Vegetative Barriers

For

Erosion Control

Kika de la Garza Plant Materials Center

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I. INTRODUCTION

Vegetative barriers or grass hedges are currently being evaluated as an alternative conservation practice. Vegetative barriers are narrow strips (1-3 feet wide) of stiff, erect densely growing plants, usually grasses, planted across the slope perpendicular to the dominant slope.

Over forty years ago, the USDA-Soil Conservation Service referenced the use of vegetative barriers in an agriculture handbook on conservation. (USDA-SCS, 1954) More recently, the World Bank has promoted the use of vetiver grass (Vetiveria zizanioides (L) Nash) as a hedge against erosion (NRC, 1993).

The main purpose of vegetative barriers is to:

1) Retard and reduce surface runoff by promoting detention and infiltration.

2) Disperse concentrated flow and prevent ephemeral gully development.

Secondary benefits that sometimes can be realized are:

1) Entrap sediment-borne and soluble contaminants and facilitate their transformations.

2) Reduce soil loss by causing deposition of eroded sediment on hill slopes.

3) Facilitate benching of sloping topography.

4) Provide valuable wildlife habitat.

II. CONCEPT OF USE

Erosion, whether caused by wind or water, accounts for the loss of tons of soil every year. Gully erosion is the most obvious form of erosion with the deep down-cutting of the soil profile. However, sheet erosion is the most insidious form of erosion. Raindrops pound the ground dislodging soil particles which are carried away by the surface runoff. Sheet erosion is a slow but steady form of erosion that covers vast amounts of acreage. It is difficult to see since it takes small amounts of soil over a long period of time.

Erosion can be controlled in two different ways. 1) The surface can be protected or reinforced by residue or through vegetation such as pastureland or a grass waterway. 2) The surface or slope can be flattened through benching or terracing. Earthen terraces or vegetative barriers stair-step water down the hillside. These barriers inhibit surface runoff, slowing and ponding water and capturing and preventing sediment from flowing downhill (figure 1).

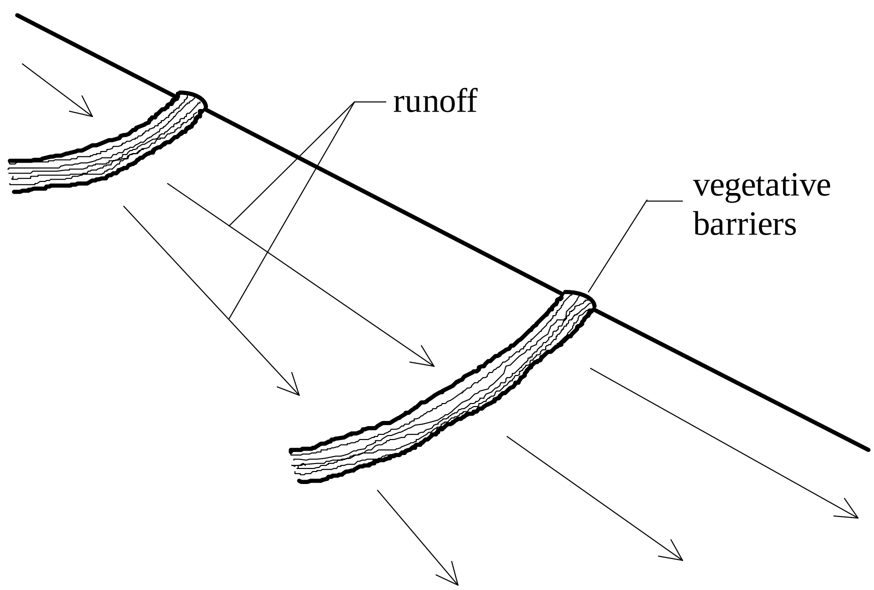

Figure 1

Vegetative barriers inhibit the flow of water because of their dense concentration of thick stems, thus slowing and ponding water and causing sediment to deposit in back of them (Meyers et al. 1994). Over time these deposits can develop into benched terraces (Aase and Pikul, 1995). These barriers function to diffuse and spread the water runoff so that it slowly flows through them without erosion. Vegetative barriers are resilient to failure because water passes over a broad area secured with perennial root reinforcement.

