Vegetative Effects and Management Implications of a Fall Prescribed Burn On an Illinois Hill Prairie

John E. Schwegman and William E. McClain

Illinois Department of Conservation
524 S. Second Street
Springfield, Illinois 62701

ABSTRACT: A 8ha (20 acre) loess sail hillprairie in central Illinois was burned in the fall of 1983 to determine the effects of fall burns on invading woody vegetation and herb frequency. Comparisons were made with spring burns of a similar prairie. Woody stems of smaller size classes increased as a result of sprouting similar to the response to a spring burn. Five annual and biennial species increased notably in frequency after the fall burn. Three of these species were present in the spring burn plots but did not show a similar response to spring burning. Increased fire scarification of seed, and soil disturbance by rain and freezing are postulated as the reasons for increases in annuals following the fall burn. Farly sprouting of Melilotus alba en the fall burn site facilitated selective control ofthis weed with 2, 4-D herbicide.

INTRODUCTION

To accomplish more prescribed prairie burning with a limited staff, the Illinois Department of Conservation began an experimental fall burning program in 1983. Most historical accounts of prairie fires in Illinois indicate that presettlement burning frequently occurred in the fall (Oakwood 1885, Beckwith 1879), so that fall fires were a natural part of Illinois prairie ecology.

Autumn burning has generally been avoided in Illinois and elsewhere to maintain winter cover for wildlife, retain a more pleasing appearance of the unburned landscape over winter, and protect soil from erosion. This rationale, which leads to a dependence on spring burning of grasslands, may ultimately affect the natural character of our native prairies.

While extensive research, summarized in Henderson (1982), documents the effect of burning on grassland, the bulk of these studies deal with spring fires. Studies relevant to fall burning include Anderson (1965) who demonstrated a reduction in productivity in Kansas prairie burned in December as opposed to that burned in spring. This effect is attributed to increased moisture runoff during the winter in the absence of grass cover. This lost soil moisture would be expected to heighten summer drought stress on a variety of plant specieso

Bragg (1982) shows that more fuel is available in fall. If weather parameters are equal, a hotter fire should be attainable in the fall than the spring. Personal observation indicates that fall fires will carry through wet prairies imd marshes that rarely will be dry enough to burn in the spring.

The foregoing evidence indicates that fall fires will probably have significantly different ecological impacts on prairie than spring burns. This study was initiated to determine the effect of fall fires on control of woody plants invading prairie and their effect on abundance of various herbaceous prairie plants. Other studies have been initiated to determine the effect of fall burns on small mammal and bird populations.

MATERIALS AND METHODS

This study was conducted at the 21.5 ha (53 acre) Revis Nature Preserve in Mason County in central Illinois. The 8 ha (20 acre) prairie occupies steep to rolling deep loess soils en the north valley wall of the Sangamon River. It is dominated by little bluestem (Schizachyrium sccparium) with an

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MATERIALS AND METHODS

This study was conducted at the 21.5 ha (53 acre) Revis Nature Preserve in Mason County in central Illinois. The 8 ha (20 acre) prairie occupies steep to rolling deep loess soils on the north valley wall of the Sangamon River. It is dominated by little bluestem (Schizachyrium scoparium) with an

admixture of taller grasses in draws and in lower slopes. Rough leaf dogwood (Cornus drummondi) is the principal woody invader of the prairie. Cool season exotic grasses are essentially absent from the sample plots. A detailed floristic description of the area is given in Evers (1955). Management of the study area has included spring burns in 1975, 1977, and 1980.

Six circular .01 ha quadrats were sampled and permanently marked in the prairie border zone that included invading woody plants. Nine square meter quadrats were nested within each circular quadrat to determine frequency of herbaceous plants. Density data was recorded for woody sterns ≤ 9 cm (3.5 inches). Woody stems were placed in five size classes:

A. less than breast height
B. breast height but ≤ 1 cm (0.39 in)
C. > 1 cm but ≤ 3.5 cm (1.4 in) dbh
D. > 3.5 cm dbh but ≤ 6 cm (2.4in) dbh
E. > 6 cm but ≤ 9 cm (3.5 in) dbh

The quadrats were established and sampled 22 September 1983. One of the quadrats was left unburned as a control plot. Most of the prairie and the other quadrats were burned 17 November 1983. The bum occurred between 11 a.m. and 12 :30 p.m. after a heavy frost had dried. A moderately hot fire was obtained with a fifteen mph wind and 70 percent relative humidity. All plots were burned with a head fire. Post bum sampling was conducted 28 August and 18 September 1984.

