Considerations for Prescribed Burning

Cooperative Extension Service • Circular 522
College of Agriculture and Home Economics

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Grasslands evolved under the influence of fire. In pristine times, natural periodic prairie burns resulted in fire-modified vegetation types dominated by grasses. Fire is considered the primary agent that maintained grasslands before the middle 1800s. As the fire incidence began to decline in the mid-1800s, the brush problem began to increase. A reduction in fires, along with fencing, periodic droughts, overgrazing and increased cattle numbers, is considered the cause of the increase in brush density and stature. These factors allowed woody plants to spread from draws and waterways to the uplands.

In the past two decades, however, man has rediscovered fire and its benefits—particularly the benefit of prescribed burning. There are several reasons for the resurgence of fire. These include the rising cost of chemical and mechanical brush control alternatives; advantages of fire in controlling various pests; realization that fires can benefit wildlife; and better overall understanding of the benefits, control and use of fire in the ecosystem.

FIRE AND THE ECOSYSTEM

The ecosystem balance is governed by a set of natural laws. Disregard for these laws results in major short- and long-term changes in the environment.

Reduced fires, coupled with the disturbance and misuse of native vegetation, have caused the grassland communities to deteriorate. Desirable species are now completely absent or have been seriously reduced.

Recent studies in the Southwest have shown when burning is returned to the ecosystem and is coupled with sound grazing management, desirable species return more rapidly than when either procedure is applied alone. The grazing animal's influence on grassland is natural and the prolonged absence of grazing is as unnatural as the omission of fire. Both must be carefully manipulated to reinstate and maintain rangeland integrity.

RESEARCH RESULTS

Research Results from across the southwest have shown the general benefits of fire as a grassland management tool. Some of these benefits include increased herbage yields, improved forage use, increased use of less palatable species by increasing palatability and nutritional values, increased forage availability, improved wildlife habitat, undesirable shrub control, mineral seedbed formation and control of certain parasites. Removing accumulated litter, promoting wood borer activity on honey mesquite, controlling cacti and controlling or reducing less desirable broadleaf species, such as common broomweed, are other benefits of burning.

Wildfires Versus Prescribed Burns

Burning is becoming more widely recognized by ranchers, land managers and range conservationists. However, this shift in attitude has not been without resistance, mostly because the fear of fire is deep seated. Many people identify any fire with catastrophic wildfires. Such attitudes can be changed by understanding that properly applied range fires (prescribed burns) can be controlled effectively. Also the risk of creating wildfires can be virtually eliminated through proper planning and application.

Wildfires usually start during dry periods when excessive amounts of highly combustible materials have accumulated. Wildfires are difficult to control and generally detrimental to the ecosystem. They damage desirable plants and magnify drought conditions.

Prescribed burns usually are used when soil moisture conditions are adequate for new plant growth. The fires result in little, if any, permanent environmental damage. Prescribed burns often increase forage availability and quality by removing old, rough top growth that is of little forage value and by reducing undesirable plants. However, total production on burned areas may be depressed for a few years after the burn. Range burning can be approached logically so results are beneficial and, in most cases, predictable.

Fire Effects

Although fire had a major role in developing and maintaining grasslands, it probably functioned in pristine times primarily in tobosa grass swells and lowland areas of the shortgrass prairies. Many researchers consider fire to be of limited value in the arid and semiarid regions of the Southwest, because of the low fuel loads available for burning and the neutral to unfavorable response of many grass species in the shortgrass prairies.

Vegetation Response

Many desirable grass species in the shortgrass prairie can be damaged by fire, especially under dry conditions. The grasses that, in general, tolerate burning are blue grama, sideoats grama, lovegrasses, slim tridens, green sprangletop, Arizona cottontop, sand dropseed and buffalograss. These grasses can be damaged severely if burned under dry soil conditions.

Grasses that are damaged by burning at almost anytime include black grama, galleta, three awns and the *Muhlenbergia* species, such as bush muhly. Also, cool-season grasses can be damaged greatly by fire.

The midgrasses that grow in the New Mexico's sandyland areas might have a favorable to neutral response to burning under good soil moisture conditions. However, these grasses would be damaged severely under most circumstances, resulting in severe soil erosion possibilities.

Forb response to burning is based on timing of the fire. Winter burning decreases cool-season forbs but increases warm-season forbs. Spring fires decrease both warm- and cool-season forbs. However, legumes respond favorably to burning, increasing on burned areas.

Fire is best used in New Mexico on seeded lovegrass pastures, tobosa grass flats, giant sacaton flats and other lowland areas. Fire also can help control young juniper regrowth on areas previously treated by chemical or mechanical practices and can improve some sagebrush-infested areas.

