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Growth Rate of Four Range Grasses in Northcentral Oklahoma

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Growth Rate of Four Range Grasses In North Central Oklahoma

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Little is known about the growth rates of native Oklahoma grasses. Research reported herein was made to determine the growth rate of little bluestem (*Andropogon scoparius* Michx.), big bluestem (*Andropogon gerardi* Vitman), indiangrass (*Sorghastrum nutans* (L.) Nash.), and switchgrass (*Panicum virgatum* L.).

These species were selected on the basis of their wide range throughout the eastern prairie region of Oklahoma. They are the dominant grasses in the study area (Duck and Fletcher, 1945; Bruner, 1931; and Harlan, no date). Relative grass composition, basal cover, forage yields and mulch production were determined to provide study area information.

Several workers have studied the effect of climate on grasses (Rice, 1950; Ashapenek, 1962; Larsen, 1947; McMillan, 1956 and 1959; and Benedict, 1940). Other research has correlated growth, particularly height, with root depth (Weaver and Darland, 1947), forage production (Klages, 1942), and general vigor of grass (Weaver and Darland, 1947).

Description of the Study Area

The study site was a native prairie two miles north and one-half mile east of Stillwater, Payne County, Oklahoma, in the northcentral part of the state.

Climate

Records from the United States Weather Bureau for Stillwater, 1893-1960 inclusive, show a mean annual precipitation of 30.83 inches. Eighty-one percent (24.95 inches) falls during the months March through October, the period covered in the study. During this eight-month period in 1961, 31.65 inches of rain fell, 6.7 inches above the long-term mean for these months.

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The mean annual temperature for the sixty-seven years was 60.9° F. The temperature averaged 68.1° F during the eight month study period, 1.9° below the long term mean of 70.0°. No frost occurred during the study period.

Vegetation

Vegetation was vigorous and healthy, dominated by tall and mid-grasses. There were some broad-leaved plants, but they comprised less than five percent of the total vegetation. The dominant grasses were little bluestem, big bluestem, indiangrass, switchgrass, tall dropseed (*Sporobolus asper* (Michx.) Kunth), sideoats grama (*Bouteloua curtipendula* (Michx.) Torr.), and scribner panicum (*Panicum scribnerianum* Nash).

The area had been mowed occasionally but not for at least three years preceding this study. It had burned accidentally in the past, but not during the last five years. There was a large accumulation of mulch and standing organic material in the area. The standing material was mostly little bluestem seed stalks and leafy material and stalks of other species.

Soil

The soil in the area is a deep, reddish, sandy clay loam, prairie soil. It contains 2.5 per cent organic matter and is slightly to moderately acid. The soil series is Vernon Loam as classified by the Soil Conservation Service.

Methods and Procedures

Relative composition and basal cover of the grasses were determined by the point quadrat method of Levy and Madden (1933).

Forage production was determined by clipping 25 randomly located quadrats 11½ x 24 inches in size. The areas were clipped at ground level the last of August and the vegetation separated into little bluestem, big bluestem, indiangrass, switchgrass, other grasses, and forbs. The samples were air-dried and forage weight converted to pounds per acre.

Mulch consisted of all non-living, unattached plant material. The amount present on the study area was determined from material collected from 15 randomly located quadrats 3.1 feet square. Mulch depth was measured at 10 random points within each quadrat.

Observations and growth measurements were made periodically on little and big bluestem, switchgrass, and indiangrass from March 6 to October 28, 1961. Twenty clones of each species were selected for study; each clone was marked for individual identification. The plants were measured for height, leaf length, leaf width, and stem diameter. Plant height was measured approximately every seven days and the other measurements were made bi-weekly.

Plant height was determined by extending the leaves upright and recording their average height. This represented the vegetative portion (excluding seedstalks), except in switchgrass where each vegetative culm eventually produced a seedstalk. Seedstalk heights were taken as separate measurements in the other species.

