

NATIVE WARM-SEASON GRASSES

Using Prescribed Fire to Manage Native Grass Forages in the Mid-South

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Introduction

Throughout North America – and the world – grasslands have been maintained by fire for millennia. Fire and drought held back the encroachment of trees and kept grasslands from becoming closed canopy forests (Fig. 1). Fire is effective at maintaining grasslands because grasses are “fire adapted”; that is, they respond well to fire—rapid re-growth, improved seed germination, even providing their own fuel (in the form of litter) to carry fires.

One reason switchgrass, for instance, has been identified as a prospective fuel source is the amount of energy present within its leaves and stems. If you have ever burned a stand of switchgrass, then surely you appreciate just how intense a fire it produces. The image of a prairie fire in the Great Plains in the early days of settlement is well known, and such fires were common. In fact, most grasslands in the central and southern United States burned on a one to three-year interval. Fire is not only a natural process, it is also an excellent tool to manage native grasses that provides a number of benefits to cattlemen.



Figure 1. – Prescribed fire can be a valuable tool for maintaining healthy, vigorous grasslands.

Benefits of Burning

Fire has many beneficial effects on grasslands beyond just holding back the growth of trees and shrubs. One of the most obvious is that fresh growth of grasses following a burn provides higher quality forage. Native Americans and early European settlers were well aware of this and frequently burned grasslands to improve forage for game, such as bison and elk, as well as cattle. Prior to the passage of fencing laws in Tennessee in the 1940s, cattlemen in the state burned off range each spring. Even today, ranchers in the Great Plains and parts of the South, notably Florida, still rely on annual or biennial burning to improve forage quality and quantity.

Forage Quality

The primary reason for burning native grasses in the Mid-South today is to improve forage quality. New grass growth following fire is more palatable (i.e., less lignin, silicates, tannins, etc.) to cattle. However, that is not the only reason. New shoots arising following burning also have a greater crude protein content than unburned grass at the same stage of maturity (Table 1). Studies have shown that cattle preferentially graze areas that have been burned recently (Fig. 2; also see sidebar, “Patch-burn Grazing”). Cattle even will select pastures burned the previous year over those that have not been burned or were burned two years previously. A 16-year study showed that steers on native grasslands burned in spring



Figure 2 – A pasture managed with prescribed fire. Area in foreground was burned in April and area in background was left unburned. Note increased grazing pressure in burned section. Cattle selectively graze burned areas within a pasture.

gained more than those on unburned range during May (2.4 vs. 1.8 lb/day) and June (2.1 vs. 1.8 lb/day). However, for the balance of the summer (July – September) there was no difference in rates of gain.

Nutrient Cycling

Another reason forage quality improves following burning is fire releases nutrients that had been tied up in senescent material and litter. Burning releases nitrogen, which contributes to the improved crude protein levels in the grass, and phosphorus. It is important to note though, that nitrogen and phosphorus are also volatilized during the burn. Also, the nutrient content within the grasses peaks within six weeks of the fire. Long-term annual burning actually depletes soil nitrogen pools, which is one reason nutrient-thrifty native grasses are more competitive with burning.

Competition Control

Prescribed fire can also improve stands by helping control competition. Seedlings of woody plants can be killed by fire. Large saplings (>3 inches ground diameter) of most species of woody plants will likely survive, but can be top-killed by fire (Fig. 3). Repeated burns can eventually kill rootstocks of the less fire tolerant species of these larger woody plants. This control of woody plants is precisely how grasslands remained grasslands historically. In parts of the Great Plains, woody encroachment following years of fire suppression has become a substantial problem, one that is now quite expensive to address.

Plant characteristic	Increase (%)
Leaf N-content	41
Net photosynthesis rate	48
Shoot mass	223
Tiller density	110
Leaf Area Index	49

Table 1. Changes in big bluestem plants as a result of burning. Values are the percent increase in burned vs. unburned bluestem for each plant characteristic. These plant responses underscore why native grasses are considered to be “fire-adapted.” Adapted from Knapp, A.K., J.M. Briggs, J.M. Blair, and C.L. Turner. 1998. Patterns and controls of aboveground net primary productivity in tallgrass prairie. In Knapp, A.K., J.M. Briggs, D.C. Hartnett, and S.L. Collins, editors, Grassland Dynamics: Long-term ecological research in tallgrass prairie. Oxford University Press, NY, NY.



Figure 3 – Switchgrass stand burned in March. Note top-killed woody stems.

