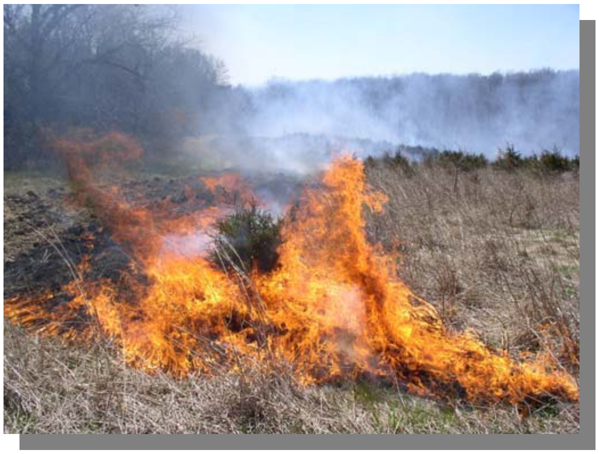
Prescribed Burning

Conservation Practice Information Sheet ***(IS-MO338)***

Conducting a Successful Prescribed Burn

What is Prescribed Burning?

Naturally occurring fires have historically been an important factor in determining plant and animal distribution and composition in Missouri. While natural fires are random and uncontrolled, prescribed burning is the process of applying a controlled fire to a predetermined area to meet certain goals and objectives. Prescribed fire is used as a tool to manage natural communities and planted grass stands. It can set back succession by controlling woody invasion, improve wildlife habitat by stimulating desirable and suppressing undesirable plant species, improve poor grazing distribution, and reduce wildfire risk. Other uses of prescribed burning include preparing sites for planting or seeding, removing slash or debris, and enhancing seed production of target plant species.



Prescribed burning, when implemented according to a written plan, is a relatively safe and economical tool to manage grasslands and other vegetative communities. (Photo by Dwight Snead, MO-NRCS)

Preparing for a Prescribed Burn

Pre-Burn

A written prescribed burn plan should be developed ahead of the burning time. This plan needs to be prepared by a qualified person and should address the following:

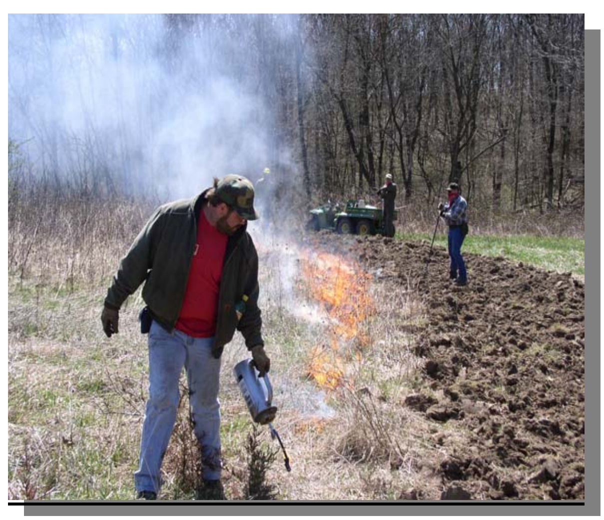
- Landowner and site information
- Description of burn area, including land use, present vegetative cover, and topography
- Objectives of the burn and planned timing to accomplish them
- Acceptable weather conditions to safely complete the burn
- Primary and secondary firebreaks
- Hazards within and adjacent to the burn unit
- Equipment and personnel needs
- Precautions to prevent escapes and actions needed to suppress an escape
- Maps showing adjacent land uses and hazards and the firing sequence
- Contact information for local authorities, including the local fire department

The prescribed burn plan should be reviewed in advance of the burn day. This allows time to arrange for equipment, personnel, and the installation of the firebreaks. It is important to emphasize that the prepared plan is specific to the area and the planned burning season. If the plan is to be used for a subsequent burn season, it might be necessary to revise the plan to address new conditions.

Firebreaks are used to contain the fire within the burn area. They should be of sufficient width to control the back and flank fires (2-10 times the height of adjacent vegetation). There are several types of firebreaks, but by far the safest and most effective is a bare, mineral soil break created with a disk, plow, or roto-tiller. Where erosion is not a concern, these firebreaks can be installed months ahead of the planned date of burn, especially if moist soil will limit equipment access immediately prior to the burn.

