Conservation Practices to Promote Quality Early Successional Wildlife Habitat

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GRASSLAND MANAGEMENT

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Acknowledgments and disclaimer

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Eradicating Tall Fescue and Other Nonnative, Perennial, Cool-season Grasses for Improved Early Successional Wildlife Habitat

The quality of early successional cover for wildlife is determined by plant composition and structure. High-quality habitats are dominated by plants that provide protective cover; nutritious food sources; and allow travel, feeding, and loafing within and under the cover. Tall fescue develops a dense structure near the ground and a deep thatch layer that limits mobility of several wildlife species, including gamebird chicks and ground-feeding songbirds. Dense growth and thatch also suppress germination of desirable forbs that provide an important food resource. To determine the best methods for eradicating tall fescue, researchers evaluated two herbicides (glyphosate and imazapic) applied at different times of the year (spring and fall) with and without disking in the season after application. They applied these treatments in three fields across Tennessee. Prior to herbicide application, fields were prepared for spraying by haying or grazing to remove all debris from the field. The tall fescue was allowed to regrow 6 to12 inches before applying herbicides. Fall applications of glyphosate (2 qt/acre with surfactant) and imazapic (12 oz/acre with surfactant), with and without disking, provided greater reduction in tall fescue coverage than spring applications, with and without disking. Disking following fall herbicide applications did not further reduce tall fescue coverage. By the second growing season after treatment, coverage of native warm-season grasses increased after fall herbicide applications, with or without disking, and after spring herbicide treatments. Forb coverage increased dramatically following all treatments. Like the warm-season grass response, many of the forbs were desirable and some were undesirable. Nonetheless, food resources for northern bobwhite were increased following all treatments. Forb coverage, both desirable and undesirable, tended to decrease in the second year after treatment. The structural characteristics of the field improved dramatically following eradication of tall fescue. The openness at ground level was increased following all treatments, especially the disking treatments. Vertical structure was increased following all treatments except for spring sprayings, which did not kill tall fescue, as well as the fall spraying treatments. Increased vertical structure provides additional winter cover as well as nesting cover. Spraying tall fescue in the fall with 2 quarts per acre of a glyphosate herbicide is recommended. If undesirable grasses are expected to become a problem, apply imazapic (6–8 oz/acre) before undesirable plants emerge (April). If desirable plants do not emerge from the seedbank by the second growing season following spraying, it may be necessary to plant a mixture of native grasses and forbs. Burning and disking during subsequent years will be necessary to achieve the desired balance of native grasses, forbs, and shrubs.

TECHNICAL NOTE

Eradicating Tall Fescue and Other Nonnative, Perennial, Cool-season Grasses for Improved Early Successional Wildlife Habitat

GRASSLAND MANAGEMENT

Tall fescue (*Schedonorus phoenix*) is a perennial cool-season grass brought to North America from northern Europe sometime in the late nineteenth century. It was developed as a livestock forage, released in 1943 (KY 31), promoted widely, and planted as such through the 1950s and 60s. By the 1970s, tall fescue had become the most important cultivated pasture grass in the United States. Today, tall fescue is grown on more than 35 million acres (fig. 1). Without question, there is hardly a field from southern Pennsylvania to eastern Kansas, south to eastern Texas and over to northern Georgia that has not been invaded by or planted to tall fescue in the past 50 years. This has been detrimental for many wildlife species.

Problems with tall fescue

The primary negative effect of tall fescue for many wildlife species is the growth habit. The quality of early successional cover for wildlife is determined by plant composition and structure. Tall fescue, as well as other perennial nonnative, cool-season grasses, generally develops a dense, sod-forming structure near the ground. Upon senescence, the leaves droop to the ground and a deep thatch layer develops relatively quickly (fig. 2). For some birds, such as the eastern meadowlark (*Sturnella magna*), nesting structure in this environment is quite suitable. However, for other species, there are many limitations.

Dense growth near the ground and a deep thatch layer restrict mobility of several wildlife species, including young eastern wild turkey (*Meleagris gallopavo*) and northern bobwhite (*Colinus virginianus*) and ground-feeding songbirds such as field sparrows (*Spizella pusilla*) and grasshopper sparrows (*Ammodramus savannarum*), thus limiting the amount of usable area for these birds. Dense growth and thatch also suppress germination of

Figure 1. Millions of acres have been planted to tall fescue since the 1950s, much to the detriment of many wildlife species. (Photo credit Craig Harper)

Figure 2. The dense structure of tall fescue (top) and orchardgrass (Dactylis glomerata) limits mobility of ground-feeding birds and suppresses germination of the seedbank. (Photo credit Craig Harper)

the seedbank. Thus, more desirable plants, such as broomsedge (*Andropogon* spp.) and little bluestem (*Schizachyrium scoparium*), blackberry (*Rubus* spp.), American pokeweed (*Phytolacca americana*), native lespedezas (*Lespedeza* spp.), ticktrefoil (*Desmodium* spp.), partridge pea (*Chamaecrista fasiculata*), and ragweed (*Ambrosia* spp.), may not be present, and the resulting structure is dramatically different. Even when present, seed from many of these plants are unavailable to foraging birds if buried in deep thatch. In effect, suboptimal structure and reduced food resources limit the amount of usable space and reduce the carrying capacity of the property to support various wildlife species.

Other effects of tall fescue on wildlife are less obvious. An endophyte fungus found within tall fescue produces ergot alkaloids, which are highly toxic to livestock. Cattle consuming tall fescue (either grazing or as hay) often experience poor weight gains, reduced conception rates, intolerance to heat, failure to shed the winter hair coat, elevated body temperature, and loss of hooves. Problems with horses are more severe, especially 60 to 90 days prior to foaling. Fescue toxicity in horses often leads to abortion, prolonged gestation, difficulty with birthing, thick placenta, foal deaths, retained placentas, reduced (or no) milk production, and death of mares during foaling. Specific physiological effects of the endophyte on wildlife are less known. However, cottontail rabbits (*Sylvilagus floridanus*) gain less weight and produce smaller litters in tall fescue habitat, and when fed a diet of tall fescue seed, bobwhites exhibit cloacal swelling, which may ultimately lead to increased mortality.

Given the detrimental effects of tall fescue on many wildlife species, a concentrated effort to improve early successional cover is being spearheaded by the Northern Bobwhite Conservation Initiative (NBCI). A priority of the NBCI is conversion of non-native grass monocultures, including tall fescue, to more desirable plant communities for northern bobwhite, as well as a wide variety of other species dependent upon early successional habitats.

Research Treatments

To help provide accurate information related to eradicating tall fescue, researchers evaluated two herbicides (glyphosate and imazapic) applied (Pest Management, CPS Code 595) at different times of the year (spring (March) and fall (September)) with and without disking (Upland Wildlife Habitat Management, CPS Code 645, Early Successional Habitat Development/Management, CPS Code 647) in the season after application. They applied these treatments in three fields across Tennessee where tall fescue coverage exceeded 90 percent. Prior to herbicide application, fields were prepared for spraying by haying or grazing to remove all debris from the field. The tall fescue was allowed to regrow 6 to 12 inches before applying herbicides. To further evaluate seedbank response, half of the spring herbicide treatments were disked the following fall and half of the fall herbicide treatments were disked the following winter. A 10-foot offset disk was used to incorporate approximately 50 percent of the aboveground residue into the soil (fig. 3). Thus, the plots were not "lightly" disked.

Response to Treatment Applications

Fall applications of glyphosate (4-lb formulation at 2 qt/acre with surfactant) and imazapic (2-lb for-

Figure 3. Disking helps stimulate the seedbank after tall fescue has been eradicated with the appropriate herbicide application. (Photo credit John Gruchy)

mulation of imazapic at 12 oz/acre with surfactant), with and without disking, provided greater reduction in tall fescue coverage than spring applications, with and without disking. Two growing seasons following spring herbicide applications, tall fescue coverage exceeded 40 percent. Even when combined with disking, tall fescue coverage exceeded 20 percent on spring-sprayed plots the growing season following disking. Coverage of tall fescue was reduced to approximately 2 percent following fall applications of glyphosate, whereas fall applications of imazapic reduced tall fescue coverage to approximately 10 percent (fig. 4). Disking in March following fall herbicide applications did not further reduce tall fescue coverage.

Applying herbicides correctly with respect to field preparation, rates, and timing is critical. Burning, haying, or grazing prior to postemergence herbicide applications ensures herbicide contact with actively growing plants, instead of senescent stems and leaves; thus, effectiveness is increased (fig. 5). Cool-season grasses are actively growing in the fall and spring. However, during the fall, these grasses are translocating carbohydrates and other nutrients from the leaves to the roots in preparation for winter senescence. Thus, herbicide applications are more effective at killing perennial, cool-season grasses in the fall than during spring when these grasses are transporting nutrients from the roots upward.

