Grasslands Partnership
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grasslandspartnership.org

Report No. 2023-6 October 2023

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Summary

This report, addressing perennial grassland buffer strips, is one of a set of seven describing practices supported by the Grasslands Partnership project. Perennial grassland buffer strips would be planted on edges of row crop fields on farms that also include pasture land. Preparation, species selections, planting, first and second year management are all addressed in the report. Additional resources are suggested for clarification.

PERENNIAL GRASSLAND BUFFER STRIP PRACTICE GUIDELINES

Introduction

This document provides guidance to Grasslands Partnership participants on the selection and implementation of perennial grassland buffer strips (i.e., field border/buffer/filter/birds/avifauna/pollinator strips) that will be planted on row crop fields. Perennial grassland buffer strips are one of the six practices supported by the Grasslands Partnership and offer multiple benefits for climate-smart livestock production, including supporting pollinators (which may in turn help increase crop yield), reducing nutrient and sediment runoff, sequestering carbon, providing enhanced habitat for at-risk birds, and even improving harvest logistics (e.g., by not getting stuck in low wet areas). These buffer strips will be planted to a high-diversity, native plant mix that includes grasses and forbs (including leguminous forbs) to ensure the greatest possible benefit**.** Native warm-season perennial grasses are included for their ability to store large amounts of carbon in the soil with minimal inputs and compete with invasive weeds typical to cropping systems. The recommended native forbs are included as ideal pollinator habitat. Some of the forbs will be legumes for their biological nitrogen fixation potential. The combination of species will provide ideal habitat for pollinators, birds, and overall ecosystem biodiversity.

Species Selection and Establishment Preparation

Species Selection

There are many species options for field buffer strip plantings, but all should include a base of native warm-season perennial grasses and regionally adapted native forbs. The three to four best options for native grasses include big bluestem, Indiangrass, little bluestem, and side oats grama. The options for forbs (including leguminous forbs) will be much broader depending on the region and microclimate of the site, but a minimum of 6 forbs will be required for all field border plantings. Basic suggestions include partridge pea,

This material is based upon work supported by the U.S. Department of Agriculture, under agreement number NR233A750004G086. Any opinions findings conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. In addition, any reference to specific brands or types of products or services does not constitute or imply an endorsement by the U.S. Department of Agriculture for those products or services.

desmodiums, lanceleaf coreopsis, oxeye sunflower, cup plant, purple coneflower, black-eyed Susan, and Maximilian sunflower. Other beneficial forbs to accomplish the goals for the project may include: a solidago species (e.g., showy goldenrod, tall goldenrod, giant goldenrod, seaside goldenrod, gray goldenrod); a monarda species (e.g., spotted beebalm, wild bergamot); and an early blooming species (e.g., penstemon species). At all sites it will be important to include 1-2 species that will establish under a range of conditions and provide early competition with weeds (e.g., blue mistflower). Since this project is over a 9-state range, the forb species listed above provide only a general framework and individual state coordinators will select the specific species based on local adaptation and preferences. Note: lowland switchgrass and eastern gamagrass are not in the preferred list of native grasses since they do not combine as well with forbs and can be overly competitive (especially switchgrass), but in waterlogged or frequently flooded areas of a field these could be considered. Some states may choose to include native wildryes into their seeding mixture, but due to the competitiveness and short lifespan of these species they should never be more than 10% of the native grass component (eg. – Canada wildrye; Virginia wildrye; Riverbank wildrye).

Seed Characteristics

Because of long and fluffy awns of grasses like big bluestem, little bluestem, and indiangrass, it will be important to use a drill equipped with a specialized "native grass box," with the exception when broadcast seedings are used on tilled soil. If a no-till drill with a native grass seedbox is not available, then blending seed with kitty litter, pelleted lime, cracked corn, soy meal or other carrier will improve flow rate through the drill. The seeding rate for field borders should be at least 40 pls/ft^2 or 4-5 lbs pure live seed (PLS) of native grasses plus 4-8 lbs PLS of forbs (combined) per acre. Note: the ideal drill will have a native seed box and another box suitable for forbs, since the forb seed may "run right through" the larger opening gaps necessary for native grass seed.

Cultivar Selection

Ideally, when selecting cultivars, choose ones with an origin close to the planting site. Those from farther south than the planting site will normally perform better than those from substantially (greater than 200 miles) farther north. On the other hand, southern origin plant material moved too far north has increased risk of winterkill. With some species, limited availability of local ecotypes may dictate cultivar choice, but all collaborators should ensure that the cultivars in their chosen seed mixture will survive the climatic conditions of the region where they are planted.