Other types of firebreaks:

- Close Mowed Breaks are constructed by mowing to keep the fuel load to a minimum and allowing short, green growth that will slow fire spread, but not necessarily stop it. Raking residue from the mowed area, away from the burn unit, reduces available fuel within the break and makes it much easier to control and extinguish the fire.
- Burned or Black Lines are established in conjunction with mowed breaks or wet lines (see below). They are prepared by lighting short sections, allowing them to burn a certain width, then extinguishing the fire. A new length of line is ignited and the process is repeated. Burned breaks should be installed during evening or early morning hours when the temperature is low and the humidity is high, resulting in an easy to control fire. These breaks are time consuming to install, can potentially escape, and have limited application. However, they may be useful in situations where equipment access is limited.
- Wetlines require high volume sprayers to moisten vegetation off of which the back fire will be lit. They can be enhanced with chemical fire retardants mixed in the spray water. Once the fire backs off the wetline, the vegetation is sprayed again to extinguish any burning material on the downwind side of the fire. They can be used to enhance the effectiveness of another type of firebreak (such as close mowed), and are often used to cross waterways.
- High Mowed Intensity Reduction Lines are installed adjacent to the primary firebreak by mowing a strip around the perimeter of the burn unit to a height of 8-12 inches. This will reduce the flame length and heat along the firebreak. This is extremely important in tall fuels and is very helpful to the holding crew, especially when using close mowed firebreaks.
- Blown or hand-cleared Lines are installed by back pack blowers and/or rakes by removing litter to expose mineral soil. These firebreaks may be installed in wooded areas, across wooded draws, along dozed permanent firebreaks, or for short distances where larger breaks are infeasible (such as across a wet waterway).



Bare soil firebreaks are the safest and easiest on the burn crew of all the types of firebreaks. Once the fire burns to the break it will go out because there is no available fuel to sustain combustion. (Photo by Dwight Snead, MO-NRCS)

If the burn unit contains live, volatile woody species—such as red cedar—over 4 feet tall close to the firebreak it is imperative to remove them from within 50 feet of the primary firebreak. They should be cut and dragged to the middle of the burn unit or removed entirely. This will reduce the possibility of embers being carried up and blown across the firebreak causing spotfires or escapes.

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Burn Day

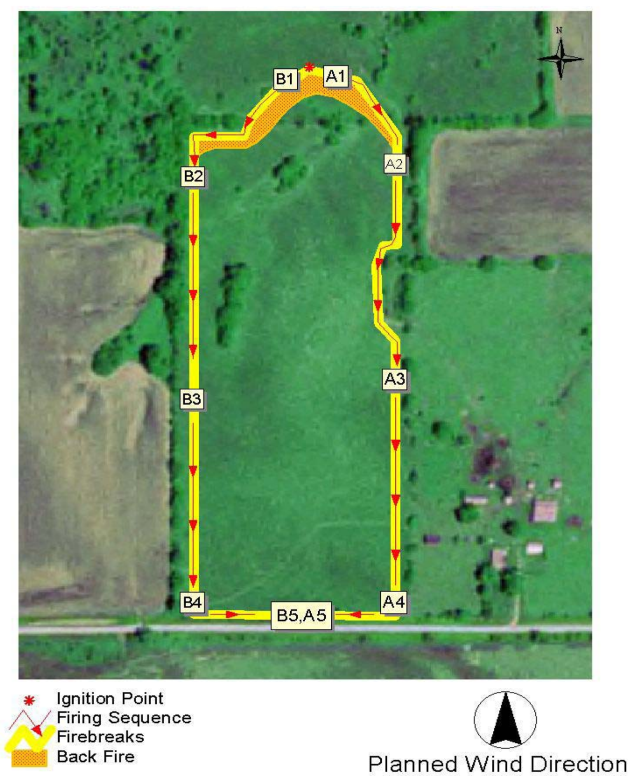
On the morning of the burn, a qualified "Burn Boss", with suitable training, should supervise all phases of the application of a prescribed burn and review the Pre-Burn Checklist. This review serves as a reminder to take all the necessary precautions to ensure that burn will be completed as safe as possible. Besides the items outlined on the checklist, it is the responsibility of the Burn Boss to do the following:

- Make sure all participants are properly dressed, in good physical condition and properly trained.
- Check all firebreaks to ensure that there is no fuel continuity across the fire break.
- Provide protection to potential hazard areas as identified in the plan.
- Ensure proper notifications have been made, especially local authorities (including local fire department).