Figure 5. It is important to prepare a field by burning, haying, or grazing prior to spraying to ensure the herbicide comes in contact with actively growing grass. (Photo credit John Gruchy)

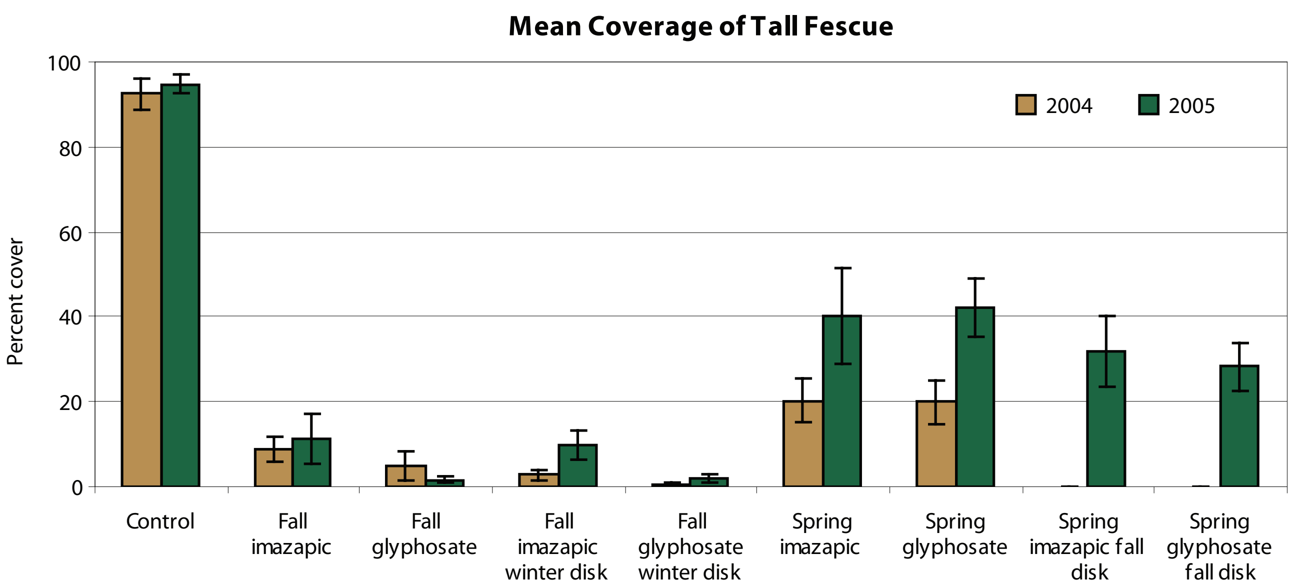

Figure 4. Fall sprayings were more effective than spring sprayings, regardless of herbicide and whether the site was disked the season after spraying.

Seedbank Response

It is not necessary to plant native grasses and forbs if desirable species are present in the seedbank. The sod cover of tall fescue and other nonnative perennial cool-season grasses act like a carpet over a field, preventing much of the seedbank from germinating (fig. 6). Once the carpet is removed, the seedbank can be evaluated.

Occassionally, undesirable species await release in the seedbank. It is quite common to kill tall fescue and find a layer of bermudagrass (*Cynodon dactylon*), johnsongrass (*Sorghum halepense*), and/or sericea lespedeza (*Lespedeza cuneata*) waiting underneath. This illustrates why it is most important to wait at least 1 year before planting native grasses and forbs. If desirable species are present, there is no need to plant. If undesirable species are present and planting is necessary, the undesirable species need to be controlled before planting. It can be difficult, if not impossible, to control some undesirable species (bermudagrass and sericea lespedeza are two good examples) after planting without killing desirable native grasses and forbs. Waiting 2 years after eradicating tall fescue before planting native grasses and forbs is recommended so an objective evaluation can be made as to whether planting is necessary.

Figure 6. Control plot at one of the research sites; tall fescue acts as a carpet over the field, suppressing much of the seedbank from germinating. (Photo credit John Gruchy)

In the study, species richness increased after all treatments, ranging from 35 (spring imazapic) to 94 (fall glyphosate, winter disk) percent. Some of these plants were desirable; some were not.

By the second growing season after treatment, coverage of native warm-season grasses increased after all fall herbicide applications, with or without disking, and after all spring herbicide treatments (fig. 7). Native warm-season grass coverage in the spring herbicide/fall disk plots was not as extensive because there had been only one growing season

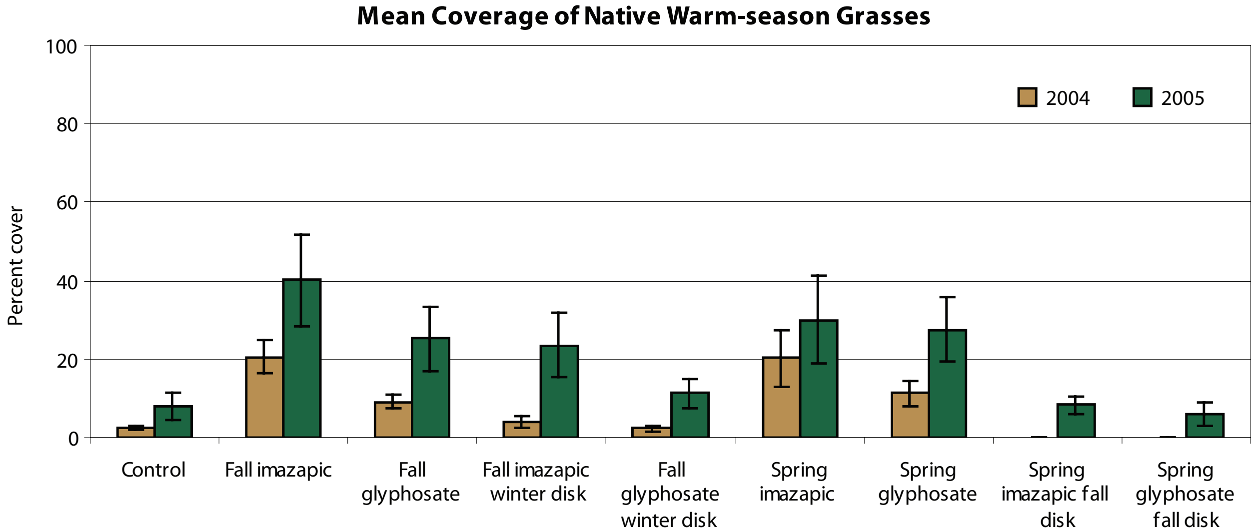

Figure 7. Desirable native warm-season grasses increased in the second growing season following treatments.

following the fall disking treatments when the data were collected. Perennial grasses require 2 to 3 growing seasons to become established from the seedbank following disking. This is evident in the increase of native warm-season grass coverage in all treatments from 2004 to 2005 (fig. 8).

Coverage of undesirable warm-season grasses, such as johnsongrass, crabgrass (*Digitaria* spp.), and broadleaf signalgrass (*Urochloa platyphylla*), also increased, or at least remained the same, following all treatments (figs. 9 and 10). Again, this illustrates the need to evaluate the seedbank before planting. If undesirable species can be removed with selective herbicides without harming desirable species germinating from the seedbank, there is no need to spend time and money planting.

Forb coverage increased dramatically following all treatments. Like the warm-season grass response, many of the forbs were desirable and some were undesirable. Nonetheless, food resources for northern bobwhite were increased following all treatments (figs. 11 to 13). Forb coverage, both desirable

Figure 8. This plot was sprayed with imazapic in fall 2003 and disked in March 2004. By August 2005, broomsedge bluestem is the dominant grass and several forbs have become established. (Photo credit Craig Harper)

Figure 10. This plot was sprayed with glyphosate in spring 2004. By August 2005, tall fescue remains in the understory and the dominant grass is johnsongrass. (Photo credit Craig Harper)

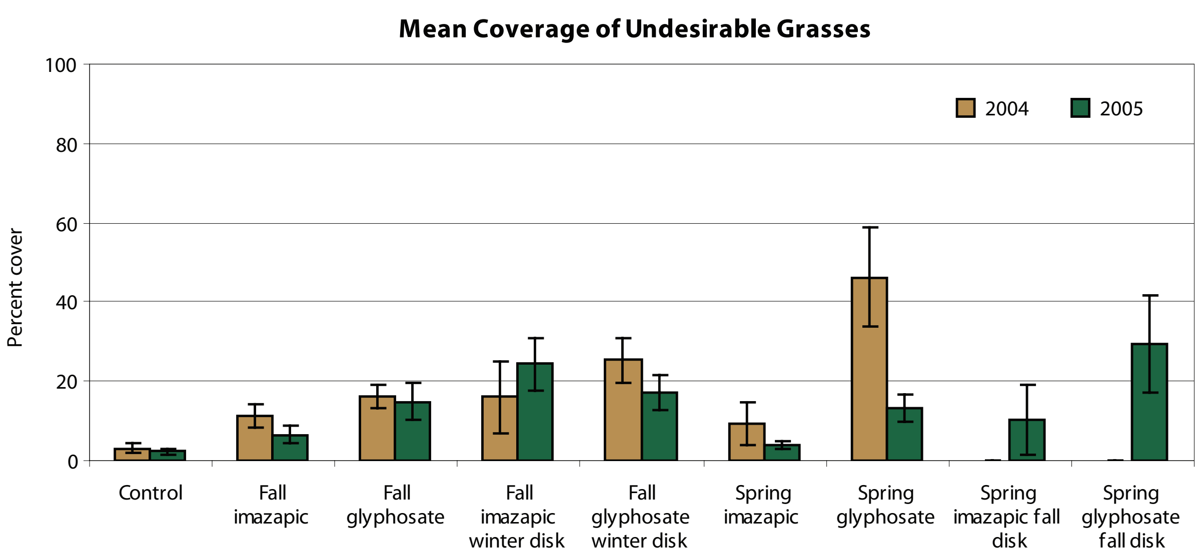

Figure 9. Undesirable warm-season grasses increased following treatments. Aggressive undesirable grasses, such as johnsongrass and crabgrass, may be controlled using selective herbicides.

and undesirable, tended to decrease in the second year after treatment. This illustrates the concomitant increase in perennial grasses with a decrease in forb coverage. Thus, management is necessary to maintain the appropriate balance between grass and forb coverage, which depends upon landowner objectives. Plant species composition in early successional communities should be managed by prescribed burning (CPS Code 338) and/or disking (CPS Codes 645 and 647). Timing of these practices influences plant composition.