Site Selection

Buffer strips should only be planted into fields that have been planted to annual crops for at least the past three years. The cropping system can be either tilled or no-till. Ideal sites are those where the potential for significant weed pressure is low. When planting into fields with a long history of no-till crop production, care should be taken to avoid sites known to have herbicide-resistant weeds, unless there is a clear strategy to deal with these problem weeds prior to planting. Ideal locations are those where the crop yield has been marginal over time due to soil type or texture, drainage limitations, and other considerations. In fields where dicamba-resistant soybeans will be planted, it is important that precautions are taken to reduce drift that may injure or kill forbs. Note: Buffer strips can be planted

around any cropped fields, including annual hay/silage fields (e.g. – silage corn, sorghum-sudangrass, cereals for silage, etc.).

The minimum size for field border plantings is 60 feet wide and no smaller than 1.5 acres (i.e. - 60' x 1089' = 1.5 acres; 100' x 653 = 1.5 acres; etc.). This acreage can be a combination of more than one field. The border can narrow to less than 60 feet if required to "square up" a tree line, but the average width should be at least 60 feet..

Seedling Year Fertility Management

As long as levels of phosphorous and potassium are not in the "low" range per soil test, there is no need to amend soils. Native grasses and forbs not only can tolerate moderate fertility, but lower fertility sites are helpful for reducing / not encouraging annual weed species. Do not add any supplemental N either prior to or following planting during the seedling year as this can enhance weed pressure. Native grasses and forbs are not as sensitive to acidic soils as many other common forage grasses, therefore pH levels above 5.0 are usually sufficient for successful establishment.

Controlling Competition from Weeds Prior to Planting (Table 1)

Native grasses and forbs are often slow to germinate and have slow initial aboveground growth as they put most of their energy into growing strong root systems during their early development. Therefore, it is critical to reduce competition prior to planting and to continue to reduce weed competition post-planting. Ideally, choose sites for buffer strips that are not expected to have severe weed issues.

If the chosen buffer strip area has a history of warm-season annual grass weeds (e.g. - crabgrass, foxtails, broadleaf signalgrass, etc.) they should be controlled prior to planting. One option is to use a summer crop rotation the year prior to seeding or a cover crop over winter. Another strategy is to allow the initial flush of these warm-season annual species to occur and then apply 1.0-1.5 quarts of glyphosate per acre or a grass-specific herbicide (e.g., clethodim products) once these annual seedlings are 3-4 inches tall. In fields where severe pressure from annual grasses is expected, consider allowing a second flush of these weeds followed by a second herbicide application prior to planting. This will obviously delay the planting date, but it is best to plant into a weed-free seedbed.

If annual grasses are not expected to be a problem, then one burndown spray of glyphosate or gramoxone will likely be the only pre-plant weed control needed before establishing the buffer strip mixture. That is, unless tillage is the desired pre-plant weed control.

Herbicides containing imazapic (Plateau, Panoramic and Impose) provide very good control of many of the most problematic grassy weeds and can be used prior to establishment and on newly established stands of native grasses (i.e. - big bluestem, little bluestem, Indiangrass, and sideoats grama) with many of the recommended forbs. If using imazapic pre-plant, it is essential that all forbs in the seed mixture can tolerate this product (Table 2). It is best to use boom sprayers for uniform application. This will reduce skips and/or overlap of the spray that can occur with boomless sprayers (Note: A double application of imazapic in an overlap strip will often damage desired species). In addition, collaborators will need to be especially cautious of potential drift and/or overspray to their row crops when applying herbicides to buffer strips. It is essential to check previous cropland herbicide use since some products

require waiting up to 18 months before seeding native grasses and forbs. See chart for herbicide residue guidelines for Kentucky and surrounding states (https://weedscience.ca.uky.edu/files/crop_replant_and_rotat.pdf).

Table 1. Application rates, timing restrictions and classes of weeds controlled for herbicides labeled for use in native warm-season grass and forb mixtures during establishment.

Active Ingredient	Herbicide	Rate per acre	Timing Restrictions	Weeds Controlled[1]
Glyphosate	Roundup	1-4 qts	PRE, dormant post	BL, G
Paraquat	Gramoxone	1-4 pts	PRE, dormant post	*BL*, G
Imazapic	Plateau, Impose, Panoramic	2-6 oz.	PRE, Established[2]	*BL, G*

Note: Check label to ensure it is recommended for the species of native grass(es) and forbs in the planting.

[1] BL=broadleaf, G=grass. If italicized, control is very selective or marginal.