Results

Vegetation Analyses

Vegetative basal cover was 12.2 per cent of the total area, based on the results of 110 samples (10 pins per sample) with the point quadrat (Table I). Little bluestem, big bluestem, indiangrass, tall dropseed, and switchgrass comprised over 94 per cent of this vegetation. Of these five, little bluestem was by far the most prevalent species, comprising one-half of the vegetative cover. Big bluestem and indiangrass were secondarily important species, comprising 18.9 and 16.4 per cent, respectively.

Table I. Basal cover and percent composition of grass species on the study area.

Species	Basal Cover Percent	Relative Composition Percent
Little bluestem	6.1	50.0
Big bluestem	2.3	18.9
Indiangrass	2.0	16.4
Tall dropseed	0.6	4.9
Switchgrass	0.5	4.1
Sideoats grama	0.2	1.6
Scribner panicum	0.2	1.6
Carex sp.	0.1	0.8
Others	0.2	1.6
Total	12.2	99.9

Slightly over 4,000 pounds of air-dry forage per acre were produced (Table II). The four dominants produced 90 per cent of this forage. Little bluestem, although contributing 50 per cent to the vegetative composition, contributed only 38.8 per cent of total forage production. Indiangrass produced 27.7 per cent, big bluestem 19.7 per cent and switchgrass 4.8 per cent. Forbs comprised only 3.3 per cent of the total forage production.

Samples showed an average of 4,375 oven-dry pounds of mulch per acre. The quantity was more than the total poundage of living material produced. Average depth of this mulch was 5.4 centimeters.

Growth Measurements

Climatic conditions during this study were very favorable for plant growth. There were no apparent environmental stresses on the vegetation.

When field investigations began on March 11, 80 per cent of the little and big bluestem plants showed bud enlargement at the crown. Indiangrass and switchgrass initiated growth more slowly. On March 11, indiangrass had no crown bud enlargement but switchgrass had 40 per cent enlargement.

Little Bluestem

Shoot formation in little bluestem was underway on April 3 when the soil temperature at one-half inch was 62° F. Little bluestem height increased at a steady rate until mid-June (Fig. 1). Then height was 40 cm,

Table II. Forage production of dominant species.

Species	Pounds of forage per acre (air dry weight)	Percent of total
Little bluestem	1,587.0	38.8
Indiangrass	1,131.0	27.7
Big bluestem	797.5	19.7
Switchgrass	195.5	4.8
Other grasses	230.5	5.7
Forbs	135.5	3.3
Total	4,077.0	100.0

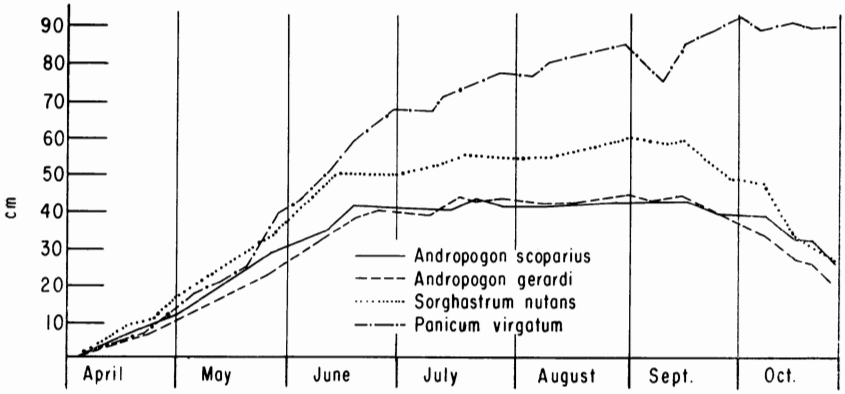

Figure 1. Growth rate curves based on the average vegetative height of 20 plants for each species.

representing an average growth increment of 0.6 cm per day. The vegetative portion (excluding seed stalks) remained between 40 and 45 cm until September 9 when the leaves and shoots began deteriorating. In Nebraska, Weaver and Flory (1934) reported that vegetative growth of little and big bluestem was 85 per cent complete by June 30.