The vegetative barrier concept should not be confused with vegetative filter strips. Vegetative filter strips are a broad area of vegetation ranging from 15 to 30 feet wide whose purpose is to remove nutrients, pesticides and sediment from surface runoff. Vegetative barriers, on the other hand, are narrow strips of vegetation which are designed primarily to slow runoff, capture sediment and resist gully development. However, the two practices can be very complimentary. Research has reported that vegetated filter strips can be effective at nutrient removal and trapping sediment where water flows are shallow and uniform (Magette et al., 1989). Meyer et al., 1994 documented that stiff erect grasses such as vetiver (Vetiver zizanioides (L) Nash) and switchgrass (Panicum virgatum L.) can retard runoff and capture sediment from concentrated flow. Thus, as a vegetative barrier matures it reduces water velocities and establishes a broad uniform vegetative surface for the uptake of nutrients. Vegetative barriers have potential to not only reduce erosion but can enhance vegetated filter strips in the uptake of nutrients.

Practice Application

Vegetative barriers can be applied to eroding sites on areas of cropland, pastureland, feedlots, mined land, gullies, and ditches. This practice should be used in conjunction with other conservation practices in a conservation management system. 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 may need to be considered to adequately handle surface and subsurface water. This practice may improve the efficiency of other practices such as stripcropping, filter strips, riparian buffer zones, grassed waterways, diversions, and terraces.

Vegetative barriers have their greatest potential in use as a method for controlling ephemeral gully development in concentrated flow areas, and as water detention barriers with buffer strips and filter strips to ensure more uniform entry of runoff and nutrient uptake.

III. DESIGN CRITERIA:

According to the April 1997 NRCS Interim Practice Standard:

For Controlling Sheet and Rill Erosion, Trapping Sediment, and Facilitating Leveling of Cropland:

Figure 2 is a definition sketch of a system of vegetative barriers. The vertical interval (VI), or vertical fall between sequential barrier centers, limits barrier spacing. The maximum VI for this purpose is the lesser of 6 ft (2m) (USDA-Soil Conservation Service, 1954) or the spacing calculated by formulas for terraces (refer to Practice Standard 600-1, TERRACE). On slopes less than 5%, the terrace standard often results in a maximum VI less than 6 ft. A smaller VI than the maximum value may also be needed where subsoil conditions make the development of deep benches undesirable.

W_1= design width of barrrier
W_2= design width of cropped strip
S_0 = original land slope steepness
S_1 = future barrier backslope steepness
S_2 = future steepness of cropped interval
V_1 = vertical interval between barrier