Figure 12. Plot was sprayed with glyphosate in fall 2003 and disked in March 2004. By July 2004, ragweed is the dominant cover. (Photo credit John Gruchy)

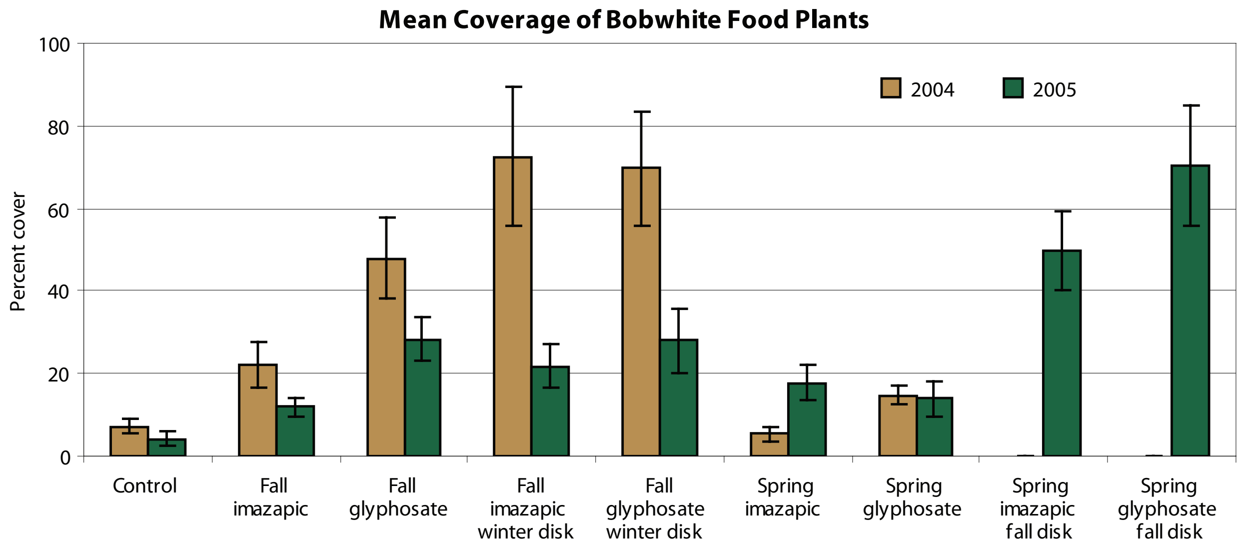

Figure 11. Fall herbicide applications reduced tall fescue cover and increased bobwhite food plants. Disking following herbicide applications resulted in a greater increase in food plants than herbicide application alone.

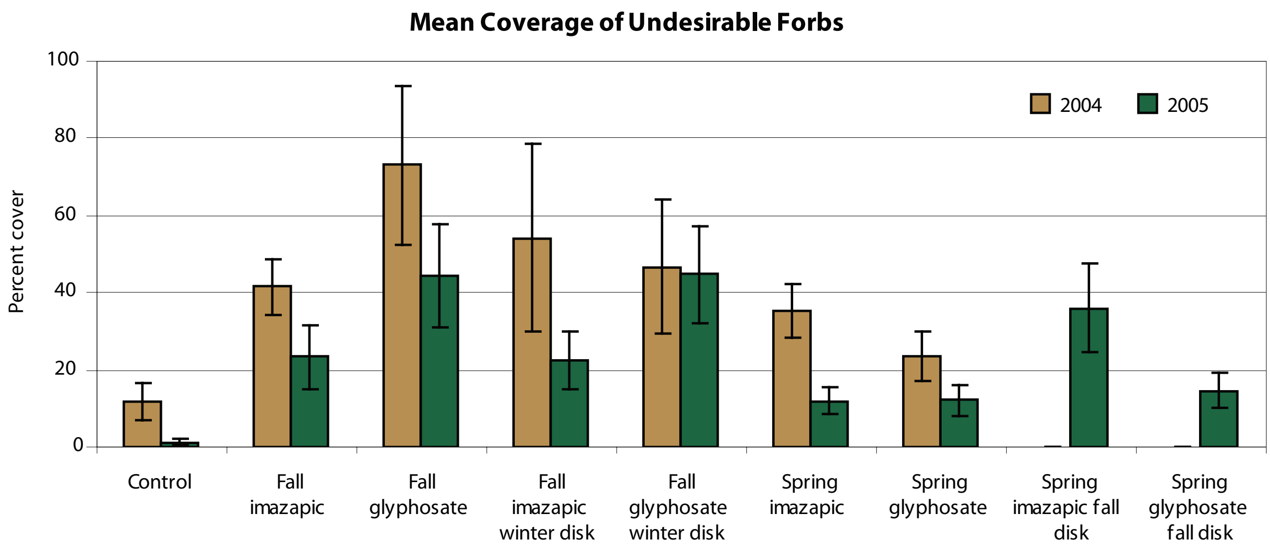

Figure 13. Undesirable forbs, such as narrowleaf plantain, pigweeds, and thistles, also emerged from the seedbank following tall fescue eradication. Undesirable forbs can be controlled using selective herbicides.

Effect on vegetation structure

In addition to a more favorable species composition, which improves nesting opportunities and food resources for many wildlife species, the structural characteristics of the field also improve dramatically following eradication of tall fescue. In the study, mean ground sighting distance was increased following all treatments, especially the disking treatments (fig. 14). This measurement directly relates to the ability of northern bobwhite and other ground feeding birds to travel throughout the field.

Vertical structure was increased following all treatments except for spring sprayings, which did not kill tall fescue as well as the fall spraying treatments (fig. 15). Increased vertical structure provides additional winter cover, as well as nesting cover for birds that nest aboveground in forbs, tall grass, and shrubs.

Does orchardgrass = tall fescue?

Orchardgrass is another perennial cool-season grass from northern Europe. It is not as aggressive as tall fescue, but its growth structure is similar. In fields where orchardgrass was present in the study, its

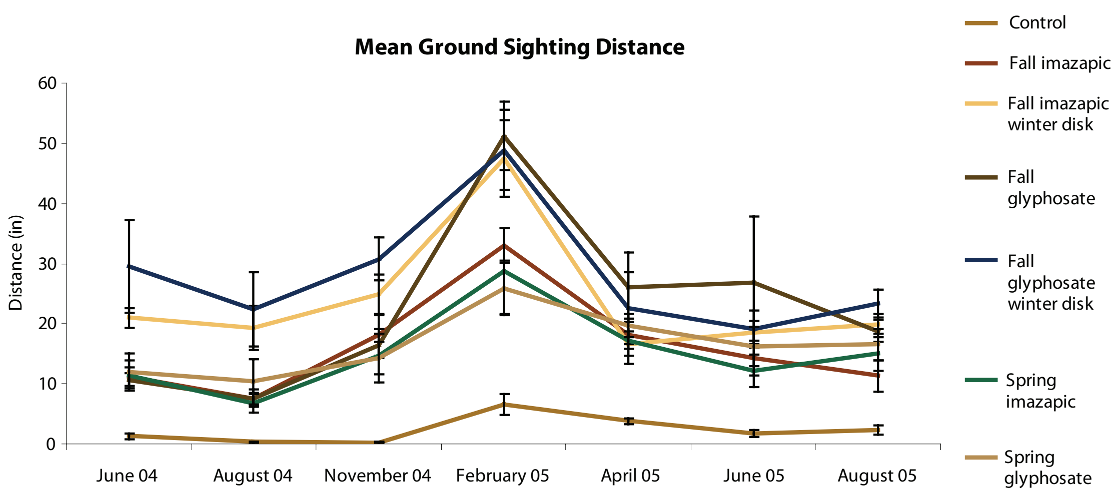

Figure 14. Ground sighting distance is the maximum distance a prone observer can see without being obstructed by vegetation. This measurement is used as an index of mobility for gamebird broods.

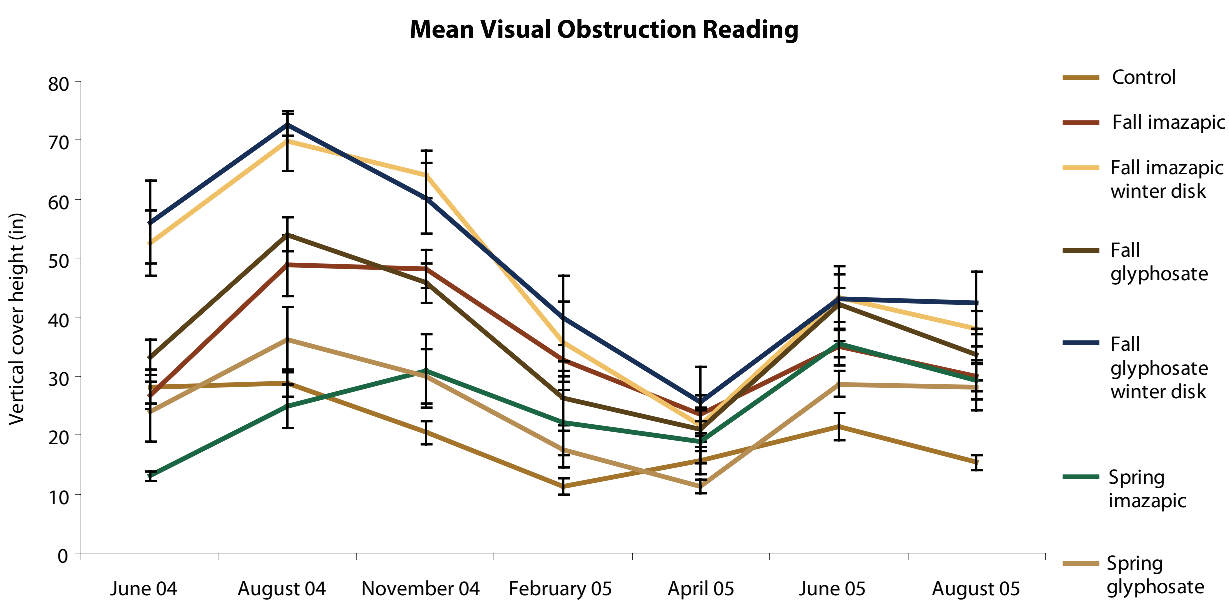

Figure 15. Visual obstruction reading is used as an index of vertical cover. All treatments increased vertical cover.

coverage increased dramatically when tall fescue was killed with imazapic (fig. 16). In plots containing orchardgrass, the mean ground sighting distance following fall applications of imazapic was equal to that in tall fescue control plots (fig. 17). The orchardgrass spread in the imazapic-sprayed plots because imazapic does not control orchardgrass. Thus, it was released. In plots sprayed with glyphosate in the fall, orchardgrass was killed along with the tall fescue (fig. 18). Spraying glyphosate in the spring was relatively ineffective at killing orchardgrass, similar to tall fescue.

