lovegrass developed slowly by early harvests and more rapidly by later harvests. Rate of development of the grasses was slower during 1974 due to less precipitation. Little bluestem development was least affected by the climatic conditions of 1974 compared to 1973, and sand lovegrass was affected most.

Growing point elevation occurred in mid June for switchgrass, followed by little bluestem and sand bluestem in late June to early July. Sand lovegrass had the latest growing point elevation in mid to late July, but the rate of elevation was rapid

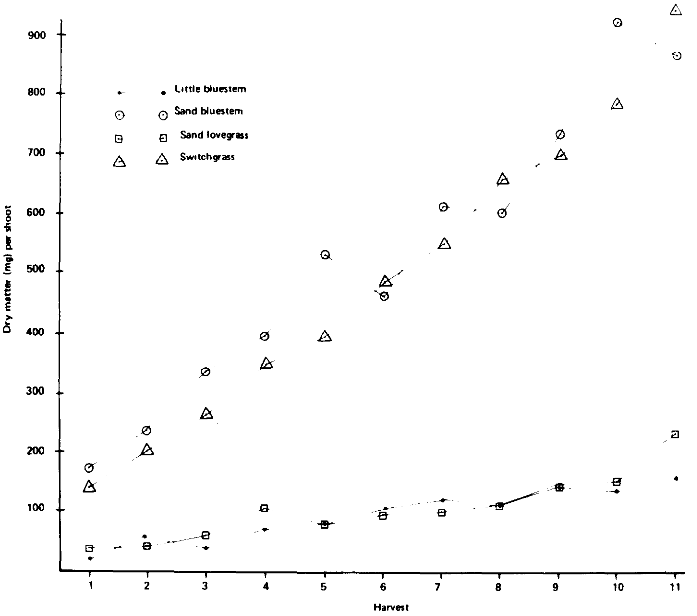

Fig. 1. *Plant dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning June 4, 1973, near Halsey, Nebr.*

after that time. Growing points had elevated above the 2.5 cm height by late June for switchgrass, mid July for little bluestem and sand bluestem, and late July to early August for sand lovegrass. Branson (1953) suggested that the early vulnerability of the growing points of switchgrass could contribute to its rather rapid decrease in density under heavy grazing.

Plant dry matter accumulation per shoot generally increased with successive harvests for all four grasses in 1973 and 1974 as plant development advanced (Fig. 1 and 2). An increase in dry matter as the growing season progressed allowed for a greater forage supply, which was associated with potentially greater stocking rates. Dry matter accumulation occurred up to and including the last harvests; thus additional accumulation likely occurred after harvesting ceased.

Plant dry matter accumulation for each grass was nearly equal at the early harvests both years. At subsequent harvests, dry matter accumultion became progressively less in 1974 than in 1973, which was associated with the lower precipitation in 1974. Dry matter accumulation of the tall grasses was affected more by the reduced rainfall in 1974 than that of the mid-grasses. At the last harvest, dry matter production of the tall grasses was less in 1974 than in 1973, while the mid-grasses remained the same. Although the tall grasses still had greater dry matter production during the dry 1974 growing season, the mid-grasses can be important forage plants by maintaining a more stable forage production from year to year in spite of fluctuating climatic conditions.

Similar to plant dry matter accumulation, both leaf blade and stem dry matter accumulation generally increased with successive harvests for all grasses in 1973 and 1974 (Fig. 3, 4, 5, and 6.) Forage at the early harvests consisted of leaf material with little or no stem material. As the rate of stem dry matter accumulation increased, rate of leaf blade dry matter accumulation slowed. Therefore, leaf blade to stem ratios decreased with successive harvests.

Leaf blade and stem dry matter accumulation per shoot were significantly greater for the tall grasses than for the mid-grasses at the last harvests. Sand bluestem had the greatest leaf blade dry matter accumulation. Stem dry matter accumulation was significantly higher for switchgrass than for the other three grasses. This was associated with its advanced development. Leaf blade to stem ratio appeared to be greatest for sand bluestem and

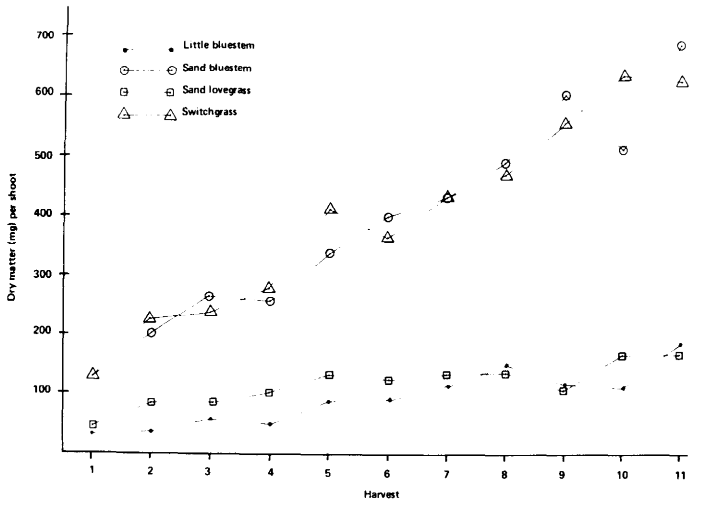

Fig. 2. *Plant dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning May 27, 1974, near Halsey, Nebr.*