To compare fall burn herb frequency with a similar spring burn. previously unpublished data from Fults Hill Prairie in Monroe County, Illinois is presented. This data comes from eighty square meter quadrats around sixteen permanent points on a grid covering the entire 0.52 ha (1.28 acre) pr91ne. Floristically this prairie is similar to Revis but has deep loess soils on only about 20 percent of the area. The majority of the prairie has limestone bedrock very near the surface. The area was burned during the springs from 197 2 through 197 5 and sampled in September 1971 and each year after burning.

The weather during 1984 was atypical at Revis with a cold late spring followed by a hot draughty summer until heavy rains returned in late August.

RESULTS

Woody stems of all species and size classes in the Revis burn plots increased from 12,900 stems/ha (2.471 acres) before the burn to 25,100/ha (2.471 acres) after it. This change and near doubling of density is attributed to sprouting stimulated by fire. However, stems in size class II and larger declined from 660/ha to 300/ha (Table 1). The control plot showed total woody stems declining from 48,400/ha to 39,200/ha (Table 2). This decline was in size class I with an increase in the size class II and larger stems from 400/ha to 1100/ha. This change is attributed to drought induced mortality and possibly increasing competition with the increased number of larger shrubs. Total woody stems in the spring bum Fults study went from 2959/ha before the burn to 4448/ha after the first bum.

Herbaceous species showing a change in frequency of occurrence at Revis greater than 10 percent in either the burn or control plots are given in Table 3. The changes in Andropcgon gerardi and Phlox bifida are interpreted as a failure to properly identify the plants. The former species was not fruiting much in 1983 and many plants were overlooked in the dense Schiz achryum scoparium sod. The Phlox, a spring season species, was not conspicuous in the fall of 1983. Both species were more noticeable after the heavy late summer rains of 1984. Increases in Aster ericoides, Lobelia spicata, and Petalostemump\irpureum were due to new seedling establishment which, considering their increase in the central plots, was unrelated to the fire. The increase in Solidago rigida in the bum plots and its decline in the control are interpreted as evidence that this perennial is favored by fall burning.

The most positive response of herbs to the fall bum was among the annual and biennial species (Table 3). Linum sulcatum, which also increased on the control plot, had a greater increase in the bum than unburned plots. The increase in Gerardia aspera was possibly greater than indicated by the data obtained from the study plots as it was conspicuous throughout the burned prairie. Melilotus alba germinated prolifically in restricted patches that were mt in any of the plots. We noticed carpets of Melilotus seedlings in very early spring indicating that some of the plants may have begun germination in the fall or winter.

Three of the annual species at Revis were also present in the Fults spring burning study. At Fults Linum sulcatum increased from O percent to 3.8 percent after the first bum while Polygala verticillata increased. from O percent to 3.8 percent and Gerardia aspera went undetected until after

Table 1. The number of stems of woody plants by species and size class counted in five .01 ha quadrats before and after the prescribed fall burn.

Species	1983 (pre-burn) Size Class					1984 (post-burn) Size Class				
	A	B	C	D	E	A	B	C	D	E
Cornus drummondi	569	15	0	0	0	1165	1	2	0	0
Crataegus mollis	23	0	0	0	0	30	0	0	0	0
Ulmus americana	7	0	1	1	0	21	0	0	0	2
Rhus radicans	0	1	0	0	0	0	0	0	0	0
Rosa setigera	8	14	0	0	0	17	8	0	0	0
Celastrus scandens	0	1	0	0	0	3	0	0	0	0
Platanus occidentalis	0	0	0	0	0	1	0	0	0	0
Vitis riparia	4	0	0	0	0	0	0	0	2	0
Lonicera tatarica	0	0	0	0	0	2	0	0	0	0
Juglans nigra	1	0	0	0	0	1	0	0	0	0
Totals	612	31	1	1	0	1240	9	2	2	2

Table 2. The number of stems of woody plants by species and size class counted in the unburned .01 ha control quadrat.

Species	1983 (pre-burn) Size Class					1984 (post-burn) Size Class				
	A	B	C	D	E	A	B	C	D	E
Cornus drummondi	476	4	0	0	0	373	11	0	0	0
Crataegus mollis	2	0	0	0	0	2	0	0	0	0
Rhus glabra	2	0	0	0	0	5	0	0	0	0
Quercus rubra	0	0	0	0	0	1	0	0	0	0
Totals	480	4	0	0	0	381	11	0	0	0

Table 3. Herbs having a change in frequency greater than 10% percent between sample years (45 M quadrats for primary sample, 9 M quadrats for control).

