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Effect of Burning on Seedstalk Production of Native Prairie Grasses¹

By JOHN H. EHRENREICH and J. M. AIKMAN

The State of Iowa has acquired two prairie reserves; the Hayden prairie in 1945 and the Kalsow prairie in 1948. These were purchased by the Iowa State Conservation Commission, according to a 25-year plan, in order to save under the control of the state a living museum of the characteristic native prairie landscape with its wild flowers and fauna, and to make available a field laboratory for scientific observation and experimentation (9).

An advisory committee of the Iowa Academy of Science initiated a program for the management of the prairie reserves in 1949 (9). In 1953, Moyer (11) completed studies which involved an inventory of plant species, identification of plant communities and determination of the condition of the vegetation and soils of the two prairie tracts as to degree of disturbance from past use. Aikman (1) later reported the effects of burning in the management of native Iowa prairie. Since then Ehrenreich (6) has investigated the interactions of management practices such as burning, mowing and complete protection on the environmental factors and growth of component plants of the prairie community. Aikman (1), Curtis and Partch (4) and Ehrenreich (6) have reported an increased number and height of seedstalks of native grasses as a result of burning.

This study was conducted on the Hayden prairie, located in north-eastern Iowa and involved a further investigation of the effects of burning on the growth of certain native prairie grasses as to relative production of various plant parts. The measurements are of plants taken from an upland prairie area burned in 1956 and an adjacent unburned area.

The three chief dominants of this upland prairie community are *Sporobolus heterolepis*,² prairie dropseed; *Andropogon scoparius*, little bluestem and *Andropogon gerardi*, big bluestem. The yield of these three plants equals the total yield of all other plant species making up the vegetation of the community. Prairie dropseed and little bluestem are bunch grass dominants of the upland prairie which form crowns of about one inch to a foot or more in diameter. Big bluestem, a lowland prairie sod-former, dominates much of the area

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²Nomenclature is after Fernald (8).

between the bunches. *Stipa spartea*, porcupine grass, forms numerous smaller bunches among the bunches of prairie dropseed and little bluestem as does *Koeleria cristata*, June grass, to a lesser degree. *Sorghastrum nutans*, Indian grass, is associated with big bluestem in occupying the inter-bunch space, but to a lesser extent. *Elymus canadensis*, Canada wild rye, is a lowland prairie bunch grass that occurs rather sporadically throughout upland prairie in widely scattered bunches.

This study was conducted in late August, 1956, when most grasses had reached maturity. Enough plants were clipped so that three bundles, five square inches in cross sectional area of each species in both burned and unburned areas, were brought into the laboratory. These were measured as to total number, average height and weight of seedstalks, average length, total weight, and total area of leaves, average length and total weight of sheaths and the number, percentage purity and percentage germination of seeds (fruits) (Table 1). The percentage purity and percentage germination of the uncleaned seeds were determined by the Iowa State College Seed Laboratory.

The number of seedstalks per bundle was considerably greater for big bluestem, little bluestem, Indian grass and prairie dropseed on the burned area than on the unburned area. Compared to the unburned area there was an increase in number of seedstalks per bundle on the burned area of approximately 7 times for big bluestem, 8 times for little bluestem, 3 times for Indian grass and 8 times for prairie dropseed. In addition to an increase in number of seedstalks there was an increase in height on the burned area of about 55 percent for big bluestem, 33 percent for little bluestem, 55 percent for Indian grass and 43 percent for prairie dropseed (Table 1). The number of seedstalks per bundle and the average height was the same on burned and unburned area for Canada wild rye. Seedstalk number and height in this particular grass appeared to be unaffected by the burning treatment.

With the increase in number of seedstalks per bundle on the burned area there was a corresponding increase in number of fruits. The percentage purity was greater on the burned area as compared to the unburned area for all grasses measured except wild rye. The germination percentage was very low for all species, but was slightly greater on the burned area for big bluestem, little bluestem and Indian grass. There was no germination at all on the unburned area for little bluestem and no germination on either the burned or unburned areas for dropseed. The germination percentage for wild rye was greater on the unburned area. The seed from the plants collected was probably not sufficiently mature at the date of collection, the latter part of August, to give very satisfactory germination.

Table 1

Relative Production (dry weight) of Various Plant Parts per Bundle (5 in.² in cross section) of Some Dominant Prairie Grasses on an Area Burned in 1956 and an Adjacent Unburned Area.

