L-815

Prescribed Burning as a Management Practice

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

FIRE! *The word is feared by most people. But fire is the major factor allowing grasslands to exist. Historically, grasslands developed with fire, drought, and grazing. Natural fires ignited by lightning as well as those started by Native Americans occurred throughout the year. Most often, these fires occurred in areas with heavy growth. Heavy grazing by bison, elk, and longhorn created short areas that were resistant to burning. As fires swept through an area, the grazing shifted to the new regrowth on burned areas. Heavily grazed areas regrew and supplied fuel for future fires. In addition, Native Americans used fire for attracting game, to "fire-proof" camp sites, and in religious ceremonies. Most woody plants were prevented from establishing by recurring fires. In eastern Kansas, the grasslands were an oak savannah, which is a grassland with scattered mottes of oak trees across the landscape. Trees and shrubs survived where fire couldn't reach such as along streams and in areas with shallow soils. Today, fire combined with management, drought, and grazing, is the key to maintaining grasslands.*

In modern grassland management, the role of prescribed burning must be part of a long-term management plan. Management decisions determine how, when, and why fire will be used. Prescribed burning influences what vegetation will be present by when it is used, how it is combined with other practices, and what use is made of the land. Managing to include fire will result in different vegetation responses under different management strategies. When multiple benefits are desired (example: livestock production and wildlife habitat), management compromises will be needed.

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Benefits of Prescribed Burning

Research and experience have shown that fire can be used as a major management practice for native and introduced grasslands, hay meadows, and establishing and managing new native grass stands. It can recycle nutrients tied up in old plant growth, stimulate tillering, control many woody and herbaceous plants, improve grazing distribution, reduce wildfire hazards, improve wildlife habitat, and increase livestock production in stocker operations. To gain these benefits, fire must be used under specified conditions and with proper timing. This is termed "prescribed burning."

Timing

Timing of the burn is a critical element for obtaining the desired response. The kinds, amounts and nutritional content of various plants in a rangeland area can be changed by fire. The presence and abundance of plant species, forage yields, and range condition are all affected by the time of burning.

To control or reduce undesired plants, they should be burned at the weakest point in their growth stage. In order to damage a particular plant, burning must occur when the plant is actively growing or has buds above the soil surface, which can be destroyed. For perennial plants, the plant's food reserves should be at or near their lowest point in their annual growth cycle, so regrowth would be difficult. Perennial plants that have bud zones below the level of the fire readily resprout, normally with an increase in stem numbers. Annuals, that have their growth point above the soil surface, will be damaged or destroyed by a fire that occurs during their growth period.

Prescribed burning must be integrated into grazing management to gain the full benefits. Combining stocking rate with prescribed burning will allow the desirable vegetation to be competitive and help reduce the encroachment of many undesirable plants.

Some examples of how fire affects plants may help in understanding why timing is important. Buckbrush (coral berry) or sand plum, woody perennials, must be burned in late spring for 2 to 3 consecutive years for effective control. During late spring, both are actively growing and fire destroys the top growth. Regrowth is slow since its food reserves are low. Successive burns prevent build-up of food reserves and eventually kill the plant. Smooth sumac, another woody perennial, has a life cycle similar to warm season grasses in that it does not reach the lowest point in its food reserves until late May or June. It also doesn't begin vegetative growth as early as native grasses. Burning in late spring will kill the top growth, but results in an increase in the number of stems that resprout from below-ground buds. The net result is an accelerated increase in the size of the smooth sumac invasion area. Eastern red cedar is readily killed by burning, especially when it is less than 5 feet in height. It does not have buds that can resprout, so when this plant is defoliated, it dies. Larger cedar trees will not be killed by fire and must be cut at ground level to be controlled.

Much the same response can be obtained with forbs. Western ragweed and western ironweed are perennial forbs, which can be reduced with two or three consecutive annual burns.

Fire also can reduce the amount of undesirable grasses. Low-producing cool-season grasses, such as Kentucky bluegrass and annual bromes, are greatly reduced by a late-spring fire. They are actively growing at the time of the burn and have difficulty re-growing after the burn.

Burning to favor desired grass plants should be done when they are just starting to green up. The native grasses should have an average of ½ to 2 inches of new growth when they are burned. This occurs in mid to late spring. At this stage the plants are able to grow quickly. Ideally, the soil profile should have adequate water at the time of burning, and the surface should be damp. Big bluestem and Indiangrass are increased when the range is burned in late spring. In the tallgrass prairie area, the amounts of sideoats grama, blue grama, and buffalograss increase only slightly. Little bluestem and switchgrass decrease or are maintained by a late spring burn.