If everything is favorable, the Burn Boss should conduct a test burn in the downwind corner of the burn area and within the protection of an established firebreak. It will be used to confirm that the fire will burn as predicted, the burn will achieve the planned objective, and that smoke can be managed as planned. The burn should be deferred if the test burn is not satisfactory. or if prolonged drought or a combination of high winds and low relative humidity has caused high fire danger levels. Good soil moisture helps keep the soil temperature low during the burn. Burn when the vegetation is dry enough to carry a fire well, but while the soil surface is still damp to the touch.

Burn only within the prescription set forth in the Prescribed Burn Plan!

DIAGRAM A

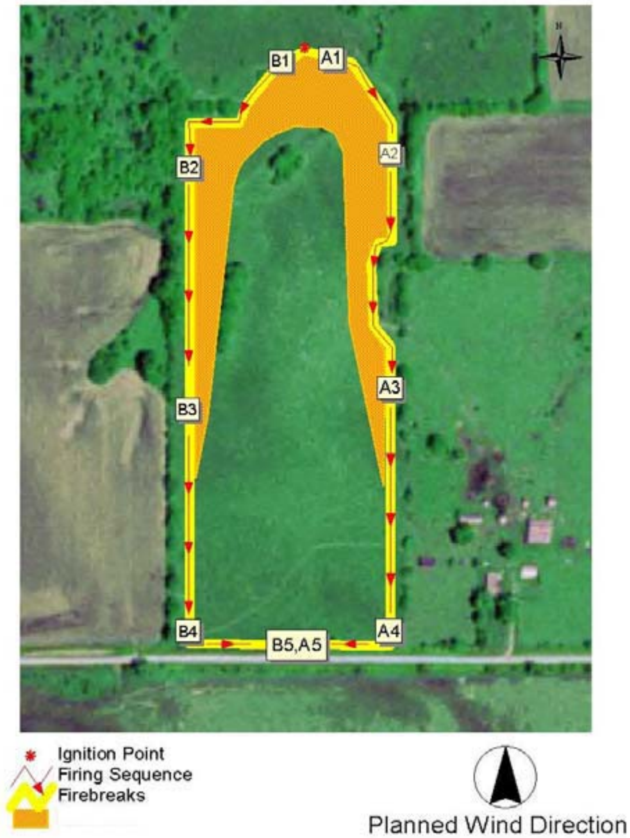


Conducting the Burn

Most prescribed burns in Missouri are conducted with the Ring-Head Fire Technique. To begin the firing process, a backfire is carefully completed on the down wind side of the area to be burned and within the protection of an established firebreak. Light the backfire in short segments, allowing the fire to burn into the field and making sure it goes out when it contacts the firebreak. The backfire should be allowed to create a burned firebreak a minimum of 50 feet wide on the down wind side of the planned burn area, before extending it into a flanking fire. **(Diagram A)**

CAUTION: *On steep slopes > 20% and when wind speed is light (< 5 mph), fire movement may be directed up slope regardless of wind direction.*

DIAGRAM B



Extend the ends of the backfire up each flank, burning from an established firebreak, creating a flanking fire and establishing a burned firebreak along the sides of the planned burn area. The ignition crew should lay the backfire and flanking fire and control the pace of the burn. The ignition crew must be careful not to lay fire faster than the holding crew can comfortably keep it controlled. **(Diagram B)**

CAUTION: *On wooded sites, hollow trees and snags can catch on fire and fall across the firebreak. If possible, cut down all snags close to the firebreak prior to burning.*

Once the backfire and flank fires have burned out, the headfire can then be set. Burning with the wind the headfire will move rapidly to complete the burn. Headfires burn with much more intensity, greater flame length and move much more rapidly. Be sure all personnel are safely out of the headfire's path before ignition. Make certain that firebreaks have been extended sufficiently with backing and flanking fires to insure that the intensity of the headfire will be safely contained. **(Diagram C)**

Patrolling the firebreaks throughout the course of a prescribed burn permits the burn crew to find and extinguish any fire escapes or spot over fires.

