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SP704-A Potential Impacts on Wildlife of Switchgrass Grown for Biofuels

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Switchgrass is currently receiving attention from many agricultural producers and investors who are interested in participating in the rapidly developing biofuels industry. As research continues to drive cellulosic ethanol production towards becoming an economically feasible reality, some producers are considering switchgrass cultivation to feed these new-generation ethanol manufacturing plants. At the same time, switchgrass and other native warm-season grasses have been promoted to enhance habitat for wildlife dependent upon early-successional plant communities. Indeed, native grasses are an important habitat component for many species of wildlife that typically use fields because of the structure and cover these grasses provide. The structure and cover within a field is determined by two things: plant composition and management. This publication addresses how plant composition influences wildlife habitat and how switchgrass grown for biofuels can be managed to benefit wildlife.

Plant composition: The good, the bad and the ugly

In general, fields with a diversity of plants attract a wide variety of wildlife. The best case scenario for many wildlife species would be a mixture of native grasses and forbs with clumps of shrubs scattered across the field. The native grasses would comprise about 50 percent of the plant cover and include some short species (such as broomsedge bluestem and little bluestem) as well as taller species (such as big bluestem, indiangrass and switchgrass). The forbs might include ragweed, pokeweed, old-field aster, partridge pea, beggar's-lice and native lespedezas. Underneath the forbs and between the grass bunches would be an open environment that would enable small wildlife, such as young wild turkeys, bobwhite quail and field sparrows, to move about and feed unrestricted throughout the field while protected by an overhead canopy. Scattered patches of blackberry, wild plum and sumac would not be more than about 100 yards apart, providing nesting structure, soft mast, browse and cover during winter.

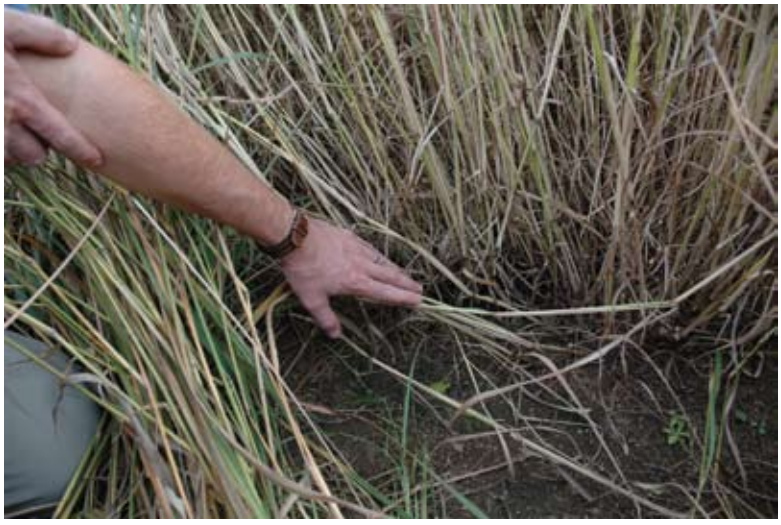
Sod-forming grasses, such as tall fescue, orchardgrass (left) and bermudagrass, inhibit travel by young game birds and rabbits. Seed and invertebrates are largely unavailable and predation is inevitable without overhead cover. When sod-forming grasses are removed, an open structure at ground level (right) enables young bobwhites and wild turkeys to travel and feed throughout the field, while protected by an overhead canopy. *Photo credit: Craig Harper*

Unfortunately, many landowners shudder when they think of such a field. Most producers have spent a lifetime trying to get rid of these plants and strive to make fields and fencerows as "clean" as possible. Today, if not cropped, fields of native early successional plants have been replaced with non-native grasses that are used for haying and grazing. Now, nearly all of the pasture and hayland in Tennessee is comprised of tall fescue, orchardgrass, dallisgrass and bermudagrass. The conversion of native grasses and forbs to near monocultures of non-native sod-forming grasses has had deleterious effects on many species of wildlife.

Why are native grasses preferable for wildlife?

Native grasses are preferable for wildlife because they can provide overhead cover and their bunch-growth nature allows turkey and bobwhite broods, rabbits and several species of ground-feeding songbirds to travel between the grass bunches while searching for seed and invertebrates. This is in contrast to the structure provided by tall fescue, orchardgrass, dallisgrass and bermudagrass. The lack of overhead cover and a dense structure at ground level prevent these fields from being attractive for many species. And, if no other cover is available and wildlife are forced to use these fields, mortality may be increased because of exposure to predators and weather.