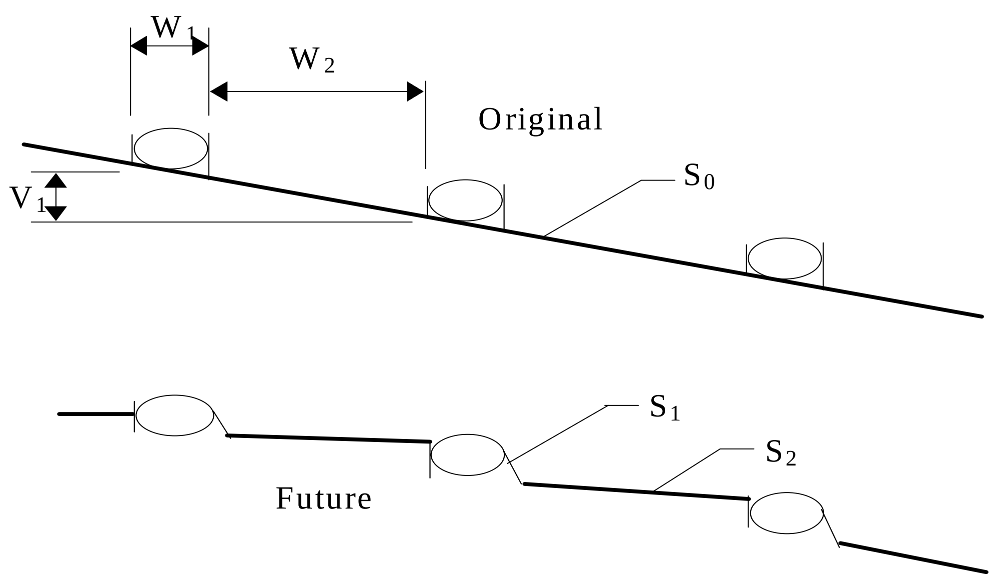

Figure 2

Vegetative barriers are arranged parallel to each other, on or near the contour, but across concentrated flow areas at angles convenient for farming. Over time, sediment and tillage will fill in the swale areas and contours will adjust to conform closer to barriers. All tillage will be done parallel to the vegetative barriers and will contribute significantly to the leveling and benching between vegetative barriers.

Gradients along barriers will be 0.6 percent or less except where the vegetative barrier crosses a concentrated flow area. Gradients entering a concentrated flow area may be 1 percent for 200 feet or 1.5 percent for 100 feet in order to get better row alignment. In designing barrier systems for variable fields, one approach is to select a constant hedge spacing based on the steepest 30% of the field that is a convenient multiple of the working width of the field equipment. Lay out barriers starting at midslope. Keep upslope and downslope barriers parallel to facilitate field operations. Where variable slopes cause excessive deviations from the contour, extra barriers can be included on the gentler slopes in order to keep barriers on steeper slopes close to the contour. For more local irregularities, a barrier's width may be altered, with subsequent barriers being parallel to the new line.

Vegetation must be established that has a density of at least 50 stems/ft^2 in all barriers. Barriers must be at least 3 feet wide. If barrier vegetation is so tall-growing that mowing is needed to minimize crop competition, barriers may be made wider to accommodate available mowing equipment. Mature barrier design width may also be wider than the amount of vegetation initially planted (Fig.2). The steepness of a stable backslope of the mature bench (S1, Fig.2), which depends on local soil and vegetation characteristics, will determine the required design barrier width. The final steepness of the cropped interval, (S2, Fig. 2) will be between 1 and 2%.

<u>Criteria for Controlling Rill and Gully Erosion and Trapping Sediment in Concentrated Flow Areas:</u>

Many fields have too much undulation to allow alignment on the contour without crossing a concentrated flow area with excessive slope for the criteria for contour vegetative barriers. In this case, or where sheet and rill erosion will be controlled with other practices such as residue management, discrete barrier sections may be installed across concentrated flow areas to control ephemeral gully development. When used to control only ephemeral erosion, barriers do not need to extend across the ridge tops but must be long enough to prevent bypass flow around the ends. At a minimum, each strip will extend far enough to provide 1.5 feet of elevation from the outer edge of the flow area to the end of the vegetative barrier. The amount of leveling anticipated as a result of tillage and sedimentation above the barrier should be considered when determining barrier length to avoid the necessity of extending barriers in the future.

In concentrated flow situations, vegetative barriers will be a minimum of 3 feet wide and consist of at least two rows of vegetation. The maximum VI for discontinuous barriers is reduced to 4 feet in order to minimize step heights. Vegetation must be maintained at a height of at least 15 inches throughout the year. Stem density must exceed 50 stems/ft2.

<u>Criteria for Trapping Sediment as Field Borders at the Bottom of Fields and/or the Ends of Furrows:</u>

Vegetative barriers may be used as field borders 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. Barriers will be used as field borders only in fields already within soil loss tolerance and will not be credited with additional soil loss savings. They will effectively reduce sediment delivery to surface water downslope of the barrier, can prevent the development of headcuts into the field, and can ensure uniform over-bank flow into streams and ditches. A series of barriers spaced at a VI of 2 feet may also serve as an inexpensive alternative to small drop pipe structures. Vegetative barriers used as field borders will be a minimum of 3 feet wide. There is no maximum crop strip width or slope length.