Summary and Management Recommendations

It is clear and well documented that tall fescue does not provide suitable habitat for many wildlife species dependent upon early successional cover. Habitat is improved dramatically for those species and others when tall fescue is eradicated and the seedbank is allowed to respond.

Planting native grasses and forbs is not necessary when desirable species establish from the seedbank. Waiting 1 to 2 years after spraying tall fescue is often

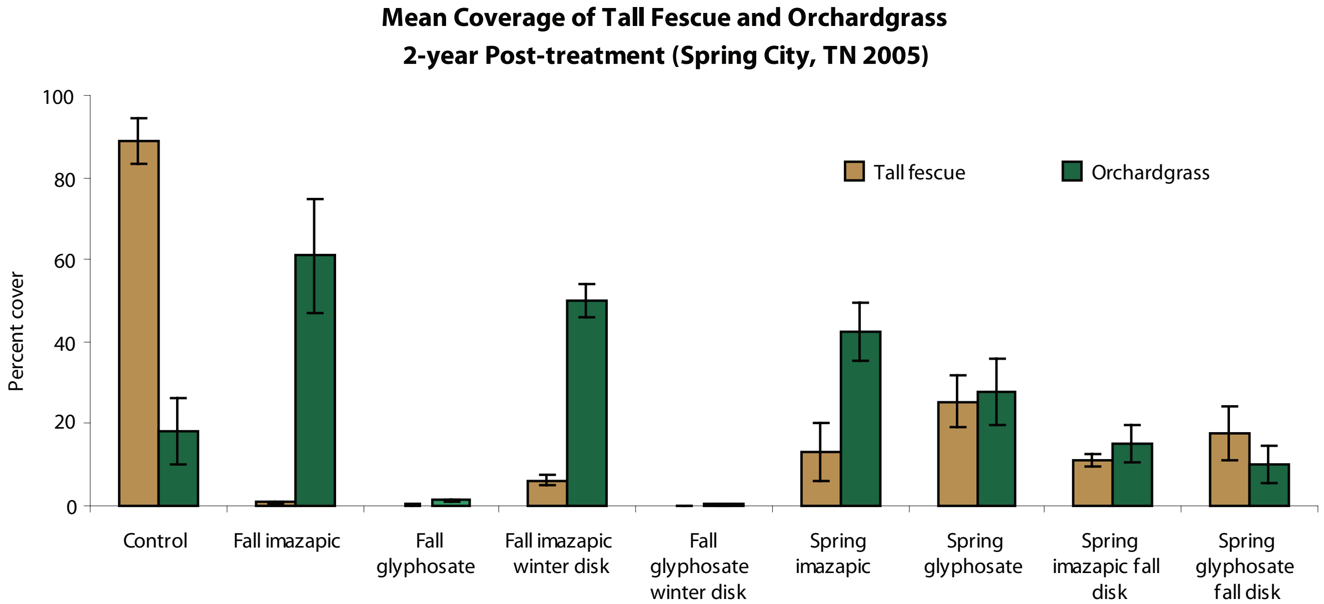

Figure 16. Orchardgrass was present in one field prior to treatment implementation. Only fall glyphosate applications reduced orchardgrass cover. Imazapic does not control orchardgrass.

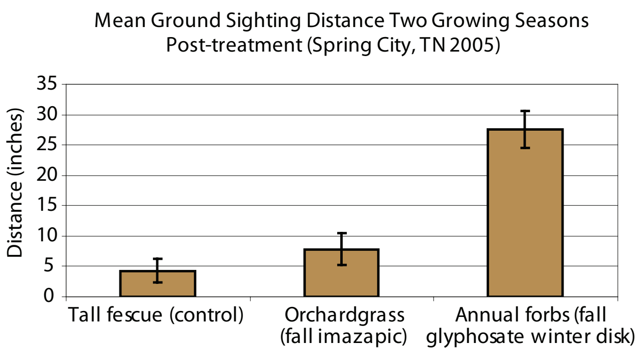

Figure 17. In areas where orchardgrass was released by fall imazapic applications, ground sighting distance was similar to tall fescue control.

a b c

Figure 18. Figure 18a shows the ground sighting distance in a tall fescue plot. Figure 18b shows the ground sighting distance in a tall fescue plot that was sprayed with imazapic the previous fall. The tall fescue was killed, but the orchardgrass was released. Figure 18c shows the ground sighting distance in a tall fescue plot that was sprayed with glyphosate the previous fall. The tall fescue and the orchardgrass were killed and the annual plant community germinated from the seedbank.

needed to evaluate the seedbank and/or control undesirable species germinating from the seedbank.

Further, it is important to realize a field dominated by native grass is not desirable for many wildlife species dependent upon early successional cover. In fact, no more than 20 to 30 percent coverage of native warm-season grasses is needed to provide adequate nesting opportunities for species such as northern bobwhite.

Arguably, to benefit the most wildlife species, the optimum plant composition would be approximately 50 percent native grasses and 50 percent native forbs with scattered shrub thickets well dispersed throughout the field.

Past research has shown tall fescue can be killed with several different herbicides. Researchers evaluated the effectiveness of two commonly used herbicides (glyphosate and imazapic) in different seasons with and without disking.

From the results, spraying tall fescue in the fall is recommended because researchers believe tall fescue should be completely eradicated instead of simply reduced to 20 to 40 percent coverage.

That being said, no single herbicide application will eradicate tall fescue from a field. As residual tall fescue seed in the seedbank germinates, spot spraying will be necessary 1 to 2 years after the initial application. Nonetheless, it much more efficient to treat 2 to 5 percent regrowth as opposed to 20 to 40 percent.

Data show that orchardgrass is structurally similar to tall fescue. Eradicating it just like tall fescue is recommended.

Thus, fall applications of glyphosate is recommended when orchardgrass is present with tall fescue.

In late winter (February–March) following fall spraying, burning is recommended to consume the dead vegetation, stimulate the seedbank, and kill undesirable winter annual weeds (such as chickweed, henbit, purple deadnettle, and wild garlic) that have germinated since spraying.

In late March/early April, a preemergence application of imazapic (such as 4–8 oz) will control undesirable warm-season grasses (such as johnsongrass, crabgrass, and broadleaf signalgrass).

Establishing favorable early successional habitat does not happen overnight. It is a process that may take a few years.

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TECHNICAL SUMMARY

Managing Early Successional Habitat

GRASSLAND MANAGEMENT

The plant communities often found in fields and forest openings are commonly referred to as early successional habitat. These types of habitats require some form of management, such as disking or burning, to keep the field plant community from becoming a forest plant community. The quality of early successional habitat is determined by the types of plants that are present and the structure of the vegetation at the ground level. Many species of wildlife thrive in early successional habitats made up of a diverse mixture of native grasses for nesting substrate, forbs to provide food, and shrubs for escape cover. Such plant communities are open at ground level with a dense canopy of vegetation at about waist high that allows small wildlife to move about easily without being exposed to predators or extreme weather conditions. Balancing the plant species composition and structure of early successional habitats can only be accomplished through habitat management. Prescribed burning removes litter, improves ground level vegetation structure, and stimulates desirable plants in the seedbank. Disking improves habitat structure and composition by incorporating litter, reducing ground level vegetation density, and stimulating desirable forbs. Research conducted in Tennessee suggests that the effects of disking and burning vary greatly based on the timing and frequency of disturbance and the local seedbank. Mowing (or bush hogging) is the least desirable practice for managing early successional habitats because it creates dense thatch at the ground level reduces cover and is not effective in controlling tree saplings. If other practices cannot be used, then mowing in late winter is recommended. Herbicides are particularly useful for controlling undesirable plants in early successional habitats. In some instances, herbicide applications result in a temporary loss of plant diversity; however, the long-term benefits of eliminating undesirable plants far outweigh any collateral damage. Selecting the proper herbicide, application method, and timing of application will maximize habitat benefits. Recommendations for managing early successional wildlife habitat are dependent upon landowner objectives. Burning during spring (March) on a shorter rotation (2–3 years) in larger blocks (50–100 acres) will promote a greater density of warm-season grasses ideal for grassland songbirds. Burning in September or spraying herbicides may be necessary in some years to control woody succession. Disking areas during the fall/winter (October–February) on a 3-year rotation will create better brood-rearing and feeding cover for bobwhites and other species. Breaking fields into smaller management units (5–10 acres) will create a more diverse array of cover types for a greater variety of species. Desirable shrubs provide important cover and should be protected. Maintaining quality early successional habitat requires active management. Landowners should be educated on the effects of various management practices, including their timing and application. It is critical that landowners think beyond their property boundaries and partner with neighbors to conserve, sustain, and increase populations of early successional wildlife.

Managing Early Successional Habitat

Establishing native grasses, forbs, and shrub cover is a common practice under many U.S. Department of Agriculture (USDA) Farm Bill conservation programs such as the Conservation Reserve Program (CRP), Wildlife Habitat Incentives Program (WHIP), and Environmental Quality Incentives Program (EQIP). Eradication and conversion of nonnative grasses and forbs, such as tall fescue (*Schedonorus phoenix*), bermudagrass (*Cynodon dactylon*), and sericea lespedeza (*Lespedeza cuneata*), to native species can have a dramatic impact on habitat quality for wildlife dependent upon early successional cover.

Advances in herbicide technology and knowledge concerning preparation, timing, and application of herbicides to eradicate various undesirable species has enabled landowners to manipulate vegetation composition to develop desirable plant communities, often without having to plant desirable species. Many of these same herbicide applications can be combined with improved technology in planting equipment, such as no-till drills with native grass seed box attachments, and knowledge of planting procedures to develop desirable plant communities even where the naturally occurring seedbank does not contain desirable species.

Once established, early successional plant communities become late successional plant communities relatively quickly, especially in the Eastern United States where average annual precipitation exceeds 40 inches per year (fig. 1). To maintain desirable cover for wildlife requiring early successional vegetation, recurring management is required.

Figure 1. Without management, early successional habitat can become mid-successional quickly. (Photo credit Craig Harper)

Options for Management

Early successional plant communities can be maintained through prescribed burning (CPS Code 338); mechanical disturbance (disking, mowing, and drum chopping); Upland Wildlife Habitat Management, CPS Code 645; Early Successional Habitat Development/Management, CPS Code 647; Brush Management, CPS Code 314; herbicide applications (Pest Management, CPS Code 595); and Prescribed Grazing, CPS Code 528. Most have advantages, and all have limitations.