Although native grasses can provide desirable structure and cover, they do not provide food for many wildlife species common to Tennessee. Mammals, such as elk and cattle, readily consume native grass forage. In contrast, white-tailed deer, cottontail rabbits and groundhogs do not graze native perennial grasses as a group any more than they would non-native perennial grasses. For these animals, various forbs are selectively grazed. And while a few birds may eat some of the seed produced by native perennial grasses, the value of these seed is similar to that of non-native perennial grasses (with the exception of tall fescue seed, which may be toxic with an endophyte fungus) in that they do not provide much energy and are not considered a quality seed source. The value of seed produced by many forbs, such as the ones mentioned above, are far superior to that of grass seed from native or non-native perennial grasses.



Although the structure at ground level within a monoculture of switchgrass is not as attractive as that within a field managed specifically for wildlife, it is much better than that provided by tall fescue, orchardgrass and bermudagrass. *Photo credit: Craig Harper*

So, how can switchgrass grown for biofuels benefit wildlife?

Given the fact that plant diversity is important for wildlife, switchgrass grown for biofuels can still be managed to provide an important habitat component for several wildlife species.

Single harvest and timing

Switchgrass grown for biofuels is typically harvested only once per year in the fall, after a killing frost, when mineral and moisture contents are at their lowest and feedstock quality is at its highest. This is advantageous for wildlife nesting or raising young in the field because the cover is not destroyed during spring and summer when it is needed most. If switchgrass is harvested for a high-quality hay crop in mid- to late May, nests of many songbirds, quail and turkeys will be destroyed and their recruitment negatively impacted. It is also at this time that white-tailed deer are fawning. Fields with substantial cover are highly sought by whitetail does as cover to hide fawns during their first several weeks of life. When fields are hayed from late May through July, it is common for fawns to be killed by mowers. If switchgrass is not harvested until after frost, cover needed for reproduction and recruitment is retained.

Advantages of delayed harvest

Delaying switchgrass harvest until late winter may provide additional benefits, including cover for wildlife, and flexibility in timing of harvest, work load and biofuels storage. A four-year study in Pennsylvania examined five upland varieties of switchgrass, such as Cave-in-Rock, and found where snowfall was less than 60 inches per year, harvest yields and

If switchgrass grown for biofuel is not harvested until March, cover is retained during winter, which is critical for bobwhites, rabbits and overwintering sparrows. White-tailed deer readily use switchgrass fields for bedding during winter. *Photo credit: Robin Mayberry*

ethanol quality and yield were not reduced by delaying them until late March. Where wildlife is important to the producer, waiting until late winter to harvest switchgrass is highly recommended, because the standing switchgrass can provide critical winter cover. If field conditions permit, harvests could be timed between fall and late winter, but harvests prior to March would result in lost winter cover and increased predation. Encouraging recruitment through enhanced cover for nesting and raising young is largely for naught if quality cover is not available during winter when mortality rates from predation and exposure can be quite high. Another benefit from late-winter switchgrass harvest is lower moisture content, which is an advantage when storing the feedstock.

When considering delayed harvest, producers growing switchgrass under a contractual arrangement should be sure the contract allows flexibility in harvest dates. If not, producers may want to work with the buyer to explore this option. Producers should understand the contract they sign. Where wildlife is a major consideration, producers should consider the impact that contractual obligations will have on wildlife before agreeing to the growing, harvesting and storage practices outlined in the contract.

Leave some for wildlife

If switchgrass is harvested in the fall (as opposed to late winter), it is particularly important to leave some area unharvested to retain as much cover for wildlife through winter as possible. Retaining at least 5 percent of the field for wildlife cover, preferably around field edges or near other cover, is strongly recommended, especially if field borders (see *What's happening around the field?* on the next page) have not been established. According to objectives, some landowners may want to defer harvests on entire fields, or as much as 50 percent of a field each year, and alternately harvest the other half each year. It is important to realize this would **not** amount to losing 50 percent of the field each year. Indeed, much of the yield from Year One is still present in the field when harvested at the end of the second year. A study examining dormant-season management of switchgrass stands grown under the Conservation Reserve Program showed standing and lodged switchgrass from the previous year's growth did not differ from annual production in fallow switchgrass stands.

When retaining cover for wildlife, strips at least 50 feet wide and/or blocks at least one-half acre are recommended. Narrow strips and small blocks will be used by wildlife, but they can also lead to increased predation as predators learn to search out these narrow and small areas quite effectively. Relatively wide strips and large blocks of cover are more difficult to search and do not present such "predator traps."

Incorporating forbs and using mixed stands

A near complete lack of food is a problem in monoculture switchgrass fields where few, if any, seed- and soft mast-producing forbs and shrubs are present. Not only do forbs provide forage, seed and soft mast, forbs also attract the majority of invertebrates that represent a critical food source for young upland game birds and songbirds. Although additional research is needed to evaluate the impact on tonnage and quality of biomass, incorporating various forbs into a switchgrass planting will enhance its value for wildlife tremendously. Partridge pea, red clover, alfalfa and annual lespedezas are just a few options for landowners interested in wildlife.

