K-STATE Kansas State University

Using Vegetative Filter Strips In Crop Fields

Department of Agronomy

Water runoff from crop fields often carries pollutants, such as soil sediments, nutrients, and pesticides, that can have adverse effects on water quality. One way to minimize this problem is through the use of vegetative filter strips. This bulletin explains the way pollutants move and the role of vegetative filter strips in reducing the amount of pollutants that leave a field.

How pollutants move

Soil sediments are physically transported by running water. As the rate of water flow slows, sediments settle out. For example, when silt-laden surface runoff encounters a terrace channel, the water usually slows as it flows along the gently-sloping channel. Sediments are deposited in a process called sedimentation, with the heaviest particles dropping out first.

Pesticides and nutrients that are strongly adsorbed by soils are transported and deposited in a similar manner. Herbicides such as trifluralin *(Treflan, Tri-4)*, for example, are tightly bound to soils and move almost entirely with soil sediments.

Nitrates and most herbicides, however, are not strongly adsorbed to soils and may be dissolved in runoff water. For example, atrazine, metolachlor *(Dual)*, alachlor *(Lasso)*, and acetachlor *(Harness, Surpass)* move mainly with the water. Practices that reduce sediment loss, but not water runoff, do not reduce losses of nitrate or herbicides that are dissolved in water.

Reducing sediment loss

Vegetative filter strips are generally planted to sod-forming grasses that help hold the soil in place, slow the runoff velocity, and provide some filtering action. Slowing the runoff velocity results in sedimentation. Larger soil particles tend to settle out readily. Finer clay particles remain suspended much longer and may require days to settle out, even in water that is not flowing.

Reducing loss of dissolved pesticides

Vegetative filter strips can remove herbicides (atrazine, for example) dissolved in runoff water to the extent that the water infiltrates into the underlying soil. If soil in the filter strip is already saturated when the runoff event occurs, there will be little or no further infiltration, with essentially no pesticide removal from the water. On the other hand, if the soil under the sod is dry, much greater infiltration may occur, which will reduce the amount of pesticide leaving the field.

Types of filterstrips

1. Grass Waterways (figure 1) are the most common type of vegetative filter strip in Kansas. These structures are designed to move water from terrace channels to lower field elevations without soil erosion. Sod-forming, cool-season grasses such as smooth brome or western wheatgrass usually line the channel.

In a well-designed and maintained system of terraces and waterways, most soil sediments settle out in the terrace channels, with some additional sedimentation in the waterway. This is a widely used and effective method to reduce soil loss.

Grass waterways are not very effective, however, for removing pesticides dissolved in runoff water. For one thing, the area of the entire field is usually many times greater than the area of the waterway. For example, if the surface runoff water from a 50-acre field drains through a 2-acre waterway, the area ratio is 25:1, and one would not expect much of the runoff water to infiltrate in such a small area. Furthermore, waterways usually follow the most direct route downhill, so are often quite steep. By design, waterways serve mainly as grass-lined conduits to move runoff water out of the field. There is little opportunity for water to infiltrate the underlying soil and little reduction in pesticide loads.

2. Filter Strip Terraces (figure 2) are strips of grass sod on the contour that surface water runoff crosses as it runs downhill. They are an alternative to earthen terraces, but have no

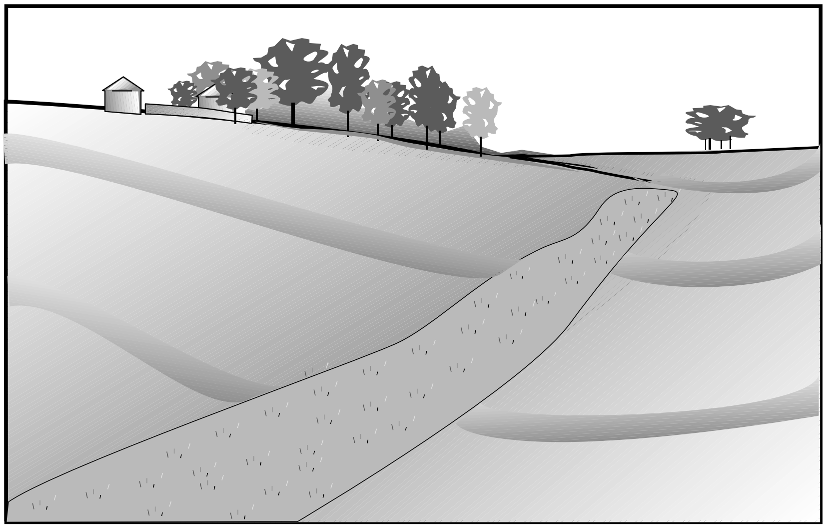

Figure 1. ***Grass Waterways*** *are the most common type of vegetative filter strip in Kansas.*