Flower stalk formation began in little bluestem the latter part of July and by August 5 nearly half of the plants had seed stalks in some stage of development. By September 15, 18 of the 20 clones had seed stalks. The average maximum height including inflorescences was 70 cm on August 26. The soil temperature at one-half inch was 74° F. The maximum soil temperature at one-half inch, 87° F, occurred on July 30.

The average leaf length of little bluestem was 26 cm on June 16 (Fig. 2). It increased to 31 cm by August 8 and then declined as the leaves died. The longest single leaf recorded was 55 cm.

The average leaf width remained between 2.5 and 3.0 mm from June 11 to October 28 (Fig. 3). This was the only species in which this measurement did not vary greatly.

Culm diameter was consistently around 1 mm in all measurements (Fig. 4).

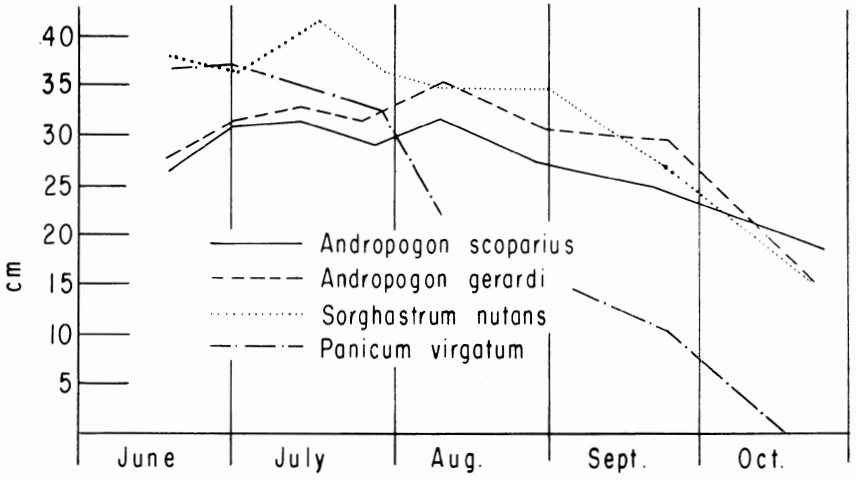

Figure 2. Average length of leaves of the four study species.

Big Bluestem

Vegetative height of growth of big bluestem closely paralleled that of little bluestem (Fig. 1). It developed somewhat slower; growth did not level off until July 16, when the average height was 44 cm. The maximum height was 45 cm on August 31. Beginning in mid-September, vegetative height decreased.

Seedstalk formation began in late July and seedheads appeared the last week in August. One month elapsed between the first culm elongation and the first inflorescence exsertion. The average height of big bluestem, including seed stalks, was 66 cm on September 9. Sixteen of the 20 clones under study developed inflorescences. The tallest flower stalk of big bluestem was 114 cm. The average growth rate was 0.7 cm per day from April 3 to September 9.

Leaf length of big bluestem averaged 27 cm on June 16 and increased to a maximum of 34 cm on August 10 (Fig. 2). The longest leaf recorded was 65 cm.

The average leaf width remained between 5 and 6 mm from June 16 to September 1 (Fig. 3). Between September 1 and October 28, the average width decreased to 3.1 mm.

The average stem diameter was 1.8 mm on June 16 and declined to 1.0 mm on October 28 (Fig. 4).