[2] Check the label closely since many forbs will not tolerate imazapic post-establishment and several will not tolerate it pre-establishment.

Table 2. Information on establishing native forbs and legumes including imazapic tolerance for pre- and post-establishment applications.

					Seeding rate (lb/ac)			
Category	Species	Latin name	Seeding time	Perennial	Blend	Single species	Establishment	Imazapic tolerance
Forbs	Canada goldenrod	Solidago canadensis	Dormant or Spring	Yes	0.1	0.5	Poor	None
	Cup plant	Silphium perfoliatum		Yes	0.3-0.5	10.0	Fair	None
	Maximilian sunflower	Helianthus maximiliani	Dormant or Spring	Yes	0.3-0.5	5.0	Fair	None
	Oxeyesunflower	Heliopsis helianthoides		Yes	0.2-0.5	10.0	Good	None
	Prairie dock	Silphium terebinthinaceum		Yes	0.3	4.0	Poor	None
	Purple coneflower	Echinacea purpurea		Yes	0.3-0.5	8.0	Good	PRE and POST[1]
	Plains Coreopsis	Coreopsis tinctoria		Annual	0.2-0.5	4.0	Good	PRE and POST[1]
	Lanceleaf coreopsis	Coreopsis lanceolata		Yes	0.2-0.5	4.0	Good	PRE and POST[1]
	Upright prairie coneflower	Ratibida columnifera	Spring	Yes	0.2-0.5	2.0	Good	PRE and POST[1]
	Black-eyed Susan	Rudbeckia hirta		Biennial	0.2-0.5	2.0	Good	PRE and POST[1]
Legumes	Illinois bundleflower	Desmanthus illinoensis		Yes	0.5-1.0	8.0	Good	PRE and POST
	Partridge pea	Chamaecrista fasciculata		Annual	0.5-1.0	12.0	Good	PRE and POST
	Purple prairie clover	Dalea purpurea		Yes	0.5	3.0	Poor	PRE and POST
	White prairie clover	Dalea candida		Yes	0.5	3.0	Poor	PRE and POST
	Panicledleaf ticktrefoil	Desmodium paniculatum		Yes	0.5-1.0	6.0	Fair	POST only
	Showy ticktrefoil	Desmodium canadensis		Yes	0.5-1.0	6.0	Fair	POST only
	Dixie trefoil	Desmodium tortuosum		Yes	0.5-1.0	6	Fair	POST only
	Roundhead bush clover	Lespedeza capitata		Yes	0.3-0.5	3.0	Poor	POST only[2]
	Slender bush clover	Lespedeza virginica		Yes	0.3-0.5	3.0	Poor	POST only[2]

[1] Some posible damage has been observed on POST applications for these species

[2] Label does not include all Desmodium and Lespedeza species, but those that are included on label have tolerance.

Planting

Native grasses and forbs can be effectively established by either no-till or conventional methods. In both cases, the key to success is ensuring a firm seedbed with a minimum amount of thatch and weed competition. Competition control is the single most important factor in successfully establishing native grasses and forbs. Therefore, care must be taken to ensure that competition control has been conducted thoroughly regardless of which establishment approach is chosen.

No-till Establishment of Native Grasses

Manage the existing crop residue or weed growth by mowing to remove excessive cover or thatch prior to seeding. If crop residue is excessive then it should be burned or baled off the field. Excessive residue is generally only a problem with corn grain or cereal crops laying on the soil surface. Undisturbed residue may impede establishment by preventing good drill penetration or by poor seed-to-soil contact when residue is pushed into the drill row. Regardless of the no-till drill used, make sure that the front coulters or the double disk planting disks are able to “cut through” the existing sod during planting.

Establishing Native Grasses Using Conventional Seedbeds

A critical issue when using tillage for native grass and forb buffer strips is ensuring that the seedbed is fine textured and firm. A good rule of thumb is that the imprint of your boot should be no more than one-quarter inch deep (Figure 1). To achieve this firmness, you may need to use a cultipacker, possibly making two or more passes, prior to seeding. Allowing rainfall to firm up the tilled ground may also be effective.

Figure 1. Well-prepared seedbed: The soil should be so firm that your boot sinks no deeper than ¼”.

Conventional seedbeds allow use of conventional drills, drop-type seeders, cyclone-type broadcast spreaders and even no-till drills (which may need to be adjusted to keep them from planting too deep in the absence of a sod). However, when broadcast sowing, increase the seeding rate by 25 percent over the standard rate. Cross-seeding (at a 90-degree angle) is used to ensure a more uniform distribution of seed, but this will be difficult with approximately 60’ wide buffer strips. A more practical method to improve distribution is blending the seed with a carrier as discussed above.