Depending on timing, burning can also help control some herbaceous weeds. Newly germinated weed seedlings are especially vulnerable to fire. Fire may destroy weed seeds that are not buried in the soil and exposed to flame or lethal temperatures. However, fire may provide indirect weed control as well. By burning when weeds are most vulnerable, and/or when native grasses are able to grow rapidly in the weeks following burning, fire can provide a competitive advantage to the grass. This is discussed below in more detail under “When Should I Burn?”.

Wildlife Habitat

Fire can improve habitat for some wildlife species by removing litter and exposing bare ground, which allows some species, such as northern bobwhite and grasshopper sparrow, to forage more effectively (Fig. 4). Depending on the timing, burning can encourage more forbs, which provide better forage for wildlife and increased insect populations critical for quail chicks and other grassland birds. Because of the improved forage quality and increased plant diversity that can result from burning, eastern cottontails can also respond favorably to this practice. Depending on how fire is applied, it can enhance habitat for a number of species of grasslands wildlife (see sidebar, “Patch-burn Grazing”). On the other hand, fire used too frequently (i.e., annually), especially if used at the wrong time of year, can be detrimental to wildlife habitat quality.

When Should I Burn?

Spring

Timing of burning should depend on your objectives. For forage production, the best time to burn is normally late March-early April. This timing coincides with the period



Figure 4 – Pasture showing edge of a recently burned area. Thatch remains on the unburned portion (left side) and bare ground is exposed on the burned portion (right side). Thatch can limit foraging and movement of species such as northern bobwhite.

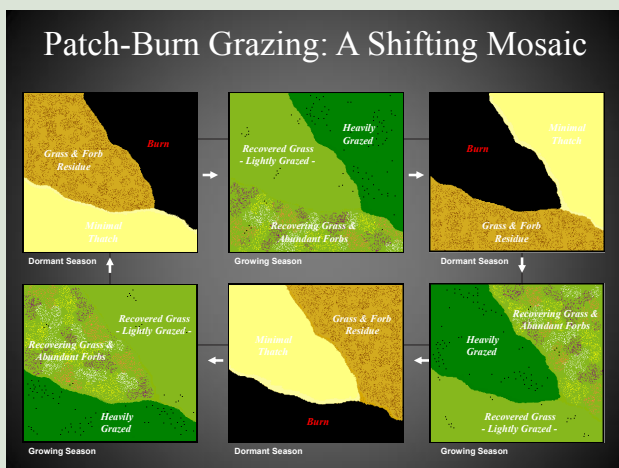
during which native grasses are breaking dormancy and beginning a period of rapid growth. This gives a strong competitive advantage to the native grasses. This is also a time when native grasses can be quite vulnerable to competition from spring weeds, most of which will already be growing and overtopping the grass. By suppressing the competition at this stage, fire will release the native grasses and provide them with additional nitrogen and phosphorous to support their growth (Fig. 5). This is why burning at this time is ideal for renovating native warm-season grass stands that have become thin and weedy. It is important to note that fire will not kill most perennial weeds, rather it will set them back by



Figure 5 – This eastern gamagrass pasture was burned in late March allowing for vigorous growth with limited weed competition.

Patch-burn Grazing

Patch-burn grazing is a term applied to a particular approach to managing pastures with prescribed fire. The basis for it, which dates back thousands of years, is that because fire improves forage quality and palatability, cattle will preferentially graze the portion of the pasture burned most recently. By burning a new section of a pasture annually, cattle will selectively graze the portion burned in the current year. They will graze the portion burned the previous year less intensively, and the sections burned two years ago the least. The effect of shifting the location of this burned patch within the pasture is to distribute grazing pressure (See figure below). Thus, in a sense, patch-burn grazing functions as a surrogate for rotational grazing. Sections may be grazed quite heavily in the year of burning, but receive progressively more rest as the number of years since burning increases. Studies have found that grazing days and rates of gain between patch-burn grazing and rotational grazing are very similar. Producers are able to save on cross-fencing, having multiple water sources, and needing to regularly move cattle with this system – without losing production. Another benefit is that the mosaic of burned patches provides improved wildlife habitat for many species and is especially productive for bobwhite quail. The cost, of course, is implementing burns each year on sections (typically one third) of the pasture. The example here is based on a three-year burning cycle. However, in drier environments or less productive sites, a four-year (one quarter of the pasture each year) burning cycle may be more appropriate.



destroying the current year's growth. Annual weeds are more likely to be killed with fire though.