Switchgrass may not be the only native grass desirable for biofuels. Research has identified mixed stands of big bluestem, indiangrass and other native grasses as desirable biofuels as well. Research is ongoing to determine if these mixtures are suitable, both in quality of fuel produced and the cost of that production, for ethanol production in Tennessee. If the production of ethanol from

cellulose does not require single-species feedstocks for conversion, great improvements can be made for wildlife habitat by using a diverse mixture of native grasses and forbs instead of switchgrass monocultures.

What's happening around the field? Even if monoculture stands of switchgrass are used for biofuels, wildlife habitat can still be enhanced if the field is broken up using relatively wide hedgerows and if borders of desirable early successional plants surround the field. Hedgerows of wild plum, elderberry, sumac, blackberry and scattered eastern redcedar can be used to break-up fields into 5- to 10-acre sections and intersperse a tremendous source of food and cover within the switchgrass. This is an excellent way to increase usable space for wildlife on the property. Hedgerows should be complemented with relatively wide field borders of native forbs and shrubs surrounding switchgrass fields. These borders will increase food availability around the field and provide a critical source of cover during winter, especially if switchgrass is harvested in the fall.

Another way to enhance the field is by thinning undesirable trees from adjacent woods. Sweetgum, maples, elms, ashes, yellow poplar and sycamore are all winged-seeded species that disseminate with the wind and can present problems by encroaching into fields. Further, these species do not produce important mast for wildlife. Wildlife habitat can be enhanced considerably by cutting and removing these trees commercially or by killing them and allowing them to remain standing as snags. Thinning these trees approximately 100 feet into the woods from the field edge will allow the crowns of adjacent desirable mast-producing trees to grow larger and produce more fruit. At the same time, additional sunlight stimulates increased groundcover, providing more food and cover around the field and increasing usable space for wildlife dependent upon early successional cover.

Final thoughts

Switchgrass grown for biofuels will not provide the same quality habitat as a diverse field of native grasses, forbs and scattered shrubs. However, if considerations for wildlife are made when planning field layout and harvest, an important habitat component for a variety of wildlife species can be provided when growing switchgrass for biofuels. Without question, **switchgrass grown for biofuels can provide better wildlife habitat than non-native grasses if the switchgrass is managed with consideration for wildlife.** Field layout, timing of harvest, retention of wildlife cover, incorporation of forbs and developing quality food and cover resources around and within the field are all very important if enhancing wildlife habitat and a resulting increase in wildlife populations are landowner objectives.

References

Adler, P.R., M.A. Sanderson, A.A. Boateng, P J. Weimer, and H.G. Jung. 2006. Biomass yield and biofuel quality of switchgrass harvested in fall or spring. Agronomy Journal 98:1518–1525.

Barnes, T.G., A.L. Madison, J.D. Sole, and M. J. Lacki. 1995. An assessment of habitat quality for northern bobwhite in tall fescue dominated fields. Wildlife Society Bulletin 23:231-237.

Giuliano, W. and S.E. Daves. 2002. Avian response to warm-season grass use in pasture and hayfield management. Biological Conservation 106:1-9.

Guthery, F.S. 1997. A philosophy of habitat management for northern bobwhites. Journal of Wildife Management 61:291-301.

Harper, C.A., G.E. Bates, M.P. Hansbrough, M.J. Gudlin, J.P. Gruchy, and P.D. Keyser. 2007. Native warm-season grasses: identification, establishment, and management for wildlife and forage production in the Mid-South. University of Tennessee, Knoxville, TN. Extension PB 1752. 189 pp. (http://www.utextension.utk.edu/publications/wildlife/default.asp).

Palmer, W.E., S.D. Wellendorf, J.R. Gillis, and P.T. Bromley. 2005. Effect of field borders and nest-predator reduction on abundance of northern bobwhtes. Wildlife Society Bulletin 33:1398-1405.

Schacht, W.H., A.J. Smart, B.E. Anderson, L.E. Moser, and R.Rasby. 1998. Growth responses of warm-season tallgrasses to dormant-season management. Journal of Range Management 51: 442 – 446.

Tillman, D., J. Hill, and C. Lehman. 2006. Carbon-negative biofuels from low-inut high-diversity grassland biomass. Science 314:1598-1600.

Washburn, B.F., T.G. Barnes, and J.D. Sole. 2000. Improving northern bobwhite habitat by converting tall fescue fields to native warm-season grasses. Wildlife Society Bulletin 28:97-104.

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