Seasonal Variation of Chlorophyll in Western Wheatgrass and Blue Grama[1]

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Highlight

Chlorophyll concentrations in western wheatgrass and blue grama were evaluated during the period June 29 through October 29, 1965, at the Archer Substation, Cheyenne, Wyoming. Chlorophyll a was more abundant than chlorophyll b in both the western wheatgrass and blue grama during the study period. Concentrations of chlorophyll a and b in the western wheatgrass was greater than in the blue grama. Chlorophyll a and b and total chlorophyll decreased with maturity of the plants.

The role of chlorophyll in providing energy for plant metabolism has long been established. However, there is a paucity of information on the seasonal variation of this biochemical constituent in native grasses.

The chlorophyll content of the cell is, perhaps, more closely associated with the photosynthetic performance than is any other factor; and wide variations in photosynthetic rate of leaves are to be expected, particularly under field conditions (Bonner and Galston, 1955).

Significant differences in percentage total chlorophyll was found in 55 clonal lines of Fairway crested wheatgrass (*Agropyron cristatum* (L.) Gaertn) by Johnson and Miller (1940). Bray (1960), working with six forests and thirteen native and managed herbaceous stands in central Minnesota, concluded that all the natural herbaceous stands had an approximately similar ratio of chlorophyll to dry weight of the above-ground parts. Bray also found a significant positive correlation between chlorophyll content and herbaceous stand height. Brougham's (1960) study suggests that the chlorophyll in a species with horizontally disposed or flagged leaves is more active or efficient in converting carbon dioxide than species with more erect leaves. A chlorophyll index for turf grass responses was determined by Madison and Anderson (1963). The chlorophyll index showed significant difference only from the fertilized treatments, and increased with an increase of N fertilizer.

During 1965, the seasonal trends of chlorophyll concentrations in western wheatgrass and blue grama were evaluated at the Archer Substation near Cheyenne, Wyoming.

Methods and Procedure

Entire plants of western wheatgrass (*Agropyron smithii*), a cool season grass, and blue grama (*Bouteloua gracilis*), a warm season grass, were clipped at ground level approximately every two weeks from June 29 through October 29 on a moderately grazed native pasture. Western wheatgrass produced no seed heads during the 1965 season, and remained green and in a vegetative stage throughout the collection period. Blue grama produced numerous seed heads that were included in the clipped plant material. Plant materials were air-dried and ground with a stainless steel Wiley Mill with 60-mesh openings. Extraction and spectrophotometer determinations of chlorophyll a and b were accomplished by Koski's (1950) technique.

Results and Discussion

Total concentration of chlorophyll and chlorophyll a and b in the western wheatgrass declined rapidly after the July 29 collection date (Fig. 1).

The total chlorophyll concentration of the western wheatgrass had a tendency to level off during the forepart of September, and it decreased again with a slight increase occurring between September 30 and October 13. The increase of chlorophyll concentration was perhaps a result of increased plant growth because of the ample moisture, clear skies, and warm daytime temperatures during the early fall.

The differences in chlorophyll a and b concentrations in western wheatgrass were quite pronounced between June 29 and July 29, after which the difference in chlorophyll a and b content decreased rapidly with maturity. On October 29 the difference between chlorophyll a and b concentration was negligible.

The chlorophyll concentration of blue grama decreased markedly between June 29 and July 14 (Fig. 1). The last rain in June (.24 inch) was on the 24th, and precipitation from June 29 to July 14 was only .14 inch (Table 1). Thus, little or no plant growth occurred between the first and second sampling dates. A decided increase in the chlorophyll concentration occurred between July 14 and

