NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATIVE BARRIER

(Ft.)

CODE 601

Switchgrass (*Panicum virgatum*) vegetative barrier study at Jamie L. Whitten Plant Materials Center, Coffeeville, MS.

DEFINITION

Permanent strips of stiff, dense vegetation along the general contour of slopes or across concentrated flow areas.

PURPOSE

- Reduce sheet and rill erosion.
- Reduce ephemeral gully erosion.
- Manage water flow.
- Stabilize steep slopes.
- Trap sediment.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all eroding areas, including but not limited to: cropland, pastureland, rangeland, forestland, farmsteads, mined land, and construction sites.

This practice applies only when used in conjunction with other conservation practices as part of a conservation management system.

CRITERIA

General Criteria Applicable to All Purposes

Physical Characteristics of Plants.

Stiffness Index. Vegetation used in vegetative barriers need to have the minimum Vegetation Stiffness Index (VSI) designated in Table 1 measured at a point 6 inches above the ground. The VSI values reflect the importance of large stems in keeping barriers upright during runoff events.

Table 1. Stem Diameter and Minimum Stem Density Values for Vegetation Stiffness Index (VSI) Values of 0.05 and 0.10.

Stem Diameter	Concentrated Flow Areas (VSI = 0.1)	Other Purposes (VSI = 0.05)
--Inch--	------------Stem density/ sq ft-------------	
0.10	1000	500
0.15	200	100
0.20	60	30
0.25	30	15
0.50	20	10
≥1.00	1.0	1.0

Density. By the end of the first growing season, gaps between plants need to be ≤3 inches.

Species Selection. Species must be adapted to local soil and climate conditions, be easily established, long-lived, and manageable. Select species that exhibit characteristics that are required for adequate function. Desirable characteristics include the ability to emerge though several inches of sediment or resume growth from buried stem nodes, have a rhizomatous or stoloniferous growth habit, and have stems that remain intact and erect year round. Examples of grass species that might be used in Florida include switchgrass (*Panicum virgatum*), eastern gamagrass (*Tripsacum dactyloides*), and coastal panicgrass (*P. amarum* var. *amamarulum*).

Do not plant any species found on the Florida Dep. of Agriculture and Consumer Services or the Florida Dep. of Environmental Protection noxious or prohibited weed lists. Additionally, do not plant any species listed as a Category 1 invasive species by the Florida Exotic Pest Plant Council (see FOTG Section I [f] [4]).

Consult the Florida Plant List for Conservation Alternatives [FOTG II (G)] for approved herbaceous and woody species for use in Florida. Other plant material not found on the list may be suitable, but they need to be approved by the Plant Materials Specialist before use.

Establishment of Vegetative Barriers.

Barriers may be established vegetatively or from seed.

Use seeding dates, depths, and rates appropriate for the species selected and the conditions of the site. Plant seeds to insure good seed-to-soil contact, and pack area after planting.

Plant vegetatively established barriers in a single row at a dense enough spacing to insure a functional barrier in one growing season. For most herbaceous species, this will require a spacing of no more than 6 inches for bare-root seedlings, cuttings, sod chunks, plugs, rhizomes, or divisions consisting of no less than 5 viable stems. Use a maximum spacing of 12 inches between plants when planting suckering shrubs or herbaceous species in 6-inch (gallon) pots or equivalent container.

Use whatever site preparation and planting date is necessary to ensure seed germination or vegetated material establishment. If transplants are used, plant in a manner that produces good root-to-soil contact and pack around plants after planting.

See Florida Conservation Practice Standards Tree/Shrub Establishment, Code 612, and Critical Area Planting, Code 342, and their accompanying guidance for more information on site preparation and planting dates.

Appropriate temporary measures, such as erosion control blankets, silt barriers or mulches, need to be used, as appropriate, during the establishment period.

<u>Barrier Alignment.</u> Remove obstructions, such as trees and debris that interfere with vegetative growth and maintenance, to improve vegetation establishment and alignment.

<u>Barrier Width</u>. Barrier widths need to be at least 3-feet wide or 0.75 times the design vertical interval, whichever is larger. Broadcast or drilled seed need to be sown in a strip at least 3-feet wide. When a row planter is used, a minimum of 2 rows needs to be sown.

Comply with applicable federal, state and local laws and regulations during the installation, operation, and maintenance of this practice.

Impact to cultural resources, wetlands, and Federal and State protected species shall be evaluated and avoided or minimized to the extent practical during planning, design and implementation of this conservation practice in accordance with established National and Florida NRCS policy, General Manual (GM) Title 420-Part 401, Title 450-Part 401, and Title 190-Parts 410.22 and 410.26; National Planning Procedures Handbook (NPPH) FL Supplements to Parts 600.1 and 600.6; National Cultural Resources Procedures Handbook (NCRPH); and The National Environmental Compliance Handbook (NECH).