<u>Criteria for Increasing the Efficiency of Other Conservation Practices:</u>

1. *Field Stripcropping or Contour buffer strips:*
Field strips are similar to vegetative barriers except they are wider, do not have as strict an alignment criteria, and require sediment accumulations to be periodically removed and redistributed on the land. Vegetative barriers established just upslope or in the upper 3 feet of the field strip where they cross concentrated flow areas could reduce the failure of field strips caused by concentrated flow.
2. *Filter Strips:* Filter strips are areas of vegetation located along field borders or above conservation practices such as terraces or diversions to improve water quality. Vegetative barriers incorporated into the upslope portion of filter strips will improve uniformity of runoff flows entering the filter and will increase filter strip longevity by promoting sediment deposition above the filter strip.
3. *Field Borders:* Field borders are areas of vegetation located along field borders to provide wildlife habitat or access to the field. Vegetative barriers incorporated into the upslope portion of field borders will increase field border longevity by promoting sediment deposition above the field border. Vegetative barriers will also provide additional wildlife cover in borders of predominantly sod-forming grasses.
4. *Riparian Forest Buffers:* Riparian forest buffers are similar to filter strips but include woody vegetation as well as herbaceous. Vegetative barriers could be used on the upslope edge of the vegetation zones.
5. *Grassed Waterways:* Waterways are designed to remove water from a field under controlled conditions. In many cases, waterways are difficult to stabilize. Vegetative barriers may help stabilize waterways by dispersing and slowing the concentrated flow.
6. *Diversions and Terraces:* Diversions and terraces are designed to intercept water flowing down a slope and direct it across the slope to a stable outlet such as a grassed waterway or underground outlet. Vegetative barriers established above the diversions and terraces will increase their longevity by promoting sediment deposition above the diversions and terraces, waterway or underground outlet. Barriers established on top of terraces may provide additional stability, but will not alter structure design specifications.

Local Experience:

It has been our experience at the Kika de la Garza PMC that a more strict design criteria is necessary for concentrated flow sites. It is extremely critical that you compute velocity of flow before constructing vegetative barriers.

The limiting factor on velocity should be the soil relationship. “Permissible velocities for channels lined with vegetation” and “Permissible velocity for vegetated spillways” in the SCS-TP-61 handbook provides a useful guide for this relationship (Table 1) and (Table 2). At this time, we would not recommend exceeding the velocities established for specified seed mixtures for newly constructed sites. As a repair or secondary treatment for existing vegetated sites, we probably can use Vegetative barriers at increased velocities of 1 to 2 ft./sec above these levels.

We believe barrier spacing should be set as close to 2 feet in vertical index as possible in order to prevent excessive erosion between barriers and to assist in water velocity reduction and improve sediment deposition.

The length of the barriers can be determined by the NRCS waterway calculation (WWCALC). In general it is important to have a consistent channel width above and below the barrier. Minimum length of the barriers are generally 20-30 feet with a minimum of $1^{1/2}$ to 2 feet in vertical height. Extending the height up to 2 feet allows for increased sediment capacity and helps prevent water flow around the barrier ends. Side slopes should be a minimum of 10:1 or gentler. The shape of the waterway for the vegetative barrier should be as close as possible to a trapezoid with a consistent flat bottom. (Figure 3)

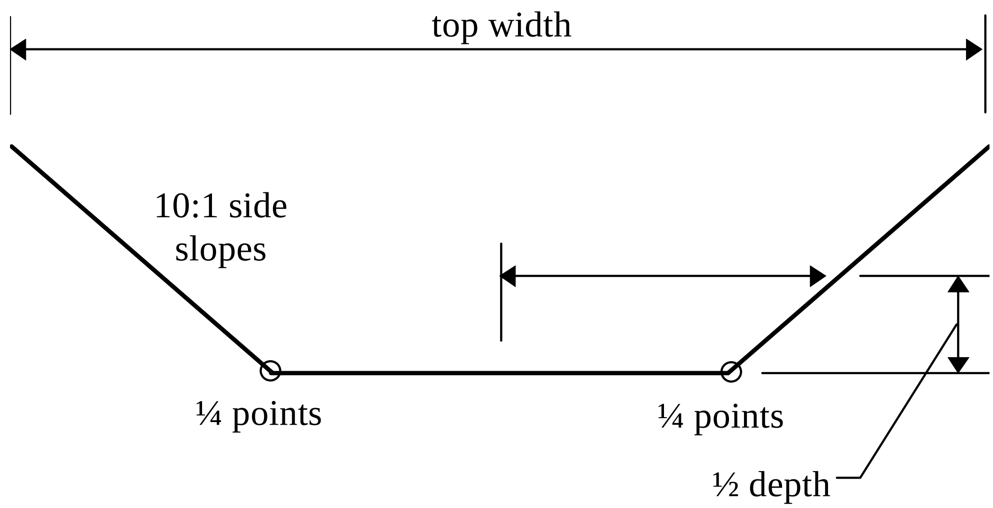

Figure 3

TABLE 1:

Permissible velocities for channels lined with vegetation[1]
The values apply to average, uniform stands of each type of cover.