	Percent Frequency of Occurrence			
	1983 PLOTS		1984 PLOTS	
Species	burn	control	burn	control
Aster ericoides	40.0	22.2	57.7	33.3
Andropogon gerardi	17.7	66.6	62.2	88.8
*Ambrosia psilostachya	15.5	absent	26.6	absent
Euphorbia corollata	8.8	absent	20.0	absent
*Gerardia aspera	absent	absent	15.5	absent
*Linum sulcatum	17.7	absent	40.0	11.1
Lobelia spicata	15.5	absent	26.6	33.3
*Melilotus alba	4.4	absent	22.2	absent
Panicum oligosanthes	20.0	11.1	2.2	absent
Phlox bifida	absent	absent	20.0	22.2
Polygala verticillata	absent	absent	28.8	absent
Petalostemum purpureum	37.7	11.1	51.1	33.3
Solidago rigida	24.4	44.4	42.2	22.2

*Annual or biennial species

the second spring burn. The frequency of other annuals at Fults, such as Gerardia tenuifolia and Cassia fasciculata, increased less than 5 percent after the first burn.

General observations after the fall burn revealed less complete consumption of fuel than is obtained in a typical spring bum in Illinois. Apparently, even though more fuel is available in fall than in spring, it is mt thoroughly dried by November. The effects of this less complete bum were most notable in the incomplete consumption of upright stems and detritus of grass clumps, such as little bluestem, and in the increased number of small patches of vegetation that escaped the fire.

No measurement of soil erosion was made, but qualitative field observations indicate some "sheet" type of soil movement occurred. In spite of the steepness and erodable nature of the loess soil, no gully erosion was noted. Soil movement appeared to be restricted by grass root crowns and roots and bases of a variety of plants. Some miniature "terraces" formed up slope from exposed root crowns and other features impeding erosion. While erosion was not extensive, disturbance of the bare soil surface appeared to be greater than after a spring burn.

DISCUSSION AND MANAGEMENT IMPLICATIONS

The data from this study indicate no significant decrease in stem numbers of shrubs for the Revis fall burn over the Fults spring burn. The increase in fire-induced sprouts seems similar on the basis of this one test. However, further study is needed to determine the effects of repeated fall burning and to determine if variation in temperature and moisture over the winter months might affect shrub mortality.

The height of presumed first year Cornus sprouts was less in 1984 than in 1983, apparently due to the summer drought. The degree to which this drought was influenced by increased runoff of moisture in the winter is unknown, but obviously it

was not adequate to kill the shrubs. The drought may have reduced photosynthesis and food storage in the shrubs that could influence their survival. Future monitoring of the test and control plots will be conducted in an attempt to determine this.

The greatest documented impact of this fall burn is on frequency of occurrence of herbaceous plants, especially the increase of annual and biennial species. It appears that some fall burns are different from spring burns in regard to their impact on the presence and number of annual plants in the prairie. The factors playing a role in this may be the greater exposure of seed to scarification by fire in the fall and greater impact of rain and frost in further scarifying seed and preparing the soil as a proper seed bed. The slight sheet erosion could aid in burying seed and bring buried seed to the surface. Some perennials may also benefit from such seedling establishment. Thus, it seems important to include fall burns in prairie management plans to maintain annual species and replenish their seed banks. It seems likely that fall burns will also help in the establishment of perennial seedlings.

The more incomplete consumption of vegetation in the fall burn as compared to a spring burn should benefit prairie arthropods. No measurement of insect or other anthropod populations was made, but a greater abundance of apparently suitable habitat for overwintering anthropods and their eggs or larvae was noted as compared to that remaining after spring burns on the same prairie. This question needs additional research.

Based upon our observations, soil erosion is not a serious concern associated with fall burning of loess soil hill prairies. Increased soil surface disturbance brought on by direct raindrop impact on exposed soil and increased freezing and thawing may be important in seedling establishment as discussed above.

The stimulation of early seed germination in Melilotus alba has management implications for controlling this exotic invader of native prairies. Its early emergence in the cotyledonary stage (small seed-leaf stage) after the fall burn was before many of the prairie plants started growing. We sprayed these seedlings on 14 May with low volatile 2, 4-D herbicide and obtained a good kill. The seedlings were 2-3 cm (0.78 in to 1.2 in) when sprayed but could have been sprayed much earlier had we realized this opportunity. Application of the broad-leaf specific herbicide eliminated concern about impacts on prairie monocots, but some damage to early emerging prairie dicots probably occurred. This could be reduced or eliminated by earlier treatment. We saw no evidence of drift or movement of the herbicide.

We believe that fall burning followed by early spring seedling treatment with herbicide has potential as control measure for M. alba in natural areas. This is especially true where dense stands of M. alba occur in scattered locations within a prairie.

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