Recommended burning dates for native warm-season grasses for livestock production are shown in Figure 1. It should be noted that these dates may be as much as 10 days earlier or later depending on growing conditions. Cool season grasses (smooth brome or tall fescue) are normally burned in late February or March with good soil moisture.

With no burning over the long term, prairie grasses and forbs can be completely displaced by 100 percent tree and shrub cover in less than 40 years.

Long-term research at Konza Prairie Natural Research Area, Kansas State University, has shown that annual spring burning over many years does not reduce overall forage yields. Repeated annual burns does result in a gradual decline in the percentage of broadleaved forbs and cool-season grasses and an increase in the percentage cover of warm-season grasses. When annually burned pastures are grazed, this shift is not as pronounced and a greater mix of various grasses and forbs is maintained. In addition, with no burning over the long term, the cover of woody plants increases by about 1 percent per year initially, but then accelerates such that prairie grasses and forbs can be completely displaced by 100 percent tree and shrub cover in less than 40 years.

Forage Yield

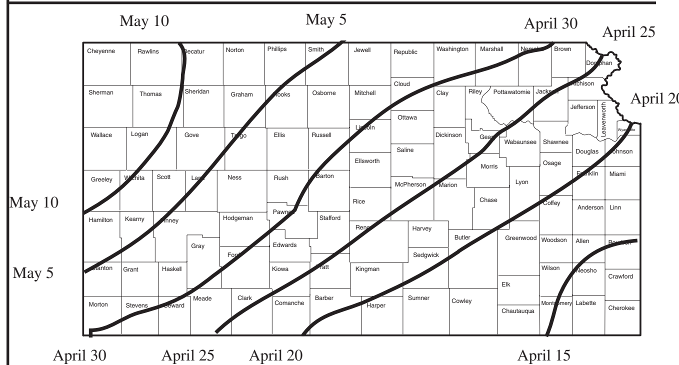

Figure 1. Average prescribed burning dates in Kansas

Forage yield is affected by the timing of the burn. Research done at Kansas State University has shown that the earlier the burning date, the lower the forage yield (Figure 2). There is no difference in forage yield between the late spring burn and unburned range.

The changes in forage yield due to the burning date are due to moisture and temperature changes. Soil moisture in early burned areas can evaporate at rates as high as one-half inch per week. Also, rainfall may not be taken into soil as readily as on the late burned or unburned areas. Soil temperature rises quickly following the burn as sunlight warms the darkened soil (old growth insulates the soil). This, along with greater sunlight reaching newly emerged shoots results in faster plant growth and greater grass tillering compared to non-burned areas. Properly timed, there is little change in soil moisture conditions, soil structure, and soil erosion due to runoff.

Grazing Distribution

Fire is an excellent management practice for improving grazing distribution. Areas that are not usually grazed or are under grazed can be burned while leaving the over-grazed areas unburned. The animals are attracted to the grasses in the burned areas since they are more accessible and palatable.

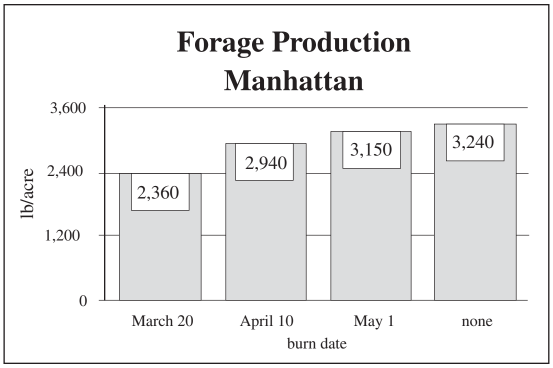

Figure 2. Average forage yield after 17 years of annual burning at the times indicated at Manhattan.

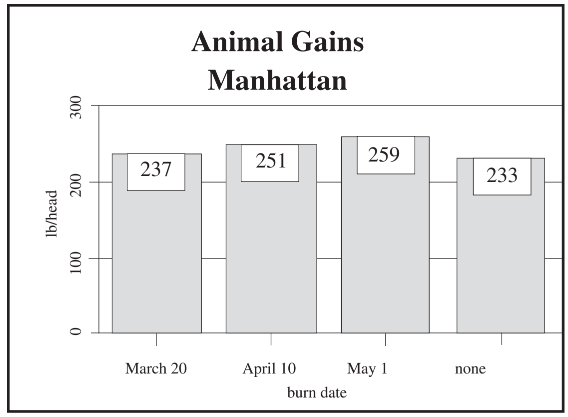

Figure 3. Average season-long stocker gains after 17 years of annual burning at the times indicated at Manhattan.