COVER	SLOPE RANGE[2]	PERMISSIBLE VELOCITY EROSION RESISTANT SOILS	EASILY ERODED SOILS
	PERCENT	Ft. per. Sec.	Ft. Per. Sec.
Bermudagrass	0-5	8	6
	5-10	7	5
	Over 10	6	4
Buffalograss, Kentucky bluegrass, Smooth brome, Blue grama	0-5	7	5
	5-10	6	4
	Over 10	5	3
Grass mixture	[2]0-5	5	4
	5-10	4	3
Lespedeza sericea, Weeping lovegrass, Yellow bluestem, Kudzu, Alfalfa, Crabgrass	[3]0-5	3.5	2.5
Common lespedeza[4]	[5]0-5	3.5	
2.5			
Sudangrass[2]			

[1]Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.
[2]Do not use on slopes steeper than 10 percent, except for side slopes in a combination channel.
[3]Do not use on slopes steeper than 5 percent, except for side slopes in a combination channel.
[4]Annuals--used on mild slopes or as temporary protection until permanent covers are established.
[5]Use on slopes steeper than 5 percent is not recommended.

TABLE 2:

Permissible velocity for vegetated spillways[1]

Vegetation	Permissible velocity[2] Erosion-resistant soils[3] Slope of exit channel		Permissible velocity[2] Easily eroded soils[4] Slope of exit channel	
	pct 0-5 ft/s	pct 5-10 ft/s	pct 0-5 ft/s	pct 5-10 ft/s
Bermudagrass Bahiagrass	8	7	6	5
Buffalograss Kentucky bluegrass Smooth brome Tall fescue Reed canarygrass	7	6	5	4
Sod-forming grass-legume mixtures	5	4	4	3
Lespedeza sericea Weeping lovegrass Yellow buestem Native grass mixtures	3.5	3.5	2.5	2.5

[1]SCS-TP-61

[2]Increase values 10 percent when the anticipated average use if the spillway is not more frequent than once in 5 years, or 25 percent when the anticipated average use is not more frequent than once in 10 years.

[3]Those with a higher clay content and higher plasticity. Typical soil textures are silty clay, sandy clay, and clay.

[4]Those with a high content of fine sand or silt and lower plasticity, or non-plastic. Typical soil textures are fine sand, silt, sandy loam and silty loam.

IV PLANTING TECHNIQUES

Successful grass hedge plantings require the selection of the appropriate grass species, good land preparation, proper planting and sound management following establishment.

TERRACES

Seeding

The appropriate grass species for seeding vegetative barriers is a perennial species which produces an abundance of stiff erect stems that are resistant to water flow and tolerant of sediment deposition.
According to Dewald et al, (1996) suitable barrier plants must satisfy several criteria. They must be tolerant to the following:
(a) herbicides used on adjacent cultivated crops; (b) partial shading from cultivated crops; (c) inundation by sediment; (d) local climatic extremes (wetness, drought, freezing temperatures, etc); and, (e) easily established from available materials. They must also have the following characteristics: (a) long lived and manageable as a narrow strip; (b) non-weedy and not too competitive with adjacent cultivated crops; and (c) relatively tolerant to defoliation if crop residues are grazed.

Grass Selection

“Alamo” switchgrass (Panicum virgatum) has frequently been selected for vegetative barriers in Texas. Its seed characteristics make it easy and cost efficient to use. It produces a tall dense growing hedge and has good drought tolerance and range of adaptability. Good quality seed with a high germination rate should be purchased from a reputable dealer on a pure live seed (PLS) basis. Seeding rates for vegetative barriers must be considerably higher than for typical pasture plantings. It is necessary to establish a dense concentration of seedlings in order to quickly develop a solid vegetative barrier. However, since we are only planting narrow strips the total amount of seed is not very much. We recommend that seeding rates be between 10 and 20 pounds of PLS/acre.