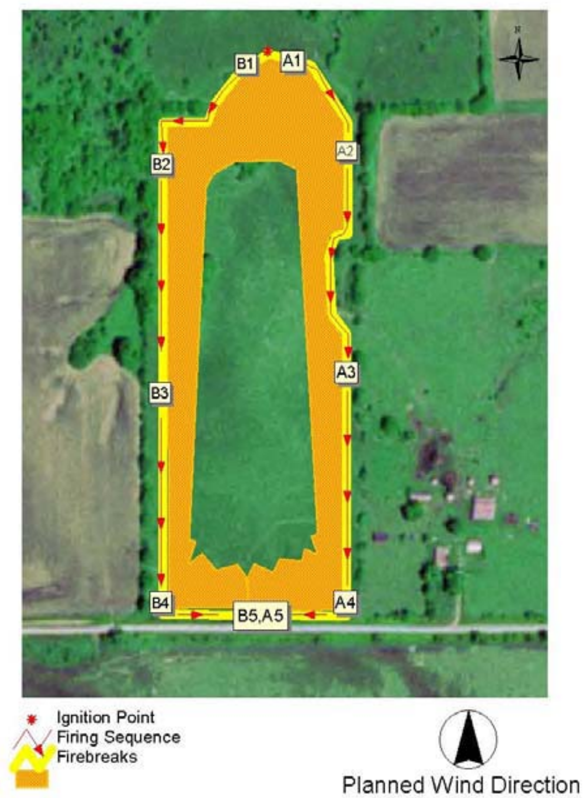


DIAGRAM C

After the headfire and backfire meet, make sure the fire is completely out before leaving the area. Permitting large fuels to smolder after the initial fire has passed contributes to the problem of residual smoke. These "heavy" fuels may produce sparks that could be blown to patches of unburned fuel and cause an escape.

Smoke Management Planning

Avoidance, dilution, and emissions reduction are ways to manage smoke from prescribed fires.

- Avoidance: Pollution can often be prevented by planning burns when conditions make intrusions of smoke into sensitive areas unlikely. Stagnant high pressure systems usually cause problems with smoke dispersion and burning under those conditions should be avoided when smoke management is critical. Most fires have an active burning period and a residual period. Wind directions during both periods must be carefully considered.

- Dilution: Smoke concentrations can be reduced by diluting smoke through a greater volume of air, either by scheduling burns during good dispersion conditions or burning at slower rates (burning smaller or narrower strips or smaller areas). Burning at slower rates may mean burning later into the evening. Usually, a morning burn has improving rates of ventilation. An evening burn generally faces deteriorating ventilation conditions.

- Emission Reduction: Backing fires consume fuel more efficiently than head or flank fires, and produce roughly one-third of the smoke of a head fire. Scheduling fires when larger fuels—such as logs or stumps—are too wet to burn also reduces emissions.

Atmospheric stability is the degree to which vertical motion in the atmosphere is enhanced or suppressed. A stable atmosphere (characterized by clear skies and cumulus clouds) enhances vertical motion, hence increases mixing and the dispersion of smoke. An unstable atmosphere (overcast skies, stratus clouds) suppresses vertical motion, thereby limiting the dispersion of smoke.

When smoke management is critical, burn when conditions are good for rapid dispersion of smoke. The atmosphere should be somewhat unstable so that the smoke will rise and dissipate; but not so unstable as to be problematic in controlling the burn.

If not carefully planned, residual smoke associated with the smoldering of larger slash or woody fuels can cause serious visibility problems, especially at night. As temperatures decline, the atmosphere becomes more stable, trapping smoke near the ground.

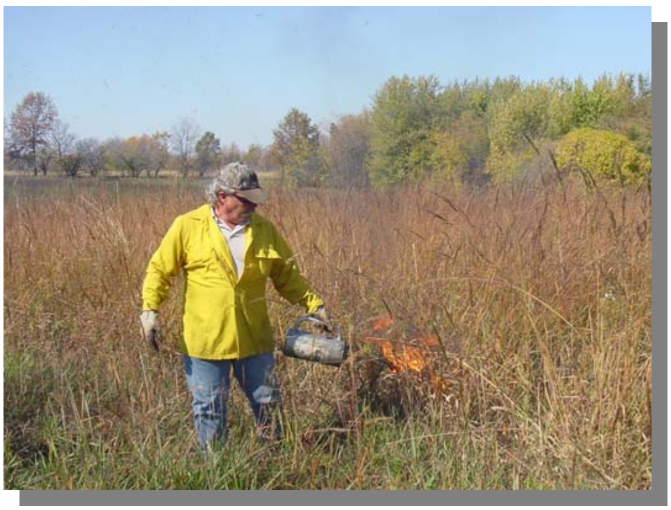
Heavy, carbon laden smoke can caused dangerous discharges from overhead, electrical transmission lines. Extreme caution should be used when burning around these lines. Divide the burn unit so the powerline right of way is not included in the burn unit or use alternative firing methods (backing fire) to reduce the smoke emissions into the lines.