Over-grazed areas generally will not have enough fuel to carry a fire, will be used less, and can recover. By burning, the grazing pattern can be changed and even out of the grazing distribution. Prescribed burning also has great value in reducing grazing distribution problems caused by a wildfire over part of the pasture. (See *Management Following Wildfire*, L-514)

Livestock Production

Research has shown that yearling or stocker animals can gain 10 to 12 percent more on late spring burned than on either unburned or early burned pastures (Figure 3). This response is apparently due to higher quality forage being available in the first half of the grazing season. These benefits are realized only during the year of burning.

Cow-calf gains on burned pastures have not shown any significant differences from unburned. Burning is primarily done to control weeds, cool season grasses and brush, improve grazing distribution, and reduce litter buildup. The benefits of burning to the cow-calf operator are in maintaining a highly productive grassland over the long term. After 2 to 4 years without burning, excess litter and old growth can accumulate, and cool-season annuals, weeds and brush can increase, thus reducing forage production. A program of burning 2 or more consecutive years, and then waiting until needed again (approximately 2 to 4 years) is adequate to provide the above benefits.

Prescribed burning, together with herbicides and other management options, can be used to reduce these plants and maintain healthy grasslands.

Weed and Brush Management

Many grass, broadleaf, and woody species can invade and reduce forage production and availability. Prescribed burning, together with herbicides and other management options, can be used to reduce these plants and maintain healthy grasslands. However, some species are enhanced by the same burns that benefit the grasslands. Smooth sumac, a shrub, can be top-killed, but new sprouts will increase the number of stems. Other species, such as rough-leaf dogwood, can be controlled, but only through long-term annual burning. Shrubs, such as buckbrush and sand plum, can be controlled with two annual burns, and then waiting 2 to 4 years before repeating.

Broadleaf species, such as ironweed, can be controlled with two annual burns with a 2- to 4-year wait before burning again. Broadleaf species, such as western ragweed, respond to burning similarly, but also are utilized by grazing livestock particularly during the May to June period. Musk thistle, a noxious weed, is not controlled by burning, but is reduced by a healthy, competitive grass stand.

For weed and brush control recommendations, see *Chemical Weed Control for Field Crops, Pastures, Rangeland and Noncropland* issued each January by the Kansas Agricultural Experiment Station.

Native Hay Meadows

Prescribed burning should be used on native hay meadows to stimulate tillering of desirable species, control weeds and brush, and remove old mulch left by haying. Timing of the burn is the same as native grass pastures. A program of burning 2 or more consecutive years, then waiting 2 to 4 years until needed again may be used to provide the needed benefits.

Wildlife

The habitat for any wildlife species must provide **cover, food, water, and space**. Cover is needed for protection from weather and predators. Space is needed for food and water plus breeding and rearing young. A mixture of different vegetation types (grass, broadleaf, and woody) may be needed to meet the habitat requirements. Fire, together with other management practices, can be used to provide these basic components.

Native wildlife of the Kansas prairies evolved with the grassland. Fire was a critical factor in wildlife habitat development. Properly used, prescribed burning can be used to increase desirable warm season grasses and forbs for food supply, nesting, and brood rearing cover for ground dwelling birds. Early spring burns are preferred over those for livestock production for maximum wildlife benefits. In addition, removal of excess litter improves access to insects, while increasing mobility and brood survival of the birds. Prescribed burning also benefits some wildlife by controlling woody vegetation. Prairie chicken populations will decline if woody vegetation becomes too dominant. Prairie chicken booming grounds may be abandoned when vegetation from the previous year is so dense or tall that courtship activities are inhibited. Bobwhite quail show remarkable responses to fire management. Feeding, roosting and travel are enhanced for quail on newly burned ranges. Burns that are 1 and 2 years old provide greater amounts of quail food than older burns. Burning pastures in a rotation within a grazing unit will result in more diverse vegetation so birds will have suitable areas for nesting, brood rearing and winter cover. Maintaining some unburned areas each year provides habitat for many fire sensitive plants and animals.

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Big game habitat can be changed with burning by changing the quality of the food resources, changing the structure of the plant canopy, and changing the chemical and botanical composition of the plant communities. Selection of habitats and foods by wildlife depends on several factors including food biomass and nutritional quality. Responses to fire by big game populations depend on what habitat factor was limiting that population size, the rate of vegetation change, and the habitat requirements of that particular wildlife species. If prescribed burning enhances that limiting factor, it will improve local wildlife populations.