Soil Effects

Burning effects on soils are minimal with the possible exception of erosion. However, if soil moisture is adequate, erosion also should be minimal because the soil surface is quickly covered with new vegetative growth. Areas of most concern include sandy soil and steep slopes.

Following a late winter or early spring burn, the soil temperature should warm more quickly on the burned area than unburned area because of the blackened surface. This quicker warm-up of the soil causes vegetation green-up about two weeks earlier on burned sites compared with unburned sites. Calcium, magnesium and soil pH increase slightly following a burn. Also, soil nitrogen might increase slightly as a response to nitrogen-fixing legumes.

Livestock Response

Livestock response to burning is good, provided the vegetation response is good. Burning under proper conditions creates positive, short-term interaction responses between livestock and forage. Burning often increases forage palatability and use. This occurs because the even-aged new growth is higher in moisture content than unburned forage. Forage quality increases as crude protein, phosphorous and digestible energy increase following burning. Forage intake increases on burned areas as diet quality and rate of passage increase. Also, livestock distribution is greatly improved because selectivity decreases. In addition, there is some indication of increased calf crop and increased production per animal on burned areas compared with unburned. These responses usually occur only for the first growing season after burning and are a manifestation of the forage response.

Wildlife Response

Wildlife are fire-adapted and evolved species. Therefore, they usually respond favorably to fire with only minor, short-term, unfavorable responses. The effects of fire on wildlife vary according to species. However, some direct effects can be noted.

Post-burn effects on birds generally are positive, because of the favorable response of seed-producing plants. Insects may be reduced temporarily, but will increase in the long run in most areas. Direct effects on birds are minimal because of their great mobility. Nesting activities are not usually underway at the time of a controlled burn. Therefore, the only effect on nesting activities is a reduction of nesting materials and the possible burn down of some nesting trees.

Direct effects on large animals also are minimal because of their mobility. Direct effects are limited to the old, sick or, possibly, newborn animals. Animals like deer, elk and antelope are attracted to burned areas, as are livestock, because of the increased forage quality and forb production.

Wildlife species directly affected to the greatest extent are rodents and rabbits, due to their reduced mobility compared with other species. Animals that can't burrow, escape into a hole or are on the fringes of the fire area are in the greatest danger. In addition, because habitat and cover are reduced, these species are exposed to predators, which instinctively are attracted to burned areas.

JUSTIFICATION FOR BURNING

A prescribed burn is planned for when weather and vegetation favor burning. All required precautions and fire control methods are employed in a well-designed fire plan. Fire use is designed to maximize the benefits of other management practices, such as grazing management and other brush control methods, in an overall, long-term plan.

Before planning a burn, the land manager must answer four questions: Why burn? What to burn? When to burn? How to burn? The answers to these questions can justify burning based on consideration of alternative methods. The areas, times and methods of burning should be selected carefully. Fire is a tool and can be justified in some circumstances and not in others. The land manager should have a well-defined reason for choosing fire as the management tool.

An area to be burned should be a natural unit. It should be of such size and shape that the fire can be directed over it to achieve the desired results,while it can be controlled with minimum effort. Such an area is determined largely by the fuel, prevailing local winds, topography and natural barriers.

Burning relatively small areas of large management units invariably results in localized overgrazing. Therefore, burning an entire pasture should be considered, so grazing deferment can be easily scheduled into the management plan. The potential for erosion to occur before replacement vegetative growth occurs also should be considered.

RECLAMATION VERSUS MAINTENANCE BURNS

The decision to burn may be based on the need for land reclamation or improved land maintenance. A reclamation fire is an intense fire used to reclaim brush-infested land. Such a fire is considered the most damaging and hardest to control, because it must be very hot. Its primary purpose is to destroy or retard growth of undesirable species that usually are present in large quantities. In general, results from the first reclamation burn only partially achieve the desired results. The first burn usually opens the brush canopy, allowing more uniform fuel to grow in amounts adequate for subsequent fires. Maximum benefits usually are not achieved until the second or third fire. Reclamation burns should be considered the most dangerous and difficult to control burns.

Maintenance fires are relatively cool fires used to maintain a desirable vegetation balance. Such fires usually generate enough heat to destroy brush seedlings and to remove resprouts from sprouting species. Maintenance fires usually are easier to control than reclamation burns, although the fire fuel load often is greater for the maintenance burn. Maintenance fires have more use in New Mexico than reclamation burns.

PREBURN CONSIDERATIONS

When planning a burn, the land manager must consider several factors. The manager must have enough forage available for livestock both before and after the burn. Preburn deferment usually is for the growing season before the burn. Postburn deferment should be until mid-growing season after the burn or until grasses reach the six- to eight-leaf stage.