Prescribed burning

Fire sets back succession, consumes vegetative material, and increases nutrient availability as nutrients from the ashes are moved via rainfall into the top couple of inches of soil. Burning also scarifies seeds, stimulates germination of desirable plants in the seedbank, and creates an open environment at the ground level that facilitates travel, loafing, and

What is succession and quality early successional vegetation?

Ecological succession is the systematic change in a plant community over time. Successional stage is defined by vegetation composition and is directly related to time since disturbance and environmental factors that influence colonization, growth, development, competition, and local extinction. Early successional vegetation is composed of species that are able to germinate, grow, and develop relatively quickly after a disturbance. This typically includes annual and perennial grasses and forbs and, on some sites, sedges and rushes. Some woody species also germinate or sprout relatively quickly after a disturbance. In the Eastern United States, a site becomes mid-successional as woody species begin to dominate, and as a forest or woodland develops, the site is classified as late succession.

Succession marches forward on some sites more quickly than others. Succession is typically faster in areas that receive abundant precipitation and where woody seed sources are nearby. Seed from wind-disseminated species, such as pines (*Pinus* spp.), maples (*Acer* spp.), boxelder (*Acer negundo*), ashes (*Fraxinus* spp.), sweetgum (*Liquidambar styraciflua*), elms (*Ulmus* spp.), and sycamore (*Platanus occidentalis*), are able to spread en masse faster and further than heavy-seeded species (i.e., oak, *Quercus* spp.). However, individual heavy-seeded species, such as oak and common persimmon (*Diospyros virginiana*), may be spread far from the parent tree by animals. Eventually, as distance from pioneering woody plant seed sources increases, occurrence of woody plants is near zero, and time since disturbance is less of a factor in maintaining a plant community dominated by herbaceous species. This phenomenon is exemplified in the few extant true prairies of the Midwest.

Quality early successional vegetation, as related to wildlife habitat, is determined by plant composition, species diversity, and the structure of cover provided. Plants that provide protective cover, nutritious food sources, and allow travel, feeding, and loafing within and under the cover are considered desirable. When many species of desirable plants are present, usable space for wildlife is typically high. Undesirable species provide suboptimal cover, seed, or forage that is not palatable and/or relatively indigestible and inhibit the mobility of small wildlife. When these plants dominate an area, usable space is limited and the number and species of wildlife present and the carrying capacity of the property may be relatively low.

feeding of gamebird broods, rabbits (*Sylvilagus floridanus*), and ground feeding songbirds. Prescribed burning may be implemented during the dormant season or during the growing season, depending on the objectives.

The effect of prescribed burning varies greatly with season of burning and fire return interval. Dormant-season burning typically maintains the existing vegetation composition, except that, over time, grass density usually increases, albeit slowly (fig. 2). Growing-season burning, if implemented repeatedly over time, may reduce percent cover of native

Figure 2. Ideally, dormant-season burning should be conducted just prior to spring green-up and used to maintain the existing plant composition. (Photo credit Craig Harper)

warm-season grasses and increase percent cover of forbs (fig. 3(a)). Growing-season burning, if implemented repeatedly, will virtually eliminate woody cover. Burning only once during the late growing season can be as or more effective at controlling woody encroachment than various herbicide treatments (fig. 3(b)). Burning on a short fire return interval (1–2 years) will promote an early successional plant community dominated by herbaceous species, whereas longer fire return intervals (3–5 years) will allow more woody plant development.

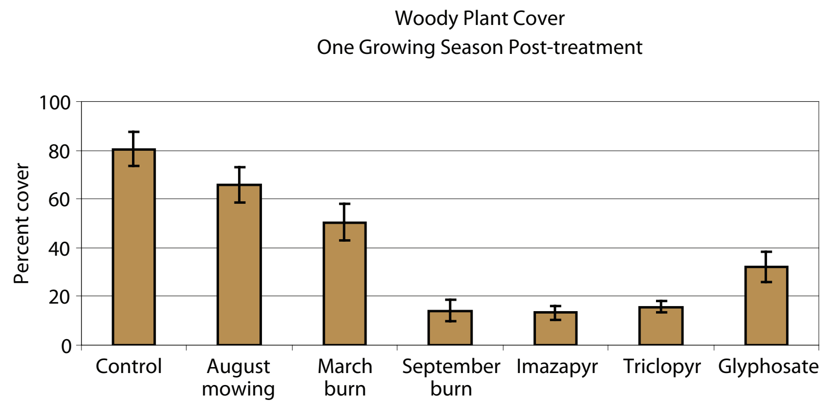
The effect of season of burning is related to nutrient balance and flow within the plant. Aboveground woody stems may be killed with either dormant-season or growing-season fire, but burning during the growing season is more effective at killing the entire plant because much of the plant's energy has been transported from the roots to the aboveground stem and leaves. This effect is pronounced by burning later in the growing season than earlier in the growing season. Burning in the dormant season and early growing season typically results in woody plants resprouting. This is a most important consideration when managing fields and manipulating plant species composition.

Plant response can also vary considerably with timing of burning within the dormant season. If problematic cool-season plants are in the seedbank, such as tall fescue, cheatgrass (Bromus tectorum), and field chickweed (Cerastium arvense), burning early in the dormant season (January–early March) will stimulate their release and growth. Burning later in the dormant season (late March–mid-April), after they have germinated or sprouted and begun seasonal growth and just prior to germination or sprouting of warm-season plants will help reduce coverage of cool-season plants and increase coverage of warm-season plants (fig. 3(c)). Treatments including dormant-season burning in March, applications of triclopyr (4-lb formulation at 5 qt/acre), imazapyr (4-lb formulation at 24 oz/acre), and glyphosate (4-lb formulation at 4 qt/acre) in July, mowing in August, and growing-season burning in September were applied to a CRP field dominated by sweetgum, red maple, and green ash. Late growing-season burning was as effective as applications of imazapyr and triclopyr at controlling woody cover, increased desirable legume cover, and reduced undesirable cool-season grass cover. Additionally, burning later in the dormant season is recommended to lessen the time between burning and spring green-up, thus reducing the loss of cover immediately following a fire (fig. 4).

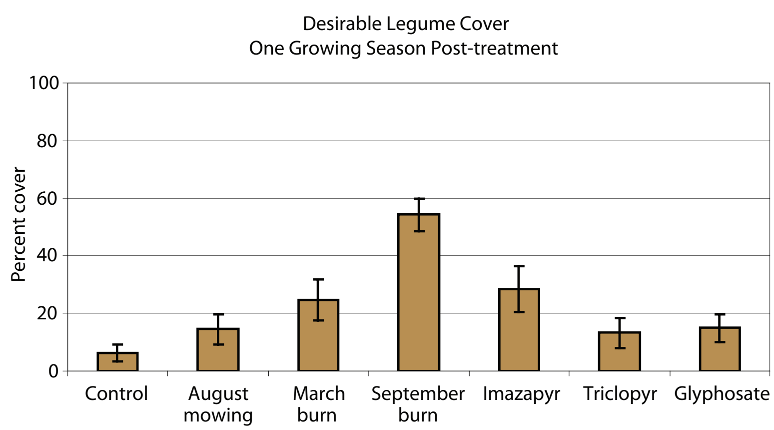
The influence of season of burn is actually greater than fire intensity with regard to changing the species composition of early successional plant communities. A raging heading fire with flame heights exceeding 20 feet in February will not kill woody stems in a field as well as a relatively cool backing fire with 12-inch flame heights in late September. The aboveground stem of woody plants is killed once the cambium layer just inside the bark reaches 145 degrees Fahrenheit.

Growing-season fire can be used without disrupting nests. As mentioned, burning during the early growing-season is not much more effective at reducing woody species than dormant-season burning. Songbird nests in fields are typically initiated starting in late April/early May. Thus, burning through mid-April does not disrupt many nests. Although bobwhites may continue to nest into September, the vast majority of nests have hatched by late September and burning at this time will not have a deleterious effect on fall recruitment.

(a)



(b)



(c)

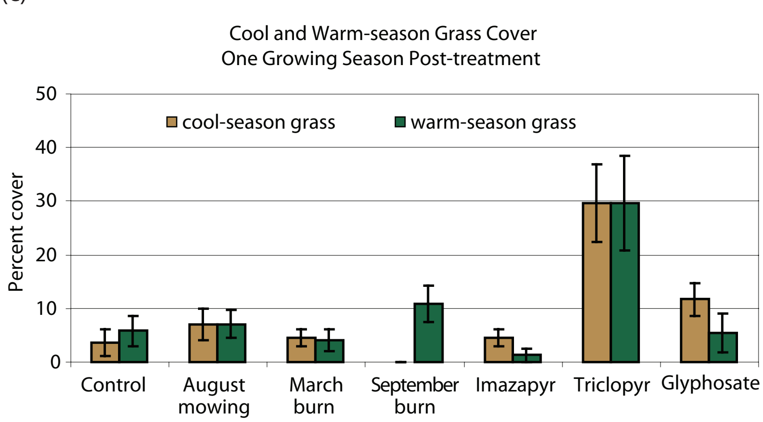


Figure 3. Although patches of woody cover provide important escape cover for bobwhites, fields dominated by undesirable woody plants do not provide adequate nesting or feeding habitat.

Figure 4. Burning late in the growing season (late September/early October) is very effective at reducing undesirable woody cover. (Photo credit John Gruchy)

Figure 5. Disking is the most effective practice to increase forb cover in a grass-dominated field, such as this switchgrass (Panicum virgatum) field. (Photo credit Craig Harper)

Mechanical disturbance

Disking, mowing, and drum chopping (roller chopping) are the three methods of mechanical disturbance most commonly used. Among the three, disking usually provides more favorable results with regard to plant composition and reduction of woody cover.