Eastern gammagrass (*Tripsacum dactyloides*) is another grass that shows promise as a seeded grass for vegetative barriers. Its large seed gives it potential for good emergence especially on the heavier clay soils. It produces a tall, wide hedge with single plants growing 3 feet wide and 3 feet tall. We recommend that seeding rates be approximately 3-4 PLS per linear foot or approximately 25-30 pounds of PLS/acre.

Seed Bed Preparation

A major cause of seeding failures is poor seedbed preparation. Seedbed preparation needs to be initiated well ahead of the actual planting. Two types of seedbed preparation are generally used for vegetative barrier seedings, no-till and clean till.

A no-till seedbed will usually have had a prior seasons crop such as wheat or grain sorghum. This crop must be shredded and then shortly before seeding the field must be sprayed to kill any weed competition. A no-till seedbed can provide an ideal, firm seed bed.

A clean seedbed simply uses tillage to provide a clean, weed-free, smooth and firm seedbed. A disk followed by a cultivator is the most frequently used tillage operation to provide a clean, weed-free seedbed.
However, a loose or rough seedbed will prevent accurate placement of the seed in the soil. Furthermore, it will prevent good seed to soil contact which is required for good germination, emergence and drought tolerance for the small grass seedling. Therefore, a cultipacker should follow cultivation to establish a smooth, firm seedbed surface.

It is our experience that switchgrass seedings on the heavy, shrink-swell clay soils of Texas tend to be extremely difficult. We recommend that switchgrass seedings be limited to the coarser textured loams and sands. An alternative planting method for heavy clay soils is the use of small transplants with a mechanical transplanter.

When To Seed

In south Texas, seeding can be done in either the spring or the fall. More important than the season of planting is the soil moisture. Good soil moisture is imperative to secure a good grass stand. If adequate soil moisture is available then seeding should be done in the spring as close thereafter to the 50% probability of the last frost as possible. In the fall, we recommend planting no later than two months before the 50% probability of the first frost.

Seeding Procedures

The width of the vegetative barriers should be a minimum of 3 feet wide. If planted with a brillion seeder the width is generally 5 feet wide. If planted with a no-till drill, it usually is seeded with the middle 6 rows of an 8 row drill at a ten inch spacing between rows. Switchgrass should be planted between one-quarter and one-half inch deep. Eastern gamagrass should be planted at approximately 1 inch deep. Eastern gamagrass is usually seeded using just 2 rows of a planter. Once the vegetative barrier is well established the barrier can be maintained at 3 feet wide with cultivation.

In a no-till operation, placement of seed is best attained with a no-till drill that is equipped with double disk openers and depth bands. A firm seedbed and appropriate tension on the disk openers should prevent the disk openers from submerging too far below the soil surface or running above the soil surface. The packer wheel on the drill will cover and firm the soil around the seed. In a clean-till operation, a brillion seeder for switchgrass can also provide a good seeding. Prior cultivation should provide a clean weed-free seedbed. The brillion seeder will then use its rollers to firm the soil, drop the seed, and then press the seed into the soil.

Transplanting

"Alamo" switchgrass has performed well as a transplant. It is easy and economical to produce 6" tall by 3" rooted transplants from seed for use in mechanical transplanters.

A clean, weed-free, but loose and friable soil is necessary for transplanting. It is preferable to form transplant beds at a maximum 3 foot spacing to improve transplant establishment. The beds improve the depth of loose friable soil and also act as small dams to capture runoff and reduce erosion. Generally two parallel beds about 4-6" in height are made with a disk-bedder following the terrace line. A mechanical transplanter is then used to plant the switchgrass transplants at a 7" interval. The transplanter uses a front coulter to break the soil, then has a shoe to set the transplant at the appropriate depth. The back of the transplanter has two press wheels to firm the soil around the transplant.