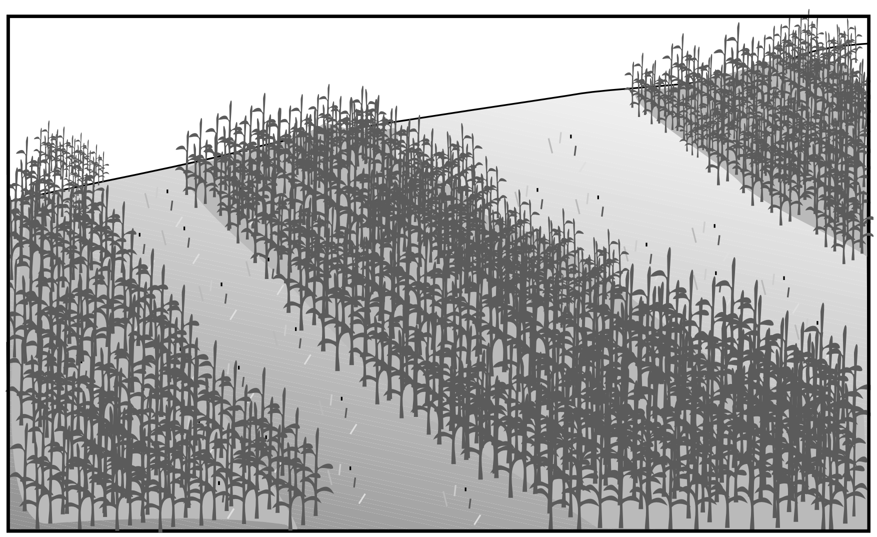

Figure 2. ***Filter strip terraces*** *are strips of grass sod on a contour that surface water runoff crosses as it runs downhill.*

channel to conduct water along the contour, as do earthen terraces. If water enters the filter strip terraces uniformly, in a shallow layer, then sediment trapping can be excellent.

Pesticide removal by filter strip terraces should be much better than by waterways because the ratio of watershed to filter strip area would be much less than for waterways. Research at the KSU Cornbelt Experiment Field in northeast Kansas showed that a 20-foot strip of smooth brome sod reduced the atrazine runoff from a 100-foot slope of no-till grain sorghum by 28 percent, averaged over five runoff events during the summer of 1992 (Marsh, 1994). The filter strip terrace also reduced sediments in runoff by 57 percent. Filter strip terraces are not common in Kansas.

3. Buffer Strips (figure 3) at lower elevations of fields, and **Riparian Strips** (figure 4) along stream banks intercept surface runoff water from crop fields. These might be ordinary grassed fence rows that runoff water crosses as it leaves fields, or strips of grasses, shrubs, and trees lining the banks of streams. For effective removal of soil sediments by these buffer strips, runoff water must flow in a shallow, even layer across the filter strip. Since these areas often have less slope than waterways or filter strip terraces, erect grasses such as bluestem and Indiangrass may provide better filtering than smooth brome or fescue.

Buffer strip/turn row combinations at the lower ends of ridge-tilled fields are ideal for treating surface water runoff. In such situations, small amounts of runoff water flow down each furrow, entering the buffer strip in a very controlled, systematic way. As with all vegetative filter strips, the

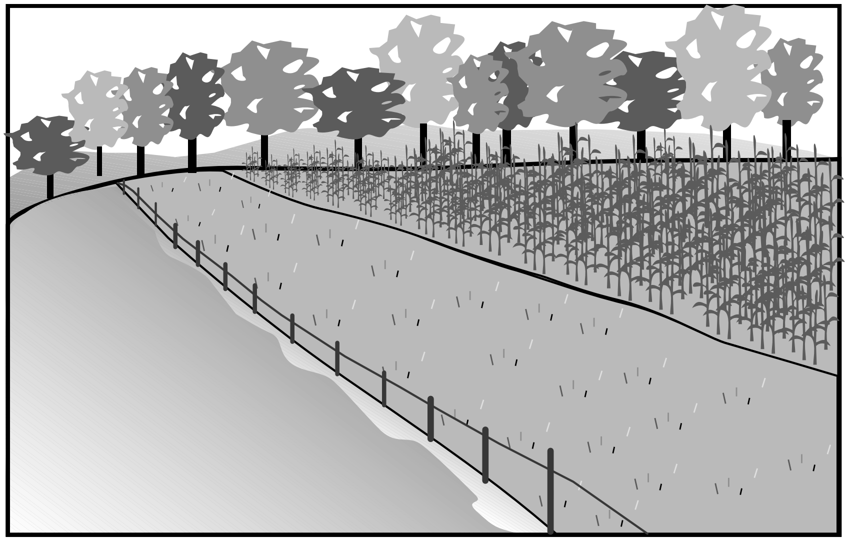

Figure 3. ***Buffer Strips*** *(at lower elevations of fields) intercept surface runoff water from crop fields.*