Planting Depth

Target depth for native grasses and forbs is ⅛ to ¼ one-quarter inch (and never below ½ inch). Achieving these shallow planting depths reliably will require careful attention to drill settings. A good rule of thumb is that when you walk behind a drill, you should see seed visible on top of the ground over about 15-20% of the length of the drill rows. Broadcast sowing will keep seed shallow — as long as the seedbed is firm — but typically will require covering the seed with a cultipacker or very light drag to ensure good soil coverage.

Seeding Rates

Seeding rate for the native grass/forbs is a minimum of 40 PLS seed ft^2 or 4-5 PLS lb/acre grass and 4-8 PLS lb/acre forbs.

Seeding Dates

Native grass and forb seed generally begin to germinate at soil temperatures above 60°F with more rapid germination at soil temperatures above 65°F. Traditional planting dates for native species in the eastern United States is when soil temperatures have warmed and after the risk of frost. In other words, from March 15 through May 15 depending on climatic zone.

Seeding can be successful across a wide range of dates though, from January through early July, as long as soil moisture is adequate. Early seedings may be helpful when seedlots of the species to be planted have high dormancy levels (which is common for certain forbs and grasses like little bluestem). When seeding no-till, a burndown spray using a broad-spectrum herbicide is important. Gramoxone is effective at temperatures above 32°F, but for glyphosate burndown it is important that weeds have begun active growth before spraying (typically 45-50°F daytime temperatures). Note: With early planting dates, the seed "sits" in the soil until the soil temperature is adequate for germination, but once the native species germinate weed control with broad spectrum herbicides is not an option.

Although successful stands have been established with seeding dates as late as early-July in the transition zone, such late plantings are riskier with limited soil moisture being the main concern. However, if you have a high-quality seedbed and are prepared to plant at this time of year, it can be successful with sufficient soil moisture, favorable weather patterns, and low seedlot dormancy.

The wide range of acceptable seeding dates underscores the importance of planting when soil moisture is good but also when weed competition has been controlled adequately. Put another way, do not get into a rush to plant. Instead, wait to plant until you have done a thorough job of weed control.

Follow Up During the Seedling Year

During the seedling year, it is critical to control weeds that form a canopy above the native grass/forb seedlings. Clipping/mowing above the seedlings is often the best way to control these weeds and can be initiated 6-8 weeks after planting if the soil is firm. This is especially true with mixed grass/forb plantings since herbicide options are severely limited. When the weed canopy is above the canopy of the desired species, using a low-drift wick applicator to apply herbicides can be an option. By mid- to late August, unless weed problems are especially severe, it is better to avoid defoliating the native grass/forb

seedlings and allow them to conserve their energy for winter survival. A good rule of thumb is that native grasses should be allowed to develop to the tillering stage before going dormant.

Evaluating Success

A plant population of at least one plant per square foot is the target. The size of the seedlings does not matter the first season as long as they are present. If the grasses have tillered and the forbs have well-established root systems, they will survive the first winter and produce a good stand. For stands less than one plant per square foot, the project will reserve funding for a replanting, as long as land owner has done "due diligence" during planting and maintenance.

Because native grasses and forbs may not germinate in any appreciable numbers for three to five weeks after planting (or, in the case of dormant-season plantings, after soil temperature thresholds have been reached), do not be concerned during the early stages of establishment. Check the field at the four to five-week mark and again over the next two to three weeks to determine what sort of stand is developing. Seedling numbers should increase during this period (i.e., four to seven weeks post-planting) and, if all goes well, by the eighth week clear drill rows should be apparent. Many producers have given up too quickly on perfectly good stands because they are not prepared for slow germination and the small initial size of the seedlings.

Second-year Management

Native grasses and forbs planted for buffer strips are normally well established the second spring (i.e., approximately 12-13 months after planting). However, weed control measures may be needed in March (e.g.-dormant season glyphosate spray) or April/May (e.g.-clipping to reduce weed competition). The dormant-season glyphosate spray is especially effective as weed control for dormant warm-season grasses, but if forbs are in a rosette stage they may be killed.

Application of N during the second year is usually not needed for grass/forb buffer strip plantings. Nitrogen at green-up will boost production of native grasses, but typically these species are already well established and do not need the added growth. In addition, taprooted forbs in buffers around crop fields are usually able to extract sufficient N for competitive growth and leguminous forbs fix their own nitrogen. In addition, second year N often has the unwanted result of encouraging weedy species and may cause the grass component of the planting to become dominant and suppress the forbs.