Additional Criteria for Reducing Sheet and Rill Erosion

Erosion reduction by barriers is achieved by diverting flow, which reduces slope length (RUSLE “L”), and/ or through the supporting practice factor (RUSLE “P”) for contouring and permanent buffer strips.

<u>Gradient.</u> Gradients along the barrier need to be between 0.2 and 1.0 percent, except where the vegetative barrier crosses concentrated

flow areas. Gradients entering a concentrated flow area may up to 1.5 percent for 100 feet in order to get better row alignment.

Perform all tillage and equipment operations in the interval between barriers parallel to the vegetative barrier.

A berm and/or a channel on the upslope edge of the barrier is necessary to redirect flow and reduce slope length. This berm and/or channel may be allowed to naturally develop at the upslope edge of the barrier as a result of tillage operations or they can be constructed. Minimum berm height/channel depth needs to be 3 inches or as high/deep as required by local conditions. These berm/channels may be created by normal tillage operations along the edge of the grass, but will not form in no-till situations and will need to be created. Where berm/channels are used, a stable conveyance system for control of concentrated runoff must be used in flow areas that receive diverted runoff.

Spacing. Base horizontal spacing between the vegetative barriers on a vertical interval of no more than 6 feet or the allowable "L" that achieves soil loss tolerance in RUSLE considering the planned practices in the conservation management system.

Plan crop strip width on the multiples of widths from planting, tillage, spraying and harvest equipment. This spacing may be adjusted up to 10 percent between the barriers.

Vegetation. Use species that will provide the designated minimum stem density with the designated stem diameter and have a vegetation stiffness index (VSI) of 0.05. See Table 1.

Additional Criteria for Reducing Gully Erosion

Alignment. Many fields have too much undulation to allow alignment on the contour across a concentrated flow area at angles convenient for the operation of farm equipment. In such cases, vegetative barriers may be installed across concentrated flow areas perpendicular to the direction of water flow. Vegetative barriers, when used to control ephemeral erosion, do not need to extend across the ridge top where water does not flow into the vegetative barrier.

Width and Length. Vegetative barriers need to be a minimum of 2 rows wide, and length will vary depending on the topography. As a minimum, each strip needs to extend far enough to provide 1.5 feet of elevation from the center of the flow area to the end of the vegetative barrier (Fig. 1). To adequately treat pre-existing headcuts along the ephemeral, place one row of a barrier at the bottom of the headcut and the other row at the top.

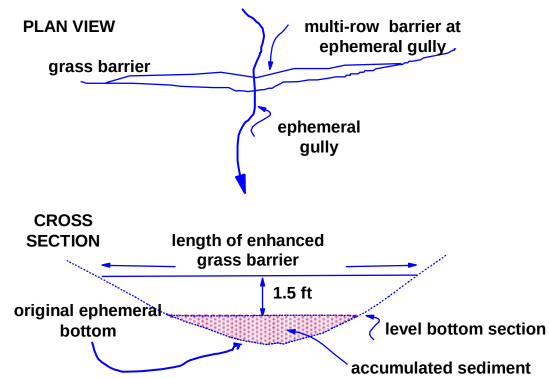

Figure 1. Two row barriers in concentrated flow areas must extend long enough to avoid bypass around the ends at high flow.

Spacing. This practice functions by having backwaters from one barrier extend up to the base of the next barrier up slope. This backwater dissipates energy and causes sediment deposition in the gully channel.

Spacing between the vegetative barriers needs to be based on the vertical interval of 1.5 feet for conditions where no tillage is performed between the barriers. For all other conditions where sediment deposition and bench development is anticipated vertical interval needs to be 3 feet.

Adjustments of 10 percent in the width of the crop strip between the barriers is allowed for wildlife habitat or maintenance concerns. Crop strip width needs to be based on multiples of widths of planting, tillage, spraying, and harvesting equipment.

Minimum Level Bottom Section Length. The minimum level bottom section length (in feet) needs to be numerically equal to the peak discharge (in cfs) for a 2-year, 24-hour design storm from the total watershed upslope of the lowest barrier. This equates to a specific discharge of 1 cfs/ft vegetative barrier. Level bottom section is defined as the bottom width of a trapezoidal waterway. This can be shaped during construction or formed by sediment deposition. See Fig. 1. Use methods in Chapter 2, Engineering Field Handbook to estimate peak discharge for local soil, climate, and management conditions.

If the channel does not have a level bottom section, the peak discharge for a 2-year, 24-hour storm cannot create velocities through the barriers greater than allowable for the soil, vegetation, and slope conditions as determined using Chapter 7 of the Engineering Field Handbook.