Native Grass Seedings

Experience from the Conservation Reserve Program has shown that prescribed burning can be used to hasten the development of newly seeded native grasses. As early as the spring after the seeding year, burning can stimulate tillering, control annual weeds, and remove accumulated mulch. Care should be exercised that soil moisture is adequate to assure regrowth after the burn.

Wildfire Hazard Reduction

Reducing the wildfire hazard with fire may seem unusual. In years of high precipitation or under light use, large amounts of old growth can accumulate. This litter provides ideal conditions for wildfires to occur during dry periods. Wildfires that occur under high winds and low humidity may burn over these areas with unusual results. As the headfire burns through, the heavy fuel load creates a hot fire that is difficult to control. If there are heavy amounts of litter on the soil surface, the litter burns slower and may create a large burning area behind the headfire. Wildfires under these conditions are extremely dangerous and difficult to control. Litter fires can be damaging to plant crowns as well.

Burning in late spring to remove the buildup of old growth and/or litter will reduce the possibility of large and extremely hot, damaging wildfires. Wildfires occurring in grasslands that are routinely burned are easier to control and less damaging to plants.

Effect on Soil Conditions

When a fire is properly timed, there is little change in the soil moisture conditions. The earlier the burn, the greater the loss of moisture. The burned soil surface readily absorbs heat so that evaporation rates are greatly increased.

Soil moisture should be considered in the timing consideration. Table 1 defines the preferred soil moisture conditions for a successful burn.

Rangeland burned too early will have high evaporation rates. When bare soil with little or no plant or mulch cover is exposed to the action of rain, the surface structure of the soil may be destroyed. This makes it more difficult for water to get below the soil's surface layer. The longer the time between the burning date and when desired perennial plants start to green up, the greater the problem. The result is reduced forage growth due to less soil moisture being available for plant growth.

Properly timed burns are done when the warm season perennials are starting to green up. This allows them to grow quickly so the bare soil surface will only be exposed for a short period of time. This reduces the erosion hazard, reduces evaporation, and allows water to penetrate the soil.

Air Quality

The smoke from a range fire causes little long-term detrimental effects to air quality. In fact, there is no known permanent environmental damage. However, short-term exposure to smoke can cause debilitating health effects to individuals with respiratory conditions such as asthma, emphysema, or cardiovascular diseases. Consideration must be given to the effect of smoke moving down wind. Also, safety must be considered for public roads and airports to avoid creating hazards down wind. The wind conditions should be stable with a speed of 5 to 15 mph to help disperse the smoke quickly. The amount and type of fuel present, the fuel moisture content, and the fire spreading rate will determine the amount of smoke produced.

Prescribed burning is an excellent management practice for grassland.

For more information on proper prescribed burning safety and techniques, see *Prescribed Burning Safety* (L-565) and *Prescribed Burning Planning and Conducting* (L-664) available from local County Extension Offices.

Summary

Prescribed burning is an excellent management practice for grassland. Properly used, it can be a cost effective method for increasing the productivity of rangeland as well as controlling many undesirable plants. It also can reduce the hazards of wildfires and benefit domestic livestock and wildlife. Safety of people on and around the burn as well as public roads and airports must be considered.

Table 1. *Preferred soil moisture and surface moisture conditions to ensure a proper burn on grass stands based on location or soil characteristics.*

Location or soil conditions	Soil moisture[1]	Surface moisture[2]
Eastern Kansas	enough to assure growth to cover the soil surface after burn	damp
Central Kansas	moisture to major rooting depth	damp
Western Kansas	moisture to full rooting depth	damp
sandy soils	moisture to full rooting depth	damp to moist
sub-irrigated soils	enough to assure growth to cover the soil surface	damp

1 Rooting depth varies with soils. Normally, the rooting depth should be considered as either the soil depth to an impervious layer that restricts root growth or the soil depth to which heavy root growth penetrates.

2 Damp = wet to touch but no free water. Moist = excess water when soil squeezed in hand.

Other publications available:

Prescribed Burning

Prescribed Burning: Planning and Conducting, L-664
Prescribed Burning: Equipment, L-876
Prescribed Burning Safety, L-565

Grazing Management

Grazing Distribution, MF-515
Range Grasses of Kansas, C-567
Stocking Rate and Grazing Management, MF-1118

Others:

Native Hay Meadow Management, MF-1042

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Publications from Kansas State University are available on the World Wide Web at: http://www.oznet.ksu.edu

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L-815 March 2000