The manager also must determine the fuel load requirements for the desired burn results. Plans must be made for undesirable species change, drought and erosion possibilities. Allotments of time and money for fire plan development and installation must be considered along with the direct costs of burning. Some of the expenses associated with burning include personnel, deferment, supplemental feed, special equipment, additional fencing and fire break installation.

The manager should decide what equipment is needed and whether that equipment is owned or needs to be borrowed, leased or rented. Equipment often used in prescribed burning includes maintainers, bulldozers, tractors with discs or other implements, water trucks, cattle sprayers and pumper trucks.

Personnel usually includes ranch hands, neighbors, firefighters, volunteers, and sometimes university, Natural Resource Conservation Service, Bureau of Land Management or Forest Service personnel. In planning a prescribed burn, one person should be designated as the "fire boss." This person should have command of the burning crew and make job assignments.

Several agencies and groups should be notified of the impending burn. These include the New Mexico Department of Forestry, Sheriff's Department, State Police, Fire Department, neighbors, oil companies and others with equipment or interest in the area to be burned.

Preburn preparations on site include arrangements for livestock, protection for feeders, pens, highlines, fences, oil and gas structures, wells, windmills, stored hay, barns, houses and cabins.

In constructing fire breaks, both natural and artificial features, including ravines, gulleys, access strips, fence lines and roadways, should be considered. In some cases, fire breaks may already have been constructed to prevent wildfires.

Before setting the fire, local weather reports and forecasts should be consulted. Weather instruments on site should include a sling psychrometer (wet- and dry-bulb thermometer) to determine relative humidity and air temperature and a wind velocity gauge. Wind speeds should be measured in the actual area to be burned rather than in adjacent open areas. Do not rely on weather station reports.

During the burn, fire crews should be stationed at strategic points. These crews should have mobile water supplies, maintainers, hand tools or other equipment to contain the fire. They should watch for fire being carried by the wind onto adjacent land. As a rule, burnings should be patrolled for at least 24 hours after they burn out. Stumps, woodpiles, manure and bases of bunch grasses may smolder for hours, and a wind gust could move a fire brand onto adjacent land causing a wildfire. All smoldering areas should be extinguished.

THE FIRE PLAN

The fire plan is a systematic and highly methodical plan, or prescription, for burning. By developing and following proper procedures, the risk of a prescribed fire turning into a wildfire is reduced greatly.

When developing a fire plan, fuel characteristics, topography and climatic conditions should be considered. The wind speed and direction, relative humidity, air temperature, season and time of day all affect fire behavior and ease of control.

The type, amount and continuity of the fuel load are factors to be considered. A fuel load of 2,000-2,500 pounds per acre of fine fuel is needed for an effective prescribed burn. However, a low fuel load can be compensated for, to some extent, by good fuel continuity, low relative humidity, slightly greater wind speeds and higher air temperatures. Fine fuel is fuel that is less than 1/4 inch in diameter and usually refers to grass, leaves, twigs and small stems. Fuel continuity refers to the fuel distribution. A fuel source that is finely divided and homogeneously dispersed provides the best results.

Volatility of fuels also is important in determining fire behavior. Volatile fuels contain relatively high levels of ether extractives, such as waxes, oils, turpenes and fats. Grasses generally are considered nonvolatile; whereas junipers, sagebrush and broom snakeweed are considered volatile. Such fuels burn rapidly and intensely and are often said to explode into flames during a fire. Volatile fuels must be