One other advantage of spring fire is that it blackens the ground, which allows the soil to absorb more solar radiation and, as a result, warm more quickly allowing for earlier and faster initial growth of the grasses. A good rule of thumb for burning at this time of year is to time the fire when there are elongated buds at the base of the plant that are about two to four inches long and the first leaves are beginning to emerge.

Dormant Season

Burning earlier in the spring, early February-late March, creates the same competitive advantage described above, but at a time when native grasses cannot take advantage of it. As a result, cool-season grasses, such as tall fescue, orchardgrass, and brome grasses, may encroach on the site and compete with the native warm-season grasses. Burning during late winter can be a disadvantage where wildlife is an objective because it reduces cover at a time when it can be most critical. This is an issue only when the whole pasture is burned. Conversely, many forbs that benefit wildlife do better after fall or winter burns. However, from the standpoint of the grass itself, burning any time after a frost up until spring dormancy break will be fine.

Growing Season

Burns conducted late in the growing season (e.g., September) can be particularly effective at controlling brush and tree seedlings. Burns at this time may reduce grass vigor somewhat and possibly lead to some stand thinning. As with mowing or grazing, late summer-early fall burning interferes with energy storage for winter, and nutrients mobilized from above- to below-ground portions of the plant will be lost. On the other hand, by mid to late summer, forage quality is already lower and a fire at this time of year can provide a flush of new growth with substantially better forage quality. Opportunities to burn at this time of year however are limited in the Mid-South.

(Left) Schematic drawing of a patch-burn grazing layout based on a three-year burning cycle. In each year, one-third of the pasture is burned (black area), with a different third burned each year until the entire pasture has been burned. The summer following each burn, cattle heavily graze the most recently burned section (dark green). Sections burned the previous year (light green) are grazed, but less intensively. Sections burned two years previously (stippled green), receive the least grazing pressure allowing for ample rest for grasses. Illustration courtesy R. Rogers.

Although it is not common in the Mid-South to burn native grasses in the spring past early to mid-April, it can be done where fuel loads are great enough. As is the case with late growing-season burns, those in mid-spring can be helpful in controlling woody vegetation. Such burns however, set-back grass growth after it is already well underway and as a result, tend to allow forbs to gain a competitive advantage. Where improved wildlife habitat is an objective, this could be a desirable outcome. On the other hand, nests of many species can be destroyed when burning after late April.

How Often Should I Burn?

Although burning native grasses has a number of benefits, it is important to understand that fire is not necessary for managing native grasses. Productive, vigorous native grass pastures can persist for decades without any fire at all. If you chose to use fire, a two- to three-year burning cycle is probably best if forage production is your primary objective. Native grasses can sustain annual burns, but that frequency is not necessary and can be detrimental to wildlife. Annual burns can, within the year of the burn, suppress forage yield somewhat, but long-term studies in tallgrass prairies have shown it does not negatively impact the site. If your goal is to suppress woody vegetation that has become well-established, more frequent burns are preferable.

A Word About Fuel Loads

If a native grass stand has not been hayed or grazed for two or more growing seasons, the amount of fuel that can accumulate is substantial (Fig. 6a). Given the flammability of dead grass, fires can be very intense. In such cases, use extra caution when burning. On the other hand, with regular grazing or hay harvest, fuel loads will be much

lower and fires will be much easier to manage (Fig. 6b). In fact, if enough regrowth is not present at the end of the growing season, fuel loads may be too low to carry a fire. This can be particularly true if there is a substantial amount of green vegetation (cool-season weeds) present.

How Should I Conduct a Prescribed Burn?

Grassland fires can be dangerous. Do not burn unless you can do so safely and legally. If you do not have any experience or training in the use of fire, do not burn without getting training or finding experienced help. Despite the benefits of prescribed fire for managing native grass forages, safety must come first.

If you decide to burn, it is important to take several steps before lighting a match. Although it is beyond the scope of this publication to provide all the information you will need to conduct a burn, there are a few key issues that must be addressed to ensure a safe and effective burn. These are briefly described below.

1. Develop a burn plan that includes placement of firebreaks (an area which a fire cannot readily cross), evaluates areas with an increased risk of fire escape, and the weather conditions under which you plan to burn. Also, identify areas that are sensitive to smoke, as well as neighbors and authorities to contact. Finally, plan a strategy for lighting the fire and the sequence of burning. The five steps below address each of these concerns.



Figure 6 – Native grasses can accumulate heavy fuel loads making burning more challenging (a). With proper grazing management, fuel loads at the end of the growing season can be much lower making burning more manageable (b).