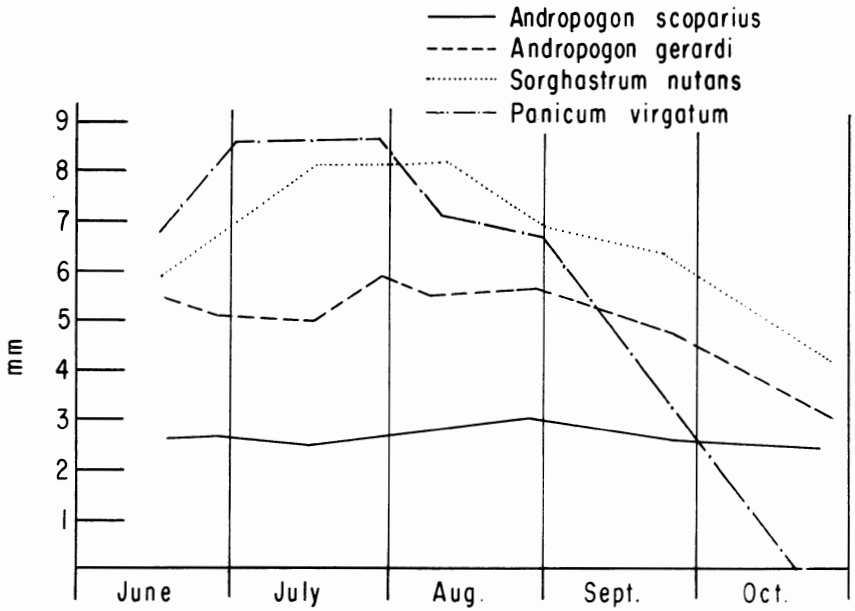

Figure 3. Average width of leaves of the four study species.

Indiangrass

Indiangrass plants increased in height at an average rate of 0.74 cm per day from early April to mid-June (Fig. 1). The average height on June 16 was 51 cm. On August 26 the maximum vegetative height of 60 cm was attained and thereafter height declined.

Culm elongation in indiangrass began on July 29. Exsertion of inflorescenses began the last week in August and continued until September 25, when all 20 clones bore inflorescenses. The most rapid elongation of seedstalks occurred from August 11 to September 24 when the average maximum height was 127 cm. The seedstalk growth rate for this period was 1.3 cm per day.

The average leaf length for indiangrass was 37 cm on June 16 (Fig. 2). The maximum length was reached one month later at 41 cm. The longest leaf measured was 65 cm.

Leaf width averaged 6 mm on June 16 (Fig. 3). The maximum width was 8.2 mm measured on August 11.

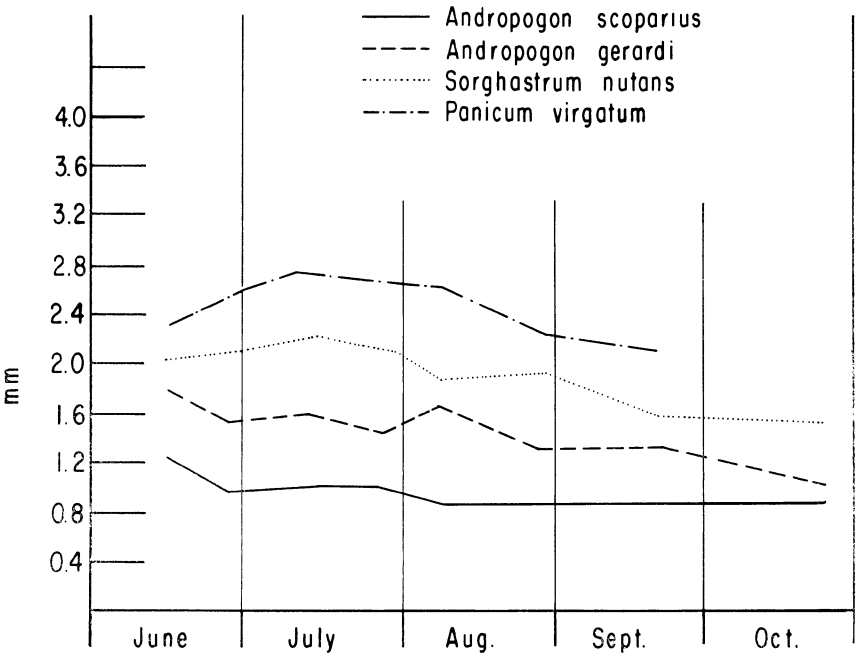

Figure 4. Average stem diameters based on 20 plants for each species.