Vegetation. Use species that will provide the designated minimum stem density with the designated stem diameter and have a vegetation stiffness index (VSI) of 0.10. See Table 1.

Additional Criteria for Managing Water Flow

For this purpose, barriers are designed to slow runoff by increasing path length. Also barriers function by retarding and spreading run-on water for subsequent treatment within filter strips and flow channels to remove contaminants by ponding, filtration, infiltration, and exposure to sunlight.

Gradient. In order to divert flow, gradients along the barrier need to be between 0.2 and 1.0 percent, except where the vegetative barrier crosses a draw (a concentrated flow area). Gradients entering a concentrated flow area may be up to 1.5 percent for 100 feet in order to get better row alignment.

In order to redirect flow, a berm and/or a channel on the upslope edge of the barrier is necessary to redirect flow and reduce slope length. This berm and/or channel may be allowed to naturally develop at the upslope edge of the barrier as a result of tillage operations or they can be constructed. Minimum berm height/channel depth needs to be 3 inches or as high/deep as required by local conditions. These berm/channels may be created by normal tillage operations along the edge of the grass, but will not form in no-till situations and need to be created.

Width and Length. Vegetative barriers can consist of 1 or 2 rows, but can be wider to adjust for planter and/or sprayer width, or for improved contour alignment. Vegetative barrier length will vary depending on the topography. At a minimum, each strip needs to extend far enough from concentrated flow areas to provide 1.5 feet of elevation from the center of the flow area to the end of the vegetative barrier (Fig. 1).

Spacing. Horizontal spacing between the vegetative barriers intended to redirect runoff is determined based on a vertical interval of no more than 6 feet or the allowable “L” that achieves soil loss tolerance in RUSLE considering the planned practices in the conservation management system, whichever is lesser.

For barriers intended to retard and spread run-on, the maximum vertical interval needs to be 1 foot.

Crop strip width will be planned in multiples of widths of planting, tillage, spraying, and harvest equipment. This spacing may be adjusted up to 10 percent between the barriers.

Maximum Watershed. The total watershed in a vegetative barrier system needs to be the smaller of a) the size that will provide runoff to impound 1 foot of water upslope of the lowest barrier in the system, or b) the size that will generate velocities greater than allowable on bare soil for the soil texture in the concentrated flow area as determined in Chapter 7 in the Engineering Field Handbook.

Vegetation. Use species to provide the designated minimum stem density with the designated stem diameter and have a vegetation stiffness index (VSI) of 0.05 for areas diverting runoff and VSI of 0.1 for areas retarding and ponding runoff. See Table 1.

Additional Criteria for Stabilizing Steep Slopes

Vegetative barriers can be used to stabilize steep slopes if they are used in combination with other bioengineering principles. Concentrated flow channels are not acceptable on the slope face.

Alignment. Install the barrier on the contour. However, if overland water flow is expected down the slope face, the barrier alignment may deviate from the contour up to a grade of 2% to divert water.

Spacing. Horizontal spacing between the vegetative barriers needs to be the spacing that results in a vertical interval of no more than 6 feet. However, if overland water flow is expected down the slope face, the vertical interval of the barriers needs to be reduced to no greater than 4 feet.

Vegetation. Use deeply rooted species that establishes easily and grows rapidly.

The vegetation stiffness needs to provide the designated minimum stem density with the designated stem diameter and have a vegetative stiffness index (VSI) of 0.05 based on Table 1.

Maximum Watershed. No maximum watershed size is given as criteria for this purpose. If, however, concentrated flow occurs on the steep slope, mitigation practices, such as a terrace or diversion, must be installed to eliminate the concentrated flow.

Additional Criteria for Trapping Sediment at the Bottom of Fields and/or the Ends of Furrows

Barriers intended only to trap sediment at the end of fields will not be credited with additional in-field erosion reduction credit. Thus, sediment trapping barriers are used at the edge of the field or end of furrows already within soil loss tolerance. They will effectively reduce sediment delivery to surface water down slope of the barrier and are desirable additions to conservation management systems.

Alignment. Vegetative barriers may be used as field buffers at the bottom of fields and/or the ends of furrows whether the furrows are aligned up and down the slope, across the slope, or on the contour.

Width. Vegetative barriers used as field buffers need to be a minimum of 3 feet wide. There is no maximum crop strip width or slope length.

CONSIDERATIONS

During the planning process, consider the following:

General Considerations

Management practices such as conservation cropping rotation and residue management must be considered in designing the conservation management system on cropland.

Associated structural practices such as water and sediment control basins, subsurface drainage, and underground outlets must be considered to adequately handle surface and subsurface water.

This practice may improve the efficiency of other practices such as stripcropping, filter strips, riparian forest buffers, grassed waterways, diversions, and terraces.