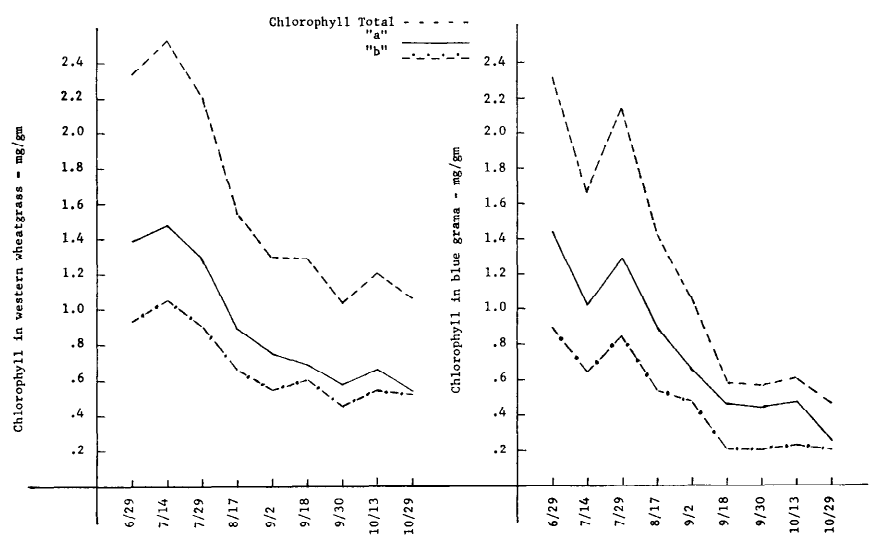

FIG. 1. Chlorophyll a and b, and total chlorophyll for western wheatgrass and blue grama. Archer Substation, Wyoming. 1965.

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Table 1. Precipitation (inches) for the sampling dates during June, July, August, September, and October. Archer Substation, Wyoming. 1965.

Sampling date	Precipitation
6/29– 7/14	.14
7/14– 7/29	1.53
7/29– 8/17	.73
8/17– 9/ 2	.05
9/ 2– 9/18	.95
9/18– 9/30	1.06
9/30–10/13	.00
10/13–10/29	1.17

July 29 as a result of 1.53 inches precipitation and resultant plant growth.

Total chlorophyll and chlorophyll a and b concentrations in blue grama again declined sharply between July 29 and September 18, probably as a result of decreasing precipitation and an increase in plant maturity. Chlorophyll concentration in the blue grama increased slightly between September 18 and October 13. The small increase was associated with conditions more favorable for plant growth as a result of the precipitation received during September.

During the study period western wheatgrass plant material contained 25% more total chlorophyll than did the blue grama plant material. The greater amount of total chlorophyll concentration in the western wheatgrass may have resulted from the plants being under more soil-water stress than were the blue grama plants.

Table 2. Total chlorophyll (mg/gm) and percentage difference between western wheatgrass and blue grama. Archer Substation. 1965.

Date	Western wheatgrass	Blue[1] grama	Percentage[2] difference
6/29	2.33	2.34	0.0
7/14	2.53	1.66	34.4
7/29	2.21	2.14	3.2
8/17	1.55	1.44	7.1
9/ 2	1.30	1.05	19.2
9/18	1.29	.58	55.0
9/30	1.03	.56	45.6
10/13	1.20	.61	49.2
10/29	1.06	.47	55.7

[1] Plant material includes seed stalks and heads.

[2] Western wheatgrass used as the base for comparing percentage differences in total chlorophyll.

Total chlorophyll concentration (percentage basis) of western wheatgrass was greater than that of the blue grama at all sampling times, except the first when they were the same (Table 2). The difference in total chlorophyll concentration between the two species was smallest during the fifth sampling period, and the greatest during the seventh sampling time. After the fifth sampling date, the difference in total chlorophyll concentration between the two species increased markedly.

Chlorophyll a was more abundant than chlorophyll b in both grass species throughout the growing season. The ratio of chlorophyll a to b decreased with time in both species. Chlorophyll a and b concentration of western wheatgrass was greater than that of blue grama. The decrease in amount of chlorophyll became more pronounced with the advance of the season. Thus, the stage of maturity and the climatic conditions appeared to influence the chlorophyll concentration in blue grama and western wheatgrass plants.

Literature Cited

BONNER, JAMES, AND ARTHUR W. GALSTON. 1955. Principles of plant physiology. W. H. Freeman Company. 499 p.

BRAY, J. R. 1960. The chlorophyll content of some native and managed plant communities in central Minnesota. Can. J. Bot. 38:313–333.

BROUGHAM, R. W. 1960. The relationship between critical leaf area, total chlorophyll content and maximum growth rate of some pasture and crop plants. Ann. of Bot. N. S. 24:463–474.

JOHNSON, I. J., AND ELMER S. MILLER. 1940. Leaf pigment concentrations and its relation to yield in fairway crested wheatgrass and parkland bromegrass. J. Amer. Soc. Agron. 32:302–307.

KOSKI, VIOLET. 1950. Chlorophyll formation in seedlings at Zea Mays L. Art. Biochem. Biophys. 29:339–343.

MADISON, JOHN H., AND AAGE H. ANDERSON. 1963. A chlorophyll index to measure turfgrass response. Agron. J. 55:461–464.