CONCENTRATED FLOW SITES

Grass Selection

"Alamo" switchgrass and Vetiver grass (*Vetiveria zizanioides*) are two grass species that have performed well as transplants in the concentrated flow zone.

Switchgrass transplants can be easily grown from seed. Transplants can range in size from 1 1/4" x 1 1/4" x 6" to 3" x 3" x 6". However, there is a balance between rapid growth and survival of the larger container versus the extra cost. It is important that the transplants have a minimum 6" rooting depth. It is also critical that the seedlings be at least 9" tall at planting to avoid sediment burial. Switchgrass is adaptive throughout Texas.

Vetiver is an introduced species from India. It has been used throughout Southeast Asia as an erosion control plant. It has excellent vegetative barrier characteristics with a deep root system, thick (3/4") stems, tall growth and dense tillering. Vetiver can not produce viable seed in Texas. Therefore, transplants have to be grown from splits. Furthermore, vetiver does not have good cold tolerance. We do not recommend that vetiver be planted north of Austin if being used for a long-term erosion control plant. If vetiver is being used as a short-term companion plant with switchgrass, it can be used throughout Texas.

Production of vetiver is best attained by planting splits on beds of a sandy loam soil. After a year of growth, the vetiver will have grown numerous tillers that are available for harvest. The vetiver is mowed at roughly a 12" height to remove most of the leaf material. Then a small blade or root plow that is roughly 3' wide and mounted on a tractor is driven down the rows to uplift the plants. Plants are then harvested and taken to a shed for processing. Plants are split with a hatchet and pruners to form a 3-4 stem clump with 4-6" roots and 9" tall stems. After splitting the vetiver, it is placed in containers of water. Vetiver can be maintained in these containers for at least a month.

Vetiver is ready for planting once the clumps have developed new, young, white roots at 1/2” long. Waiting for new roots ensures that you are planting live healthy material. Vetiver splits can also be planted in transplant containers of 2” x 2” x 6” or 3” x 3” x 6”. Vetiver transplants in containers cost more than bare-root material but have the advantage of a better root system for field survival. Containers also give a longer window for field planting. Plants can be maintained for over a year in 3” x 3” x 6” containers.

When To Plant

Planting of transplants in the concentrated flow zone is best done in spring. You want to plant after the threat of freezing temperatures but just before the spring rains. This is usually March through April. Spring plantings are desirable because this is the period of rapid growth for these warm-season grasses and it reduces the chance of sediment burial.

Planting Procedures

A planting area that is free of all plant competition is necessary. If planting in a crop field, bare-ground is necessary three feet to either side of the grass vegetative barriers. If planting in an existing waterway, grass should be killed either with a herbicide or tillage for ten feet on either side of the vegetative barrier. Two rows of transplants should be planted in the concentrated flow zone. The rows should be from 18” to 36” apart. Closer than 18” will result in plant competition and poor uniformity and functionality of the barrier.

We recommend that the down hill row be planted at a 3” spacing throughout the .5 foot depth of the concentrated flow basin. This should coincide with the half points of a grass waterway. The outside edges and the second row can be planted at a 6” interval. Transplant containers allow for accurate spacing. Bare-root vetiver clumps are planted four per foot for a 3” spacing and two per foot for a 6” spacing. Where adaptable, we prefer to plant the downhill row with vetiver and the uphill row to switchgrass. The vetiver provides quick erosion control effectiveness while the switchgrass provides good long-term control.

Planting is easiest with the use of a walk-behind ditcher. A trench six inches wide and nine inches deep can be dug with the trencher. A slow release fertilizer can then be sprinkled in the trench at a rate dictated by a soil test or at a rate of 120#/ac of nitrogen, phosphorus and potassium. Transplants are then placed in the trench and backfilled.

Where velocity will exceed 1.2 feet per second, we recommend that a straw bundle be secured abutting the downstream vegetative barrier. The bundle is made by tying switchgrass or vetiver stems to make a six foot long bundle. The width of the bundle should be around 4” - 6” in diameter. A taller bundle can be purchased commercially. However, the bundle’s main function is to prevent the transplants from being dislodged and to help absorb the water velocity as it goes through the barrier. A taller bundle will capture more sediment which can bury the young transplants. The bundles are set across the vegetative barrier following the quarter points of the concentrated flow basin. The bundles must be adequately secured with baling twine to wooden stakes spaced every 2 feet following a weaving pattern (Figure 4). It must be tied in such a fashion that if one section fails the remaining section will stay secured. Once the bundles are tied down the stakes should be hammered to compress the bundles tightly to the ground.