The average stem diameter of indiangrass was 2.0 mm on June 16. It increased to 2.2 mm one month later, but had declined to 1.5 mm by October 28.

Switchgrass

Switchgrass height increased more rapidly than the other species after May 15 (Fig. 1). The growth of switchgrass was different from the others because each individual culm could produce an inflorescence. As each culm elongated to produce the seedstalk, the leaves were elevated from the ground. In the other three species, most of the leaves came from the crown buds with an occasional culm elongating to form an inflorescence. Thus, most of the leaves were nearer the ground in the other species than in switchgrass.

It was difficult to determine when culm elongation and seedstalk development began in switchgrass since each culm bore both leaves and

inflorescence. Rapid culm elongation occurred the last week in May. Exsertion of inflorescence began July 9 and by July 13 over half the switchgrass clones had inflorescences. Inflorescences were present in all 20 clones on August 30.

Switchgrass averaged 0.57 cm growth per day from April 3 to August 31, when the plants reached 85 cm. The seedstalks did not have as much height decline as little and big bluestem and indiangrass.

The leaves of switchgrass had already reached their greatest length of 37 cm when first measured June 16 (Fig. 2). In general, the length steadily declined from that date and by mid-October no living leaves were found. The longest single leaf recorded was 60 cm.

Leaf width averaged 7.0 mm June 16 and increased to 8.5 mm by July 1 (Fig. 3). It declined rather rapidly from July 28 to October 28 as the leaves deteriorated.

The average stem diameter was 2.3 mm for switchgrass on June 16 (Fig. 4). Maximum diameter was reached July 13.

Discussion and Summary

Growth and development of the four major grass species in eastern Oklahoma prairies were studied from March 11 to October 28, 1961. Measurements were taken on little and big bluestem, indiangrass, and switchgrass for plant height, leaf length and width, and stem diameter at periodic intervals throughout the study.

The study area was essentially an undisturbed, climax prairie representative of the region. Little bluestem was the dominant species with big bluestem and indiangrass secondarily important. Forage production on the area was 4,077 lbs. of air-dry material per acre and mulch accumulation was 4,375 lbs. per acre.

Developmental growth of little bluestem, big bluestem and indiangrass was very similar. Switchgrass emerged with the other species and grew at the same rate until May 15. After that time, switchgrass grew faster and longer, still increasing in height when the other species' growth rate leveled off in mid-June.

From mid-June, size increase in the vegetative portion of little bluestem, big bluestem and indiangrass was small. From mid-September, plant height declined due to death of leaves. Switchgrass height con-

tinued to increase from April 1 to September 1, primarily due to seed stalk formation of each culm.

Little bluestem and big bluestem had nearly identical height and growth trends. However, the leaf blades of big bluestem were both longer and wider. This difference probably accounts for the greater plant production per unit of big bluestem over little bluestem observed in Table II. Indiangrass leaves were longer and wider and the plants grew taller than either big or little bluestem. As seen in Table II, indiangrass yielded 27 per cent of the total forage, although it made up only 16 per cent of the grass stand.

The big bluestem produced a lower percentage of seedstalks than the other three species. Vegetative growth of little bluestem, big bluestem and indiangrass was approximately 80 per cent complete by mid-June. Most growth after July 1 was in seedstalk formation.

Inflorescence formation in little bluestem, big bluestem and indiangrass was initiated in late August. However, in switchgrass they had matured in all plants by this time, approximately 40 days earlier than the other species. Leaves of switchgrass reached their maximum length by June 16 while the other species took until late July.

The decline in average measurements of seed stalk height and leaf width and length in September and October, indicates that big bluestem deteriorated the earliest of all species, but its seedstalks persisted longer.

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