Disking

Disking not only sets back succession, but also incorporates much of the vegetative material, including thatch, into the upper soil layer (fig. 5). This provides an open structure at ground level and increases soil organic material, which is the primary source of nitrate nitrogen, phosphorus, sulfur, boron, and molybdenum for future plant growth. Increased forb cover provides better conditions for brood rearing by quail and turkeys, seed for various birds, and more forage for white-tailed deer (*Odocoileus virginianus*) (table 1 and fig. 6). Plants such as American pokeweed (*Phytolacca americana*), ragweed (*Ambrosia* spp.), partridge pea (*Chamaecrista fasciculata*), blackberry (*Rubus* spp.), hairy white oldfield aster (*Symphyotrichum pilosum*), native lespedezas (*Lespedeza* spp.), ticktrefoil (*Desmodium* spp.), and common sunflower (*Helianthus annuus*) are all highly desirable. It is important to note that although deer are selective in what they eat, plants are not necessarily eaten based on nutritional content. For example, deer did not browse all of the plants in the chart below. Although American pokeweed, hairy white oldfield aster, and prickly lettuce were browsed heavily, blackberry, partridge pea, ticktrefoil, annual ragweed, goldenrod, and Virginia three-seed mercury were only browsed moderately. For other species, such as passion flower and sericea lespedeza, there was no sign of browsing at all, even though crude protein and digestibility ratings were high. Deer density in this area was approximately 25 per square mile and quality forage was not lacking as there were plenty of soybean fields as well as warm- and cool-season food plots on the farm. Also shown is the relative value of these plants for wild turkeys and bobwhite quail.

Timing of disking, similar to season of burning, usually influences plant composition (figs. 7–10). Although preemergence herbicide applications often reduce the cover of desirable species as well, in many instances, it is worth the trade-off to control undesirable plants before they become a problem. Disking in the fall and winter reduces native warm-season grass dominance and promotes more favorable forb cover for wildlife than disking in the spring. Disking in the summer is not recommended because cover would be destroyed during the nest-

Table 1. Percent crude protein and acid detergent fiber for selected forbs and shrubs collected in June after burning an old field in April, McMinn County, TN.

Common name	Scientific name	CP[1]	ADF	Selectivity by deer	Value as brood cover	Seed value for birds
American pokeweed	*Phytolacca americana*	32.0	12.0	High	High	High
Hairy white oldfield aster	*Symphyotrichum pilosum*	23.3	30.7	High	Medium	None
Prickly lettuce	*Lactuca serriola*	21.7	21.2	High	Low	None
Blackberry	*Rubus* spp.	19.3	18.9	Medium	High	High
Partridge pea	*Chamaecrista fasciculata*	29.6	36.5	Medium	High	High
Tricktrefoil	*Desmodium* spp.	28.2	20.7	Medium	High	High
Annual ragweed	*Ambrosia artemisiifolia*	17.8	23.9	Medium	High	High
Sumac	*Rhus* spp.	23.1	12.5	Medium	High	Medium
Goldenrod	*Solidago* spp.	16.1	26.2	Medium	Medium	None
Virginia threeseed mercury	*Acalypha virginica*	24.7	16.7	Medium	Low	Medium
Japanese honeysuckle	*Lonicera japonica*	16.2	34.2	Low	Low	Low
Canadian horseweed	*Conyza canadensis*	32.9	19.8	Low	Low	None
Sericea lespedeza	*Lespedeza cuneata*	22.2	32.6	None	Low	Low
Purple passion flower	*Passiflora incarnata*	36.6	18.9	None	None	Low

[1]Forage samples contained leaves only because that was the part of the plants deer commonly ate. Stems were not included.

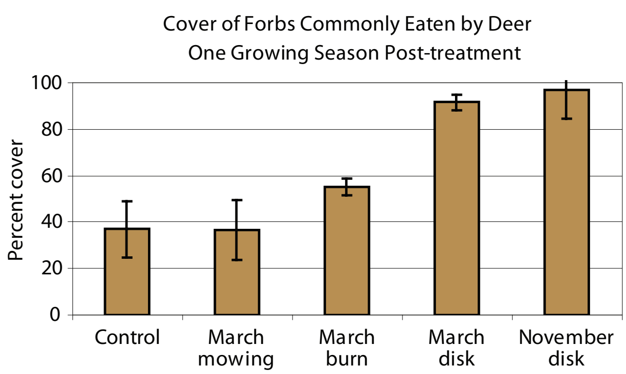


Figure 6. Disking and burning strips and/or sections within old-fields each year stimulates forbs favored by deer.

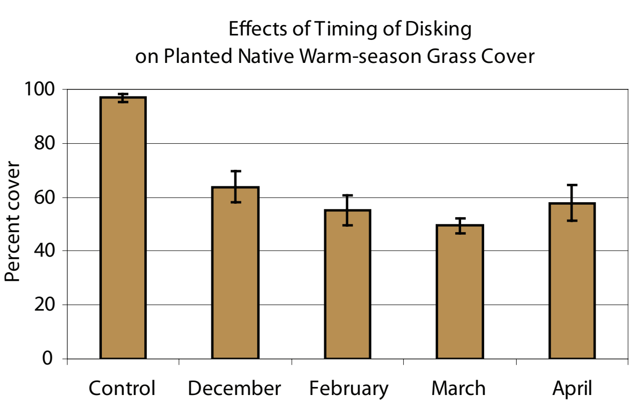


Figure 7. Three passes with a medium sized disk reduced the density of native warm-season grasses 50–60 percent one growing season following treatment, regardless of whether disking occurred in winter or spring.

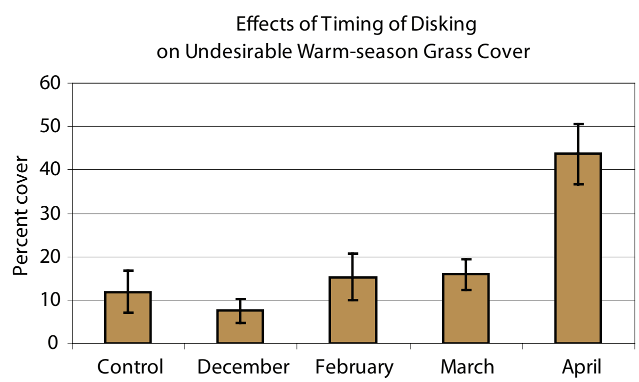


Figure 8. Disking in April resulted in increased cover of undesirable warm-season grasses, such as johnsongrass, crabgrass, goosegrass (Eleusine spp.), and broadleaf signalgrass.

GRASSLAND MANAGEMENT

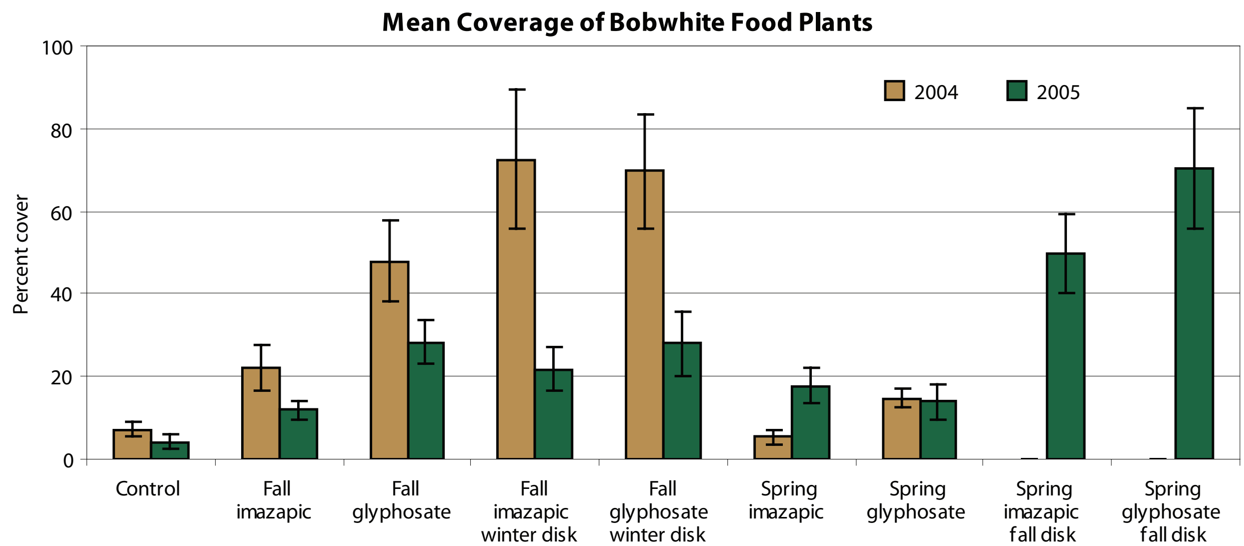


Figure 9. A preemergence application of imazapic (2-lb formulation at 12 oz/acre) controlled undesirable warm-season grasses, an important consideration if spring disturbance is necessary.

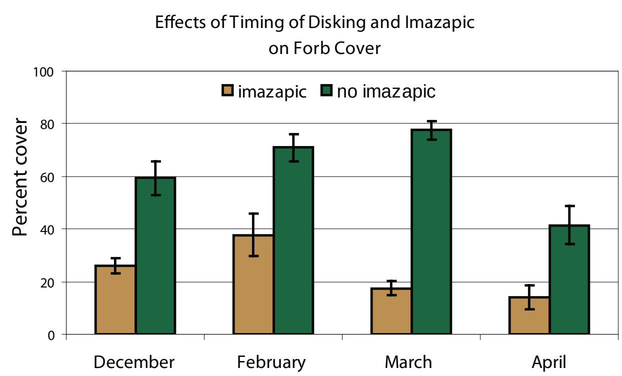


Figure 10. A preemergence application of imazapic (2-lb formulation at 12 oz/acre) also inhibited the germination of several species of forbs.

ing and brood-rearing season and because undesirable plant species may dominate. In the Deep South, disking should be completed by late February. In the Midsouth and further north, disking may be completed as late as March. Disking later than this tends to stimulate invasive nonnative warm-season plants, such as crabgrass (*Digitaria* spp.), johnsongrass (*Sorghum halepense*), broadleaf signalgrass *(Urochloa platyphylla*), sicklepod (*Arabis canadensis*), curly dock (*Rumex crispus*), common plantain (*Plantago major*), Canadian horseweed (*Conyza canadensis*), and sericea lespedeza (*Lespedeza cuneata*). Site-specific plant response is dependent upon the seedbank, which varies greatly from area to area and even among fields on a particular property. Seedbank composition and the best time for disking individual fields can be evaluated by disking a strip each month, November through March.