Prescribed Burning to Benefit Wildlife

As mentioned before, one of the primary uses of prescribed fire is to manipulate or manage vegetation for the benefit of wildlife species. The timing of the burn depends on the wildlife management objectives for the specific species. Tables 1 and 2 compare timing of burns and the expected results on the vegetation being managed. Some things to consider are:

- Burns should be managed with consideration for wildlife needs, such as nesting and feeding cover.
- Fall and winter burns generally favor the forb component in mixed stands, and help improve plant structure and habitat diversity.
- Burning in spring and fall of the same year greatly reduces stands of cool season grasses, including tall fescue.

- For the greatest plant diversity, native warm season grasses should be burned July 16th to March 15th. Cool season grasses should be burned March 15th to April 30th. Land enrolled in federal programs, such as the Conservation Reserve Program (CRP), may have restrictions on when they may be burned.
- Fields should be burned on a three to five year rotation, limiting the burned acreage to approximately a third of the cover on a given field.
- Spring burning of serecia lespedeza removes dead growth but has no detrimental effect on established plants and can actually enhance the germination of dormant seed. However, spring burning can improve the effectiveness of herbicides if applied to re-growth the same year.
- Late growing season burns have shown an improved impact on serecia lespedeza, but it is probably not feasible to eliminate a stand with fire alone.



Prescribed burning stands of native warm-season grass in the late summer or fall greatly improves habitat for small game species. It will set back the stand of grass, while allowing space for forbs and annual weeds to become established. This also creates the needed bare ground for these wildlife species and helps control unwanted wooded species. (Photo by Keith Jackson, MDC)

DEFINITION OF TERMS

Backfire: A fire set to spread against the wind to remove flammable material and thus help to stop or control the headfire. Backfires consume a greater portion of the fuel load and may be prescribed for the entire burn in some instances.

Burn Boss: A person, with appropriate job experience and authority, who supervises all phases of the application of a prescribed burn.

Convection Column: That portion of a smoke plume sharply defined by the buoyant forces of heated air and effluents.

Crew Leader: A person, selected by the Burn Boss, who directs the activity of firing and holding crews during the application of a prescribed burn. A firing crew is responsible for lighting the fire in short segments that can be handled by the holding crew. The holding crew is responsible to ensure that the fire does not escape the primary firebreak.

Firebreak: A space which is clear of flammable materials to stop or check fires. It also serves as a line from which to work and to facilitate the movement of personnel and equipment. Plowed areas, previously burned areas, wetted areas, roads, lakes, cool season grass, winter wheat, etc. serve as firebreaks. **Primary** firebreaks are those that you rely on to control the spread of the fire outside of the burn area. **Secondary** firebreaks are ones that you identify before conducting the burn that will be used to fall back to in the unlikely event your prescribed burn crosses over the primary firebreak.

Fire Intensity Reduction Line: A line constructed by reducing the height of the fuel next to the firebreak which greatly reduces the intensity of the heat at the firebreak.

Flankfire: The sides of a fire between the headfire and the backfire. Flankfires spread perpendicular to the wind direction.

Headfire: A fire which is set to spread rapidly with the wind and usually used in conjunction with backing and flanking fires. Headfires though intense move rapidly and don't as fully consume the available fuel during the initial fire as does backing or flanking fires. This causes more fuel to be left unburned or smoldering on the site.

Inversion: A layer of atmosphere where temperature increases with height. May be caused by warming aloft, like that associated with subsidence (subsidence inversion), or by cooling from below, as occurs at night at the surface (radiation inversion).

Mixed or Mixing Layer: That portion of the atmosphere from the surface up to the mixing height. This is the layer of air, usually a sub-inversion layer, within which smoke is mixed by turbulence and diffusion.

Mixing Height: The height above ground through which relatively vigorous vertical mixing occurs. Mixing height varies throughout the day and is normally lowest late at night or early morning and highest during mid- to late afternoon.

Particulate Matter: Any liquid or solid particles. "Total suspended particulates" as used in air quality are those particles suspended in or falling through the atmosphere, ranging in size from 0.1 to 100 microns.