On tilled fields, consider soil profiles that have sufficient depth to retain productivity where benches will develop as soil is moved down gradient by tillage. Soil upslope of barriers will gradually build up while soil will be removed down slope of the barrier. This effect needs to be considered with respect to soil depth, subsoil characteristics, and response to amendments.

Evaluate soils in the area of the fields where barriers are being established for their potential to create field access problems by ponding water behind the barriers. Subsurface drains perpendicular to or along the length of the barrier may improve drainage of the area upslope of the barrier.

Consider the effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water discharge.

Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by the runoff.

Consider the potential for development of saline seeps or other salinity problems resulting from increased infiltration in soils that have restrictive layers.

Consider the potential for uncovering or redistributing toxic materials such as saline soils.

Consider increasing the minimum width of the barrier to increase potential for carbon sequestration.

Wildlife Habitat

Consider the effects on wetlands and water related wildlife habitats.

Consider the effects on the availability of food, nesting and escape cover.

Economics

Consider the effects on the production of crops in adjacent fields from shading and competition for water and nutrients.

Consider the impact of land taken out of production and occupied by the vegetative barriers.

Considerations to Enhance the Functioning of Other Practices

Field Stripcropping and Contour Buffer Strips. These strips are similar to vegetative barriers except they are wider, do not have as strict alignment criteria, and require sediment accumulations to be periodically removed and redistributed on the land. Vegetative barriers established with field strips where they cross concentrated flow areas could reduce the failure of field strips caused by concentrated flow. Locate barriers used in association with field strips and contour buffer strips immediately upslope of these practices.

Filter Strips. Vegetative barriers incorporated into the upslope portion of filter strips will increase filter strip longevity by promoting sediment deposition above the filter strip. Locate barriers used in association with filter strips immediately upslope of and/or periodically within the filter strip.

Field Borders. Vegetative barriers incorporated into the upslope portion of field borders at the bottom of slopes will increase field border longevity by promoting sediment deposition above the field border. Vegetative barriers also will provide additional wildlife cover in borders of predominantly sod-forming grasses. Locate barriers used in association with field borders immediately upslope of the field border.

Riparian Forest Buffers. Vegetative barriers could be used on the upslope edge of the vegetation zones. Locate barriers used in association with riparian forest buffers immediately upslope of zone two or zone three of the buffer (see Florida Conservation Practice Standard Forest Riparian Buffer, Code 391). Consider shading effects on vegetative barrier growth when selecting species.

PLANS AND SPECIFICATIONS

Plans and specifications need to include:

1. Field map with location of vegetative barriers.
2. Width of crop strip.
3. Vegetative barrier and crop strip orientation.
4. Width of barrier.
5. Vegetative species and cultivar.
6. Vegetation establishment date, seeding rate, or vegetation spacing.
7. Guidance for operation and maintenance.

OPERATION AND MAINTENANCE

Carry out the following actions to insure that this practice functions as intended. These actions include normal activities in the application and use of the practice and repair and maintenance of the practice.

1. Reseed or replant establishment failures reseeded immediately; short gaps in seeded barriers may be reestablished more effectively and immediately with transplanted plant material.
2. Mowing of herbaceous barriers may be used as a management practice to encourage the development of a dense stand and prevent shading of crops in adjacent fields. Do not mow closer than 15 inches or the recommended height for the species, whichever is taller. Schedule mowing to coincide with access through crops in adjacent fields. Mowing in concentrated flow areas is discouraged

because it will lower the vegetative stiffness index (VSI) by reducing average stem diameter.

3. Burning of herbaceous barriers may be used as a management practice, based on a case by case analysis, to encourage the development of a dense stand and prevent the accumulation of residue in the barrier. Perform burning when the vegetation is dormant and with adequate supervision to prevent the fire from damaging surrounding areas. A controlled burn plan is required. Refer to Florida NRCS Conservation Practice Standard Prescribed Burning, Code 338, for more information.
4. Use mowing or by spraying or wick application of labeled herbicides to control weeds.
5. Use vegetation in the barrier that is tolerant to or protected from herbicide used in the cropped field.
6. Perform crop tillage and planting operations parallel with the vegetative barrier.
7. Pest control in adjacent fields needs to be performed with techniques and pesticides that will not damage the vegetative barrier. Refer to Florida NRCS Conservation Practice Standard Pest Management, Code 595, for more information.
8. Fill and replant washouts or rills immediately. Reestablish short gaps in established barriers with transplanted plant material.
9. Do not use vegetative barriers as a field road or turn row. Do not cross vegetative barriers in concentrated flow areas with machinery.
10. Do not cross vegetative barriers with water furrow plows or similar implements to cut drainage ditches to allow the passage of surface and subsurface water. If necessary, drain water with underground outlets installed up gradient of the barrier.

REFERENCES

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