Intensity of disking is another consideration. In general, it is desirable to incorporate approximately 50 percent of the vegetative material into the top layer of soil. The amount of disking (or number of passes) necessary is determined by soil texture and moisture and the type of disk used. Light tandem disks do not work well, especially with dry clay soils. Heavier offset disks work best. Regardless, fewer passes will be necessary with sandy and clay loams and when soil moisture is adequate. Heavier disks and repeated passes are required if considerable woody cover is present and the objective is to reduce woody cover and promote more herbaceous cover.

According to the amount of vegetation on the field, mowing or burning may be necessary prior to disking, especially when using a light tandem disk, which will not cut through heavy vegetation (fig. 11). Burning in the dormant-season prior to disking makes disking with a light tandem disk much easier, especially if disking is conducted several days after a rain, which makes the soil easier to work and prevents the soot and ash of a recently burned field from blowing around the tractor. Burning prior to disking also creates the perfect seedbed for top-sowing forbs into a previously grass-dominated stand.

Mowing

Mowing (or bush hogging) is the least desirable method of setting back succession and managing early successional cover for wildlife. Although succession is set back following mowing, woody stems are not killed, only cut off a few inches above-ground, and where there was one stem, several arise the following growing season. Mowing accumulates a tremendous amount of debris on the ground, which eliminates bare ground space and increases the thatch layer so that mobility of gamebird broods and ground feeding songbirds is limited. Furthermore, the seedbank is suppressed and any seed that might have been available as food is covered with debris and thus unavailable (fig.12).

If burning is not possible, no equipment is available to disk the field, and mowing is absolutely the only option, then mowing should be completed in late winter, just prior to spring green-up. This allows cover in the field to stand through the winter and does not disrupt nesting, fawning, or brood rearing.

Photo credit Mike Hansbrough *Photo credit John Gruch*

Figure 11. If a heavy off-set disk is not available, burning or mowing prior to disking with a tandem disk may be necessary.

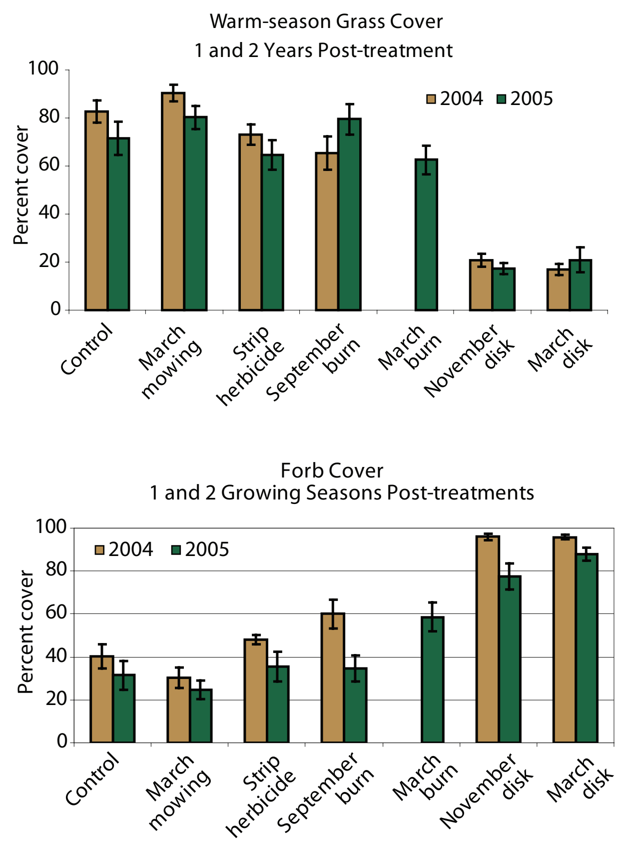


Figure 12. Treatments were applied to a field planted in native warm-season grasses in May of 2000. Disking in November or March was effective in reducing grass density and increasing forb cover. Burning in March increased forb cover one growing season following treatment and improved native grass growth and vigor. Mowing was not effective in improving vegetation composition or structure. Plots were disked 4 to 6 passes with an off-set disk.

Although mowing is disfavored as a management practice, that does not mean landowners should sell their rotary mowers. For fields dominated by forbs, mowing strips (no more than a fifth of the total field) in mid-July will increase grass cover (such as broomsedge bluestem (fig. 13)). This is an important consideration for nesting cover if bobwhites are an objective and if the field is managed with prescribed burning. Another use for rotary mowers is clearing a few strips in the fall to facilitate rabbit or quail hunting. Of course, this could also be accomplished by disking.

Drum chopping

Drum chopping, also called roller chopping, is accomplished by pulling a large drum roller with horizontal bars welded across the drum across the field with a bulldozer. This technique is most often used to set back succession where woody growth has grown too tall for disking and a closed canopy has reduced the herbaceous fine fuels to adequately carry a fire. Drum chopping is also used over large areas dominated by tall brush. A disadvantage of this technique is that extremely few landowners have access to such equipment. Additionally, drum chopping is always followed by substantial resprouting of hardwood stems. Late growing-season fire is much more effective and efficient where possible.

Herbicide applications

Herbicides are often necessary to reduce or eliminate undesirable species. Herbicides can be applied as broadcast applications, strip applications with every other or every third spray nozzle closed, or spot-spray applications (fig. 14). Dense native grasses should be sprayed before they reach approximately 12 inches or forb response from the seedbank will be suppressed by the thatch produced Broadcast applications are used when problem species are present throughout the field. Broad-spectrum or selective herbicides can be used, depending upon the plant(s) present. When undesirable herbaceous species are the target, it is important to prepare the field for spraying in the season prior to application. Spraying fields with thatch and senescent stems and leaves will limit herbicide contact to growing vegetation, which is necessary for all postemergence applications. Burning, haying, grazing, or repeated mowing in the season prior to spraying will clean the field and allow postemergence appli-

Figure 13. Additional broomsedge bluestem has been stimulated for increased nesting structure for bobwhites and to facilitate burning in a field dominated by goldenrod and dewberry. (Photo credit Craig Harper)

Figure 14. Strip spraying is easily accomplished by closing off every other or every third nozzle on the spray boom. (Photo credits John Gruchy)

cations to come in contact with the problem plants. Preemergence applications are most effective following burning or disking (fig. 9). Applications to bare ground allow herbicide contact with seedlings of problem species as soon as they germinate. Preemergence herbicide applications (such as imazapic) following strip disking can be quite effective in reducing establishment of undesirable species.

Strip applications can be used to reduce native grass cover and allow increased forb cover to develop. This is not as effective as disking, but will increase forb cover if native grasses are sprayed before they reach about 12 inches in height (fig. 12). Strip applications to native grasses taller than 12 inches is not desirable because the dead native grass will produce a thatch layer in the sprayed strips that will inhibit germination from the seedbank. Another problem with this technique is that strip applications in late April and May may release many undesirable warm-season species. Expect bermudagrass, crabgrass, johnsongrass, broadleaf signalgrass, sicklepod, and sericea lespedeza to arise if they are present. This elucidates the absolute need to get rid of problem plants before planting native grasses and forbs. If undesirable plants are not eradicated before planting, they will arise sooner or later and become problems when the field is managed. Landowners should wait a minimum of 1 year (2 yr is better) after spraying nonnative grass cover to evaluate the seedbank. This is not necessary when planting unplanted fields that were previously row cropped.

Spot spraying is an excellent technique to control problem plants, such as some woody species, that are not widespread across the field (fig. 15). Imazapyr or triclopyr are excellent choices to control problem woody stems, such as sweetgum, locusts (*Gleditsia triacanthos*, *Robinia pseudoacacia*), maples (*Acer* spp.), or elms (*Ulmus* spp.), while retaining desirable woody species, such as plum (*Prunus* spp.), black elderberry (*Sambucus nigra*), southern crabapple (*Malus angustifolia*), and sumac (*Rhus* spp.). However, efficacy varies among species and herbicides.

For additional information about herbicides and applications for managing early successional communities, refer to Native Warm-season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South. This publication can be viewed, downloaded, and/or purchased (http://www.utextension.utk.edu/publications/wildlife/default.asp).

Grazing

Early successional plant communities throughout North America were historically maintained with fire and grazing. Of course, there are no longer vast herds of buffalo maintaining the oak savannas once present throughout much of the South; however, domestic cattle can serve the same purpose. Prescribed grazing (CPS Code 528) by rotating cattle among paddocks has been promoted for some time. The intention is to prevent overgrazing and keep native grass height no lower than about 12 inches. This strategy is now being questioned in favor of a new practice being developed in Oklahoma, Missouri, and Kansas—patch-burn grazing.

Figure 15. Spot spraying undesirable woody species is easily accomplished with a tractor-mounted sprayer. This is an effective management practice during the growing season and much more sensible than recreational mowing. (Photo credit Craig Harper)

Patch-burn grazing allows cattle access to a relatively large area (perhaps 100-400 acres). A third to a fourth of the area is burned each year. Cattle graze preferentially on the recently burned area, without being fenced out of the rest of the area. Stocking rates are adjusted so that the cattle can intensively graze the burned area throughout the growing season. The cattle then are removed. The following winter/spring, another quarter of the area is burned. Cattle then are allowed back into the area and preferentially graze the most recently burned area throughout the growing season. This pattern continues such that a 3- to 4-year burning rotation is established.

Wildlife respond beautifully to patch-burn grazing. Gamebirds nest in the areas not burned recently, but move to the recently burned area with the cattle to raise broods. Songbirds nest in the areas not previously burned, yet feed abundantly in the burned area with the cattle. This entire system mimics the natural historic pattern of buffalo as they would intensively graze areas recently burned because the vegetation was more palatable and contained increased nutrition. It is important to note the areas open to grazing are not necessarily dominated by grasses. An abundance of forbs are present throughout.