Management in Years 3-5

Continued management will be required during the 3rd, 4th and 5th year of the stand. This is not only important for successful project completion, but to ensure that the field border will be sustainable for years after the project has ended. Many native grass and forb species rely on occasional disturbance to help reduce competition from other plants species that may move into the stand. The main competition source in established field borders are trees. After the establishment period in the first two years following planting, a disturbance regime will be required to keep trees out of the stand. Aside from the techniques listed below, it will be essential to monitor invasive tree establishment and reduce or eliminate invasive trees (e.g. – tree of heaven [*Ailanthus altissima*]) using spot spraying or other

techniques, since these species may be able to grow more quickly than a beneficial disturbance cycle can keep up with.

Mowing during the dormant period will be one of the easiest and most effective methods for stand maintenance. Mowing the field border at least every two to three years will be a frequent enough cycle to reduce woody growth without having a negative impact on grass and forb species. A mowing height of no less than 6 inches is required to minimize any effect on planted species. Disking is also an option for maintenance. A light disking every three years will encourage forb growth and keep grasses from becoming too thick.

Some buffer strips may be amenable to prescribed burning. Prescribed fire has been used to maintain open lands throughout the southeast since before European settlement. Our native grass and forb species are fire tolerant or even fire dependent. Dormant-season burning helps remove thatch produced during the growing season, allowing the soil to warm earlier in the spring and provide better conditions for warm-season grasses. Late-growing season burns can stop woody encroachment and promote forb growth.

Monitoring the Stand

Stands will be monitored for species composition and stand density by Extension/University staff in each state. Species composition will be determined using the step point or modified step point method during green-up each spring. Stand density will be monitored by counting plants of each species group within small quadrats (approx. 3 sqft) in late summer in years 1 and 2 to ensure successful establishment. Pollinator use and songbird habitat will be monitored by a collaborating partner, Monarch Joint Venture, and staff from the University of Tennessee, respectively.

Additional monitoring of pollinating insects using transects or traps could be undertaken in collaboration with the farm operator, Extension, and other partners. Traps can provide an opportunity for precise species identification and exact count of individuals. Sampling plots and transects require insect identification in the field but may provide more information about types of pollinators associated with plant species in the field border.

It will be important to collect baseline data for all species of interest. Baseline data will be collected using the same methods employed for sampling following field border plantings. Collecting species occurrence data prior to planting will allow us to determine if implementing field borders influences species richness and occupancy and may provide insight to the amount of time it takes wildlife species to show a response to conservation practices.

Summary

Native grass and forb mixtures for cropland buffer strips require attention to detail for successful establishment. Competition control is the single biggest challenge. Be prepared to select sites that are likely to have less weed pressure, begin weed control measures in the summer or fall prior to the expected seeding date, and continue to address weed canopies through the summer of the seeding year. Whether using tillage or no-till establishment, plant seeds into fine, firm, clean seedbeds at ⅛- to

¼-inch depth. All of these are issues that can be handled simply by paying attention to the process and being timely in implementation. Weather is easily the other biggest factor in determining the success of a planting project. Drought or excessive rainfall are problems, but in both cases, are out of our control. Fortunately, most native grasses and forbs are more resilient to extreme weather events than introduced species.

Additional Resources

CROP REPLANTING AND ROTATION GUIDE FOR KENTUCKY AND SURROUNDING STATES. https://weedscience.ca.uky.edu/files/crop_replant_and_rotat.pdf

The specific pollinator species chosen in each state will depend on adaptation and pollinator preference. Here is an example of a publication from the University of TN. PLANTING FOR POLLINATORS IN EAST TENNESSEE https://extension.tennessee.edu/publications/Documents/W1095.pdf

More details can be beneficial such as this illustrated publication from NC. CONSERVATION BUFFERS: DESIGN GUIDELINES FOR BUFFERS, CORRIDORS, AND GREENWAYS https://www.fs.usda.gov/nac/buffers/docs/conservation_buffers.pdf

Another potential useful and thorough resource. RENOVATING NATIVE WARM-SEASON GRASS STANDS: A LAND MANAGER'S GUIDE https://extension.tennessee.edu/publications/Documents/PB1856.pdf

As this practice is being implemented, it will be very important to show the benefits of buffer strips to our collaborators and the general public. One example of the types of media we will be developing is show in this Kellogg's video on pollinator strips around fields (https://www.kelloggs.com/en_US/articles/sustainability/pollinator-strips.html#:~:text=Pollinator%20strips%20are%20often%20placed,soils%20healthy%20and%20water%20clean).