		Big bluestem		Little bluestem		Indian grass		Prairie dropseed		Wild rye	
		burned 1956	un- burned	burned 1956	un- burned	burned 1956	un- burned	burned 1956	un- burned	burned 1956	un- burned
Seed stalks	no./bundle	54.0	8.0	350.0	41.0	74.0	33.0	101.0	13.0	105.0	102.0
	average height (inches)	56.0	36.0	32.0	24.0	56.0	36.0	43.0	30.0	46.0	46.0
	weight (grams)	76.5	8.2	36.7	9.3	70.8	18.0	31.7	0.5	113.5	111.0
Fruits	purity %	10.4	7.6	16.5	0.	6.4	1.9	76.2	46.3	40.1	47.9
	germination %	9.0	2.0	17.0	0.	7.0	5.0	0.	0.	8.0	44.0
	weight (grams)	16.2	1.4	22.6	3.0	18.9	5.8	7.3	0.3	45.5	49.4
Leaf blades	average length (inches)	20.0	18.0	17.0	17.0	22.0	20.0	26.0	24.0	18.0	18.0
	weight (grams)	47.4	61.8	35.6	36.6	47.8	57.6	50.1	92.3	52.0	47.4
Leaf sheaths	average length (inches)	5.0	4.0	3.0	3.0	8.0	6.0	12.0	9.0	6.0	6.0
	weight (grams)	36.2	16.0	23.2	7.8	52.1	24.0	37.3	10.4	47.3	48.2
Total weight	weight (grams)	176.3	87.4	118.1	56.7	189.6	105.4	126.4	103.5	258.3	256.0

The average length of leaf blades and sheaths was about the same on burned and unburned areas for all species. For all species except wild rye there was a greater quantity of leaf blades per bundle on unburned areas than on the burned area. In contrast there was a greater quantity of leaf sheaths per bundle from the burned area except for wild rye (Figure 1). In considering both leaf blades and leaf sheaths there was little difference in total amount of photosynthetic area on plants from burned and unburned areas.

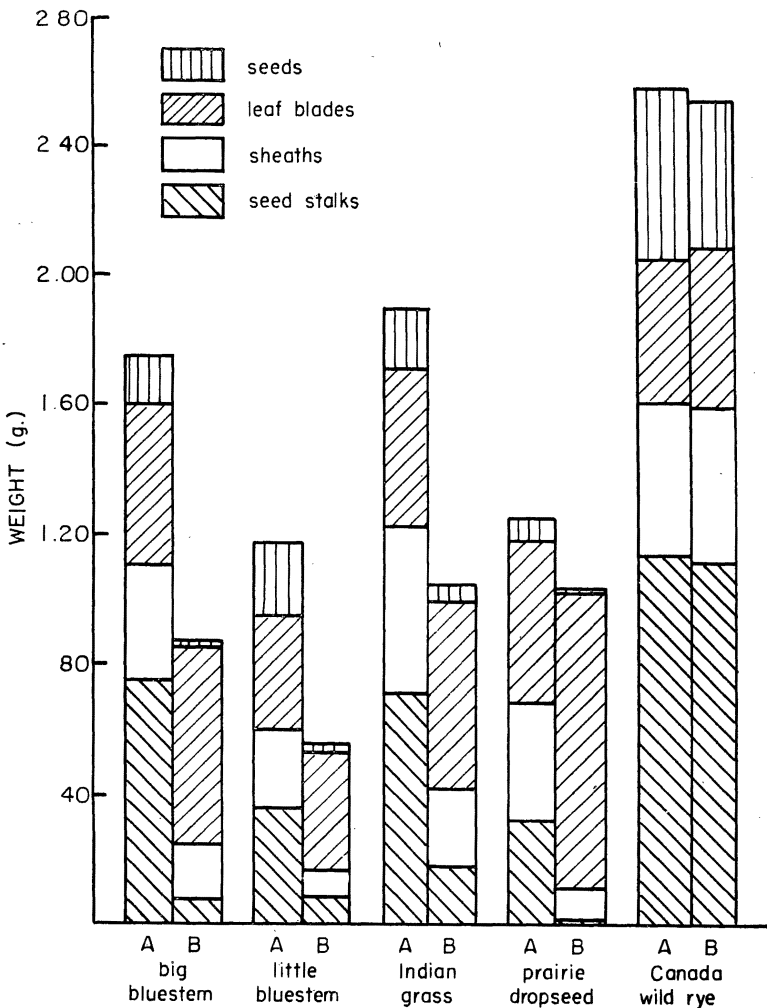


Figure 1. Relative dry-weights of component parts of some dominant grasses from 1956 burned (A) and from unburned (B) areas.

The total air-dry weight per bundle was greater from the burned than from the unburned areas for all species except Canada wild rye, in which there was essentially no difference (Figure 1). The increase in weight per bundle from the burned area was due mostly to the greater amount of seedstalks which resulted from the burning.