2. Be sure that you have adequate firebreaks in place. A good firebreak should be at least ten feet wide and must expose mineral soil. Any fuel that could carry a fire must be removed. Mowing does not provide such a firebreak unless sufficient water is applied (known as a “wetline”) immediately prior to burning. Discing is far more preferable (Fig. 7). If the fuel (native grass) is tall next to the firebreak, mowing a 6 to 10 foot swath to a height of about twelve inches adjacent to the firebreak will help reduce heat intensity during the burn.



Figure 7 – This firebreak was created using a disc and allowed for a successful early April burn. Note the exposed mineral soil and lack of thatch within the disced area. Removal of flammable materials from the firebreak is critical.

3. Pay close attention to weather conditions. Fire behavior is controlled to a great extent by wind and relative humidity. Burning native grasses when winds are greater than 10 miles per hour is not advisable. Relative humidity should be between 30 and 50%; above this range, fires will not carry well, and below this range, fires become much more intense and consequently, more difficult to control. You should burn when there is a moderate, steady wind. In the Mid-South, winds out of the southwest and northwest are typically steady and, therefore, are best for burning. Avoid weather patterns with shifting winds, such as occur in advance of an approaching front. Also, avoid weather patterns that prevent smoke dispersal, such as cloudy days.

4. Be sure you have adequate equipment and help before burning. This should include a tool for firing (a drip torch is preferred), sprayer(s) to apply water if fire escapes or spots over the firebreak, a tractor with a disc, and hand tools such as rakes or flappers. Having several people present that are able to handle strenuous activity is also essential.

5. Notify your neighbors if they may be affected by smoke and so that they will not be surprised when they see smoke and call the fire department. Also, always contact your local dispatch center so that fire authorities know you are burning. Be aware of areas that may be sensitive to smoke downwind from your planned burn including dwellings, major roads, hospitals, schools, and areas with large numbers of animals (e.g., poultry houses, dairies), and public roads.

6. Prescribed fire is implemented using one or more techniques that include back, head, strip-head, and flank fires (Fig. 8). Each of these techniques is based on how a fire is lit with respect to wind direction. A back fire is one that burns or “backs” into the wind and as such, is the slowest moving and generally easiest to control. A head fire, on the other hand, is one that burns with the prevailing wind direction. Head fires move rapidly and can be difficult to control but may be needed depending on objectives. Head fires are also faster which can help complete a burn more quickly and limit time afield. Strip-head fires are lit as head fires, but only close to the firebreak or back fire using a succession of narrow



Figure 8 – In the foreground, a disc was used to create the firebreak exposing mineral soil and removing flammable material. The blackened area resulted from a backfire and increases the ability to control the spread of fire by creating a wider fuel-free area. On the right, the fire is backing towards the blackened area. This back fire is moving slowly and has short flame lengths. As such it is easy to control. To the left, where the fire is much more intense, it is burning with the wind (a head fire), a result of a strip-head fire lit by the fire manager as he walked parallel to and approximately 50 feet upwind of the backing fire (moving from right to left). Because of the fuel load in this idle switchgrass stand, the fire manager is lighting relatively narrow strips.

“strips” lit upwind of the previous strip. Several such strips may be lit sequentially working upwind across a field until the entire area has been burned. Strip-head fires, similar to a head fire, allow an area to be burned more quickly and more intensely than would be the case if only a backing fire was used. Flank fires are those that burn perpendicularly to prevailing wind direction. With proper care, each of these techniques can be used when burning native grasses. The foregoing should emphasize how important it is to have steady winds and to light a fire with careful attention to how that wind will control fire behavior.

A common – and safe – approach to burning any native grass field is to first light a back fire (downwind side of the field). Once a substantial area has been blackened by the back fire, flank fires can be lit on either side of the field. These flank fires will burn into the field (perpendicular to the wind) and create an additional blackened area on each

side of the field. Only after both the flank and back fires have created substantial black areas should a head fire be considered. Although it will burn the balance of the field more quickly, it is not necessary to use a head fire.

Conclusions

Fire is a natural part of the grasslands of the Mid-South and native grasses particularly benefit from its proper use (Fig. 9). However, it is not necessary to use fire to manage native grass forages. If you do choose to use prescribed fire, pay close attention to the guidelines listed above. Regardless of any benefits associated with burning, make safety your first priority.



Figure 9 – Native warm-season grasses, such as this big bluestem and indiangrass mixture, can benefit from burning. This pasture was burned with an early April fire and is providing high quality forage for these steers.



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