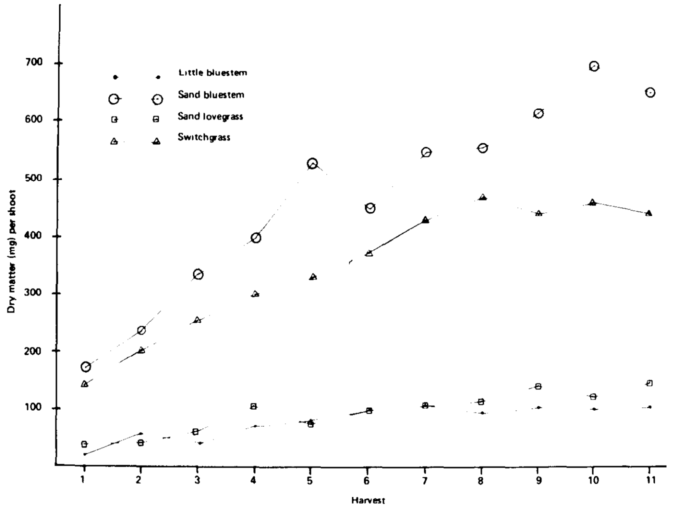

Fig. 3. *Leaf blade dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning June 4, 1973, near Halsey, Nebr.*

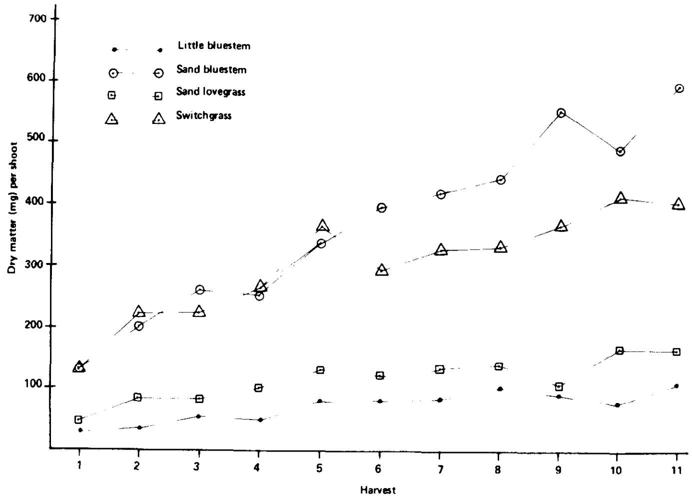

Fig. 4. *Leaf blade dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning May 27, 1974, near Halsey, Nebr.*

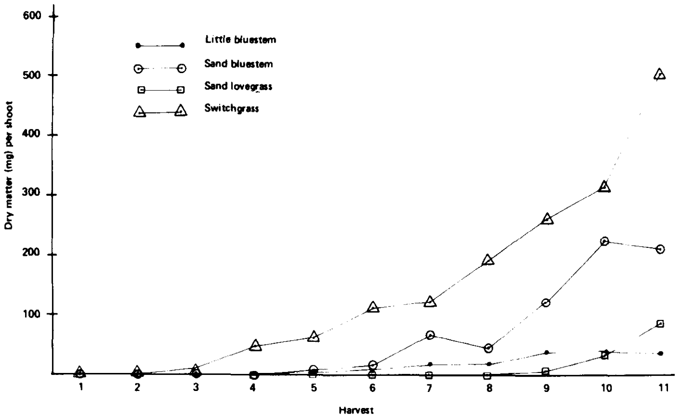

Fig. 5. *Stem dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning June 4, 1973, near Halsey, Nebr.*

lowest for switchgrass, although few differences among the grasses were significant.

Both leaf blade and stem dry matter accumulation were significantly less at most harvests in 1974 than in 1973 for the tall grasses. At the last harvest, the decrease in stem dry matter accumulation, in 1974 as compared to 1973, was considerably greater than the decrease in leaf blade dry matter accumulation.

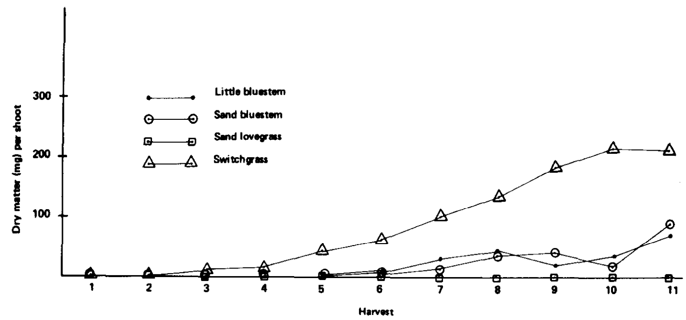

Fig. 6. *Stem dry matter accumulation of four warm-season grasses harvested at weekly intervals beginning May 27, 1974, near Halsey, Nebr.*

Thus the decrease in plant dry matter accumulation at the last harvest in 1974 can be attributed mostly to the decrease in stem dry matter accumulation. The lower dry matter accumulation was associated with the low precipitation in July of 1974, which occurred at a time when considerable leaf growth had occurred and stem growth was just beginning.

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