Table 2
Ratio of Seedstalks to Leaves on an Air-Dry Weight Basis

Treatment	Big bluestem	Little bluestem	Indian grass	Prairie dropseed	Canada wild rye
Burned	0.92	0.62	0.71	0.36	1.14
Unburned	0.11	0.21	0.22	0.01	1.16

There was a considerable difference in the ratio of seedstalks to leaves on an air-dry weight basis from plants from the burned and unburned areas except for wild rye, which showed essentially no difference (Table 2). Big bluestem had a ratio of seedstalks to leaves of 0.92 on burned areas and 0.11 on the unburned area. Little bluestem and Indian grass showed somewhat smaller ratios on the burned area and slightly greater ratios on the unburned area than big bluestem. Prairie dropseed had a very low ratio on both burned and unburned areas compared to big bluestem, little bluestem and Indian grass (Figures 2, 3). There were very few seedstalks of dropseed on the unburned area and the plants were almost wholly vegetative. Canada wild rye had no real difference in ratio on the burned as compared to the unburned area (Table 2). Fruiting in these plants seemed not to be affected by the burning treatment as it was in the other plants.

The increase in number and average height of seedstalks has been previously reported (1, 3, 4, 5, 7). Curtis and Partch (4) reported a six-fold increase in number and 60 percent increase in height of seedstalks on planted stands of big bluestem. Aikman (1) reported an average five-fold increase in number and 20 percent increase in height of seedstalks of dominant and principal subdominant grasses as a result of burning. Increase in seedstalk production from burning could be stimulated by the removal of large quantities of litter and duff, the addition of ash or a stimulation of floral bud induction resulting from the direct heat of the fire or higher temperature in early spring. An investigation is now being conducted by the authors to determine, to what extent, if any, each of these factors contributes to the phenomenon of increased seedstalk production.

It is very likely that the earlier growth (1, 2, 6) of vegetation on burned than on unburned areas has certain physiological effects on the plants which cause increased flowering. Perhaps the earlier growth results in an increased accumulation of carbohydrate and this greater supply possibly induces differentiation and growth of



Figure 2. From left to right, big bluestem from burned area, big bluestem from unburned area, Indian grass from burned area, Indian grass from unburned area.

flowerstalks. Loomis (10) has stated that an accumulation of carbohydrate reserves would result in inducing differentiation in plants. It is also possible that the addition of ash could cause this increase of flowerstalk production, but it seems more likely that the addition of nutrients from the ash is at most only a condition for greater growth and not a direct causal factor in increasing seedstalk production. It is doubtful that the direct heat of the fire could itself cause the increased seedstalk production since increased flowerstalk production has followed burning in winter when the ground was frozen and the effect of the high temperature on the plants would be slight, but this remains a possibility until more definite information can be obtained. It seems that the increased accumulation of carbohydrate material in the plant from improved plant growth conditions is the most plausible explanation of the phenomenon of increased seedstalk production as a result of burning native prairie in Iowa.

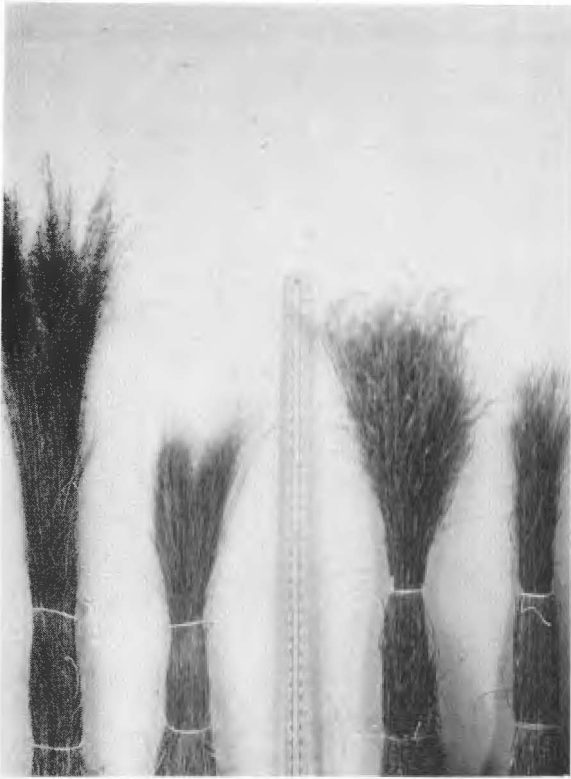


Figure 3. From left to right, prairie dropseed from burned area, prairie dropseed from unburned area, little bluestem from burned area, little bluestem from unburned area.

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