The logistics of this system and its applicability to private lands are being worked on now. There appears no reason that cattle cannot be allowed throughout an area that includes brushland and woodland, along with open areas of grasses and forbs. Ideally, the entire property can be fenced along the perimeter and sections burned within. Cattle preferentially graze and manage the vegetation. Although stocking rates may not be as high as the intensive grazing practices on nonnative grasses today, the system may have great benefit for landowners also interested in wildlife.

Management Recommendations

Recommendations for managing early successional wildlife habitat are dependent upon landowner objectives. Strategies for managing fields specifically for grasshopper sparrows (*Ammodramus savannarum*) and eastern meadowlarks (*Sturnella magna*) differ from those for managing fields specifically for bobwhites (*Colinus virginianus*), indigo buntings (*Passerina cyanea*), or white-tailed deer. That does not mean habitat needs for a variety of wildlife species cannot be met within a particular field. Nonetheless, it is important for a landowner to identify goals and objectives in a management plan before implementing management strategies.

For more information on farm-scale conservation planning for early successional wildlife, see Creating Early Successional Wildlife Habitat through Federal Farm Programs: An Objective-Driven Approach with Case Studies (http://www.whmi.nrcs.usda.gov/technical/fieldborder.html).

Considerations for plant species composition

Matching plant species composition with the desired wildlife species is an important initial consideration. Grassland songbirds, such as Henslow's sparrows (*Ammodramus henslowii*) and eastern meadowlarks, prefer grass-dominated fields with a forb component. Grasses may constitute 70 to 90 percent of the plant cover, with 10 to 30 percent forbs (fig. 16). Presence of woody structure is not preferable, and may preclude presence of some grassland bird species, depending on the amount of woody cover present. Other early successional songbirds, such as field sparrows (*Spizella pusilla*) and dickcissels (*Spiza americana*), and wild turkeys (*Meleagris gallopavo*) prefer fields of approximately 50 percent grass, 50 percent forbs with scattered shrubs/brush in the field. The scrub/shrub songbirds, such as yellow-breasted chats (*Icteria virens*) and indigo buntings (*Passerina cyanea*), use fields of grass and forbs with considerable woody cover throughout the field. This stage is also preferable for

Figure 16. Grassland songbirds prefer fields composed primarily of grass with a reduced forb component (perhaps 30%). This type of cover can be maintained with late dormant-season fire alternated with growing-season fire. (Photo credit Craig Harper)

bobwhites, rabbits, and white-tailed deer. The shrub cover is extremely important for winter cover, and various shrubs, such as plum, crabapple, elderberry, and sumac, also provide a food source.

Timing of disturbance

To maintain a grass-dominated field for grassland songbirds, burning on a 3-year fire return interval is recommended. A 3-year interval allows a slight accumulation of litter, which is desirable for grassland birds. Disking encourages too many forbs and mowing allows woody species to become problematic. To control undesirable woody species, growing-season fire should be used as needed, according to plant response. Two late dormant-season fires followed by a growing-season fire, each 3 years apart, should perpetuate a grass-dominated field and control undesirable woody growth. Undesirable forbs can be controlled with a forb-selective herbicide. Triclopyr also can be used to control undesirable woody growth and problem forb plants.

To maintain a mixture of grasses and forbs with scattered shrub cover, burning on a 2- to 4-year fire return interval is recommended. Additional forb cover can be stimulated by disking if needed.

Maintaining a mixture of grass and forb cover with considerable shrub cover requires burning every 3 to 5 years. This interval also allows maximum soft mast production. Spot spraying and/or growing-season fire will reduce problematic species and woody cover.

Pattern of disturbance and arrangement of habitat

A common mistake of many landowners is to disturb all available habitat in 1 year. It is critical to disturb only a portion of available habitat each year and leave other portions for various cover requirements. This is especially true when a landowner is managing a single field.

Disturbance patterns

When only a single field is being managed, the field should be divided into sections. Ideally, the number of sections should be divisible by the intended fire return interval or strip-disking interval. For example, if a 4-year fire return interval is intended, a 12-acre field could be separated into four 3-acre sections (fig. 17). If the field is managed by disking, strips not less than 50 feet wide should be disked and alternated so that each strip is disked every 2 to 4 years.

Figure 17. This field is being managed with prescribed fire on a 2- to 4-year fire return interval. Various sections are burned at different times to provide a mosaic of composition and structure across the field, thus benefiting many wildlife species dependent upon various stages of early successional habitat. (Photo credit Craig Harper)

A 2-year disking interval would alternate between two adjacent strips. A 4-year disking interval would alternate between four adjacent strips. Each strip could represent a quarter of the field (this may actually be blocks rather than strips), or a number of four-strip sections could be established across the field.

For more information on rotational disking, see Light Disking to Enhance Early Successional Wildlife Habitat in Grasslands and Old Fields: Wildlife Benefits and Erosion Potential, NRCS Technical Note No. 190–32 (ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/pdf/tn_b_32_a.pdf).

Is it best to disk a rectangular field lengthwise or widthwise? Research has not compared these techniques with regard to movements and survival of wildlife, but disking widthwise would increase interspersion across the field and may be beneficial for some species such as northern bobwhite.

When managing several fields in proximity, disturbing entire fields may be an option. However, depending upon the focal species for management, larger fields still should be separated into sections for management. Management blocks for grassland songbirds may be as large as 50 to 100 acres, whereas management blocks for quail, rabbits, and deer may be 5 to 10 acres or smaller.

Habitat arrangement

Grassland songbirds are able to find all of their habitat requirements in a relatively homogenous grassland complex. However, other species require more habitat diversity and depend on multiple cover types within a relatively small area. Interspersion of different plant communities that meet different habitat requirements may reduce unnecessary movements and home range size, thereby increasing annual survival. Northern bobwhite, for example, may use different cover types for nesting, raising broods, loafing, and escaping predators. Native grasses may be used for nesting, patches of annual forbs may be used for brood-rearing, a sumac motte may be used for loafing, and a blackberry thicket may be used for escaping predators and harsh winter weather. All of these cover types may be well interspersed within a field. Or, these cover types may be available separately, but in close proximity, as small fields, hedgerows, field borders, etc. The best case scenario is for them to be well interspersed within a given field, but populations will respond well if all necessary cover types are at least present and relatively close together.

Regardless, habitat arrangement on one property may be a moot point if that property is surrounded by nonhabitat. Grassland songbirds may not be found in a field with the perfect composition and structure if there are few other suitable grassland fields in the surrounding landscape. Likewise, bobwhite populations may become stagnant and decline on a property with ideal cover types and arrangement if the surrounding properties cannot support quail. It is critical that landowners think beyond their property boundaries and partner with the neighbors to conserve, sustain, and increase populations of early successional wildlife.

Conclusions

Early successional habitats are dynamic. Landowners cannot simply create or establish early successional wildlife habitat and expect it to stay that way. With just a little time, early successional plant communities become late successional plant communities. With that change in plant species composition and structure comes a change in the associated wildlife species. Maintaining early succession requires recurring management. Managing early successional plant communities requires effort and persistence. Knowledge of the various effects of various management practices, including their timing and application, is important to create desirable habitat conditions for wildlife. Landowners should realize all of these factors when identifying goals and objectives.

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University of Tennessee
Early Successional Habitat Field Day
June 22, 2006

Dr. Craig Harper (associate professor and extension wildlife specialist) and John Gruchy (graduate research assistant) of the University of Tennessee (UT) hosted a USDA NRCS Bobwhite Restoration Project Field Day on June 22, 2006, in McMinn County, Tennessee, at one of seven study sites used in their research evaluating early successional habitat management for wildlife. The Early Successional Habitat Field Day featured morning and afternoon tours, technical sessions, and vendor booths. More than 150 natural resources professionals and private landowners were in attendance (fig. 1). Topics included bobwhite biology, prescribed fire as a tool for managing grasslands and old fields (fig. 2), native warm-season grass (NWSG) establishment and management (figs. 3 and 4), and release of native plant communities from existing seed banks. Vendor booths from Roundstone Native Seed, Turner Seed, BASF, Tekota Land Clearing and Vermeer Equipment Co. (Gyro Tracs), Quail Unlimited, Tennessee Wildlife Resources Agency, and the NRCS showcased the latest technologies and information for managing quail habitat. The Field Day was attended by 40 private landowners from Tennessee, Kentucky, Georgia, South Carolina, Arkansas, and Mississippi. Also attending were 24 NRCS personnel and 92 resource professionals from 14 agencies and institutions.

Figure 1. More than 150 natural resource professionals and private landowners attended the Early Successional Habitat Field Day hosted by UT.

Attendance	
Private landowners	**40**
NRCS personnel	**24**
North Carolina Division of Wildlife Management	**16**
Kentucky Dept. of Fish and Wildlife Resources	**13**
Tennessee Division of Forestry	**13**
Georgia Division of Natural Resources	**8**
Tennessee Valley Authority	**8**
National Parks Service	**7**
USDA Forest Service	**6**
University of Tennessee / Extension	**6**
Tennessee Wildlife Resources Agency	**4**
Private consultants	**3**
Georgia Forestry Commission	**2**
Oak Ridge National Laboratory	**2**
Fort Loudon Electric Cooperative	**2**
Mississippi State University	**2**
Total	**156**

Evaluation

Overall value

Survey participants were asked if they learned new information by attending the Field Day, if they would like to attend more UT/NRCS Field Days like this one and rank the overall value of this Field Day on a scale of 1 (lowest) to 5 (highest).

	Learned new information	Attend more UT/ NRCS Field Days	Overall Value				
			1	2	3	4	5
Landowners	100	100	0	0	9	18	73
NRCS personnel	96	100	0	0	5	27	68
Resource management professionals	97	100	0	0	0	48	52
Mean	98	100	0	0	5	31	64

Figure 2. Dr. Craig Harper describes the benefits of prescribed fire in creating quality early successional habitat.

GRASSLAND MANAGEMENT