Residual Smoke: Smoke produced after the initial fire has passed through the fuel. In complex terrain residual smoke can flow down drainages at night, causing poor visibility and other problems. In addition, the particulate matter can serve as nuclei for fog formation further reducing visibility.

Smoke Intrusion: Smoke from prescribed fire entering a designated area at unacceptable levels.

Smoke Management: Conducting a prescribed fire under fuel moisture and meteorological conditions, and with firing techniques that keep the smoke's impact within acceptable limits.

Stable Atmosphere: Characterized by stable winds, ‘layered’ clouds (such as stratus clouds) and poorer visibility. A stable atmosphere results in smoke staying closer to the ground, which limits smoke dispersal and can cause dangerous visibility problems, especially around roads. Fires are easier to control with stable conditions, but smoke dispersal is usually a problem.

Subsidence: Downward or sinking motion of air in the atmosphere. Subsiding air warms due to compression. Increased temperature and decreasing humidity are present in subsiding air. Subsidence results in a stable atmosphere inhibiting dispersion.

Transport Wind Speed: A measure of the average rate of the horizontal transport of air within the mixing layer or the wind speed at the final height of plume rise. Generally refers to the rate at which emissions will be transported from one area to another.

Unstable Atmosphere: Characterized by gusty winds that are often strong, cumulus (or ‘puffy’) clouds that can grow vertically to great heights, and excellent visibility. An unstable atmosphere allows smoke to rise much higher, aiding smoke dispersal which lessens visibility problems caused by burning operations. Fires are usually more difficult to control with an unstable atmosphere, but smoke dispersal is much better.

Table 1: *Prescribed burning timing guidelines for selected objectives.*

Grass types / Growth Stages /Burning Periods	Objectives /Results
Cool-season Grasses: Less than 2” new growth February - March	➢ To stimulate or enhance cool-season grass ➢ To prepare seedbed for interseeding Legumes ➢ To stimulate germination of legumes in a heavy grass stand ➢ To control woody invasion
Cool-season Grasses: 4 – 6 “ new growth April - May	➢ To set back cool-season grass dominance and stimulate weedy growth, create bare ground, and control woody material Note: Burning during this period will seriously injure and probably kill newly germinated annual lespedeza plants.
Warm-season Grasses: Winter December - March	➢ To stimulate germination of legumes and annual weeds in heavy warm-season grass stands ➢ To create bare ground and prepare for winter overseeding of legumes and native forbs Note: Burning during this period tends not to favor WSG, CSG, or forbs.
Warm-season Grasses: 1 – 3” new growth Spring April – May	➢ To thicken or enhance poor stands of native grasses Note: Rank stands of warm-season grasses may not be utilized by certain wildlife species. Burning during this period will seriously injure and probably kill newly germinated annual lespedeza plants.
Warm-season Grasses: Summer July - August	➢ To control woody invasion Note: Summer burns are encouraged mainly for the control of woody plants. Summer burns can be very stressful on burn crews and native grass plants.
Warm-season Grasses: Fall August - December	➢ To stimulate native forb regeneration and growth ➢ To set back warm-season grass dominance Note: Burning during this period on erosive slopes may cause erosion problems.

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Table 2. Quick reference chart for selected prescribed burning activities. See Table 1 for detailed guidelines. **Green shading** indicates cool-season grass activity. **Tan shading** indicates warm-season grass activity.

Management Objective	*Jan*	*Feb-Mar*	*April*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov-Dec*
Stimulate cool-season grass		Green								
Seedbed preparation for legumes		Green								
Stimulate germination of legumes		Green								Green
Set back cool-season grasses			Green	Green						
Stimulate legumes and forbs in warm-season grass (WSG) stands	Tan	Tan								Tan
Seedbed preparation for interseeding legumes or forbs into WSG stands	Tan	Tan								Tan
Thicken poor stands of native grass			Tan	Tan						
Control woody invasion		Green				Tan	Tan			
Stimulate native forb growth in WSG							Tan	Tan	Tan	Tan
Set back WSG dominance							Tan	Tan	Tan	Tan

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For additional information on prescribed burning, contact your local USDA Service Center or Missouri Department of Conservation office.

(Nate Goodrich, Douglas Wallace, and S. Douglas Peterson, NRCS, Missouri were editors for this information sheet)