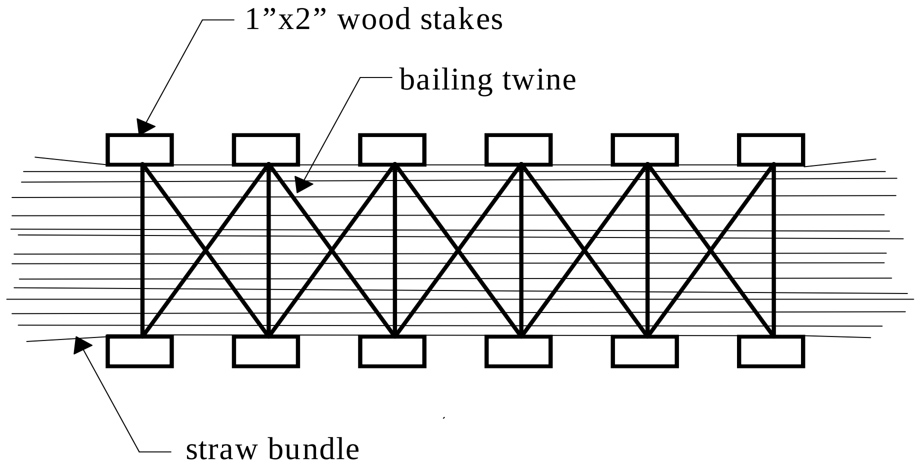

Figure 4

Once the transplanting and the placement of the bundles have been completed, all the transplants should be watered. This is done to eliminate any soil voids and give good soil moisture for rapid vegetative barrier establishment.

V MANAGEMENT

A newly installed barrier will require periodic inspection to ensure that there are no large gaps in the barrier. If gaps in the barrier are twelve inches or more, replanting will be necessary. Vegetative transplants should be planted in the gaps at a three inch interval and then watered. We also recommend that adjacent barriers be trimmed to twelve inches to reduce competition.

In the establishment year, be prepared if necessary to water your transplants. This may not be cost-effective for terraces, but watering plants in the concentrated flow zone is feasible. The landowner should be prepared to accept a travel lane in his crop field to facilitate watering of the vegetative barrier. In general, the transplants will need an average of 2” of rainfall or more per month in the initial growing season to survive and become established.

Cultivation of transplant rows in cropland is encouraged to reduce weed competition and to minimize soil cracking during drought years. Periodic cultivation as close to the vegetative barrier as possible may also be necessary to reduce and control downstream plunge pools in the concentrated flow zone.

Vegetative barriers should be mowed annually at a 12” height to maintain stem density and control tall weeds. Burning is not recommended for vegetative barriers unless the barrier has become decadent from many years of growth. Although burning stimulates grass growth, it also reduces the vegetative barrier effectiveness for controlling erosion.

Fertilization is generally not required for vegetative barriers on cropland. Mature vegetative barriers that are grown with a waterway may benefit from selective placement of fertilizer at a 60#/acre rate of nitrogen, phosphorus and potassium.

CONCLUSION

There are numerous advantages to vegetative barriers. Seeded terraces are less expensive to construct than conventional earthen terraces. There is less earth movement and soil compaction. Vegetative barriers can reduce concentrated water velocities. It can revitalize and support waterways by capturing and spreading eroded sediment. It can enhance nutrient uptake of filter areas. Vegetative barriers can provide a cost effective technique for water and sediment control basins. Furthermore, vegetative barriers can provide critical wildlife habitat when annual crops deteriorate.

However, there are several factors in Texas that must be resolved before vegetative barriers will reach full conservation use. Can vegetative barriers provide a <u>cost effective</u> alternative to conventional methods of conservation? Will there be adequate contractor and landowner interest to apply this alternative practice? The answers to these questions will come over the next few years as more land owners apply this conservation practice.

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