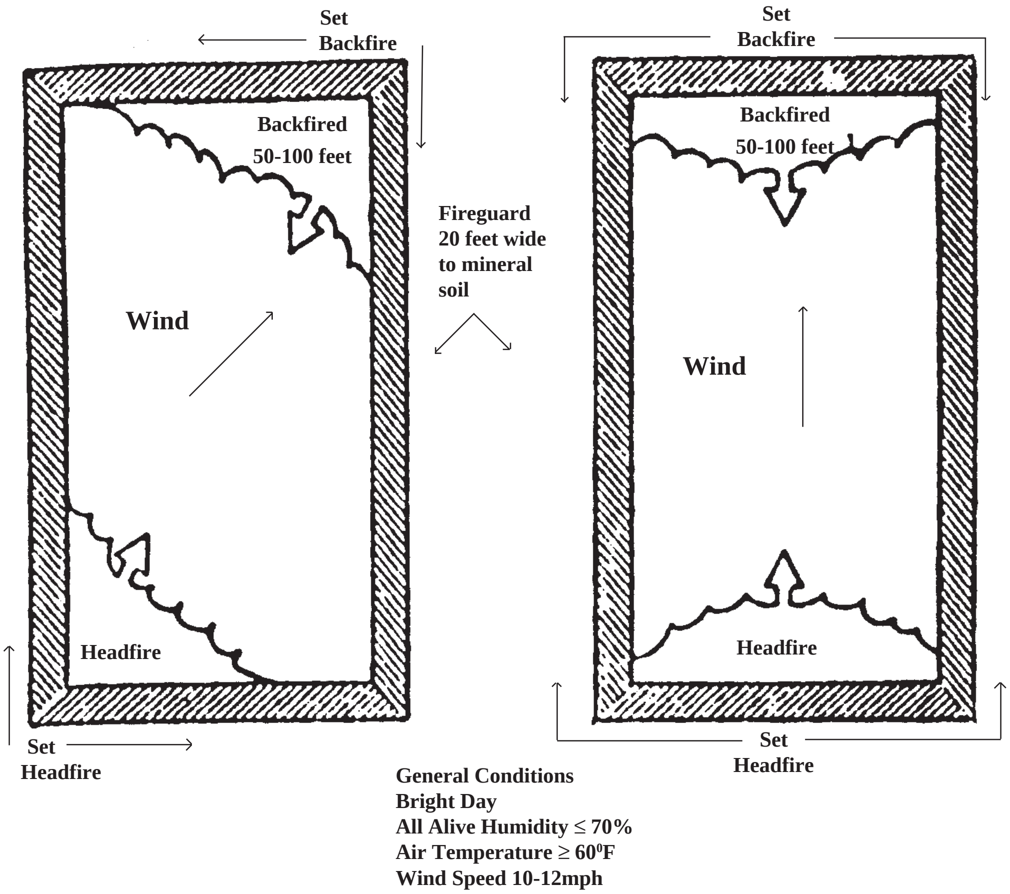

Figure 1. Procedures for igniting backfires and headfires in oblique winds, left, and in direct winds, right. Adapted from C. J. Scifres.

burned with a somewhat different plan than that used for nonvolatile fuels.

Topography and slope exposure have a definite influence on fire behavior. In general, considering constant fuel loads, fires move faster upslope than on level ground. This is because convection preheats the fuel as the fire moves uphill. Fires move up a 10 percent slope about twice as fast as on level ground and about four times as fast up a 20 percent slope. Fires move most slowly down slope.

High air temperatures favor high fire temperatures and affect the amount of heat needed to ignite the fuel. Relative humidity affects fuel moisture content and the amount of heat needed for fuel ignition. Wind is needed to drive the fire. It has a major effect on the fire front's speed and intensity and, to some extent, determines the fire's success. Wind direction governs the fire's direction and is important in managing smoke. Wind also is the most treacherous environmental variable, because it can change more quickly than any other. Wind speed should be between 4 and 15 miles per hour and should never exceed 20 miles per hour. A simple shift in wind direction can change an easily controlled, cool fire into an uncontrollable, hot fire that can cause great damage. The lower the relative humidity and greater the air temperature and wind speed, the faster the fire will spread and the more intensely it will burn.

Time of day affects fire behavior. Mornings are cooler, have higher humidity and more stable wind conditions than periods later in the day. As the day continues, relative humidity declines, air temperature increases and wind speed and direction become variable.

In addition, the season has an effect on fuel characteristics, weather, plant tolerance, fire intensity and vegetation response. Fuel load, fuel stature and fuel moisture content vary according to season. Air temperature, wind, relative humidity and soil moisture also are affected by season. Plant tolerance is somewhat determined by season, because plants that are physiologically active are damaged most by fire. Subsequently, plants are more tolerant when physiologically inactive. A summer burn is more intense and more difficult to control than a winter burn. All things being equal, herbaceous vegetation responds most quickly after a late winter or early spring burn.

Weather conditions and fire guard construction are summarized in table 1.

Basic schemes for lighting prescribed burns in oblique and direct winds are illustrated in fig.1.

For more information concerning prescribed burning, contact your local county Extension office.

Table 1. Weather conditions and fire guard construction Adapted from H. A. Wright.

	Fuel Type	
Conditions	**Nonvolatile**	**Volatile**
Perimeter fire guard width (feet)		
Upwind side	10	10
Downwind side	10	15
Width of backfire (feet)	100	400
Fire guard for backfire (width, feet)	10	10
Wind speed (mph)		
Backfire	8	8*
Headfire	8-15	8-15
Relative humidity (percent)		
Backfire	50-60	50-60*
Headfire	25-40	25-40
Air temperature at headfire set (F)	60	65-75

*Burn in winds of less than 8 miles per hour and when relative humidity is 50 to 60 percent if grass fuel is more than 2,000 pounds per acre. If grass fuel is less than 2,000 pounds per acre, burn when wind is less than 8 miles per hour but when relative humidity is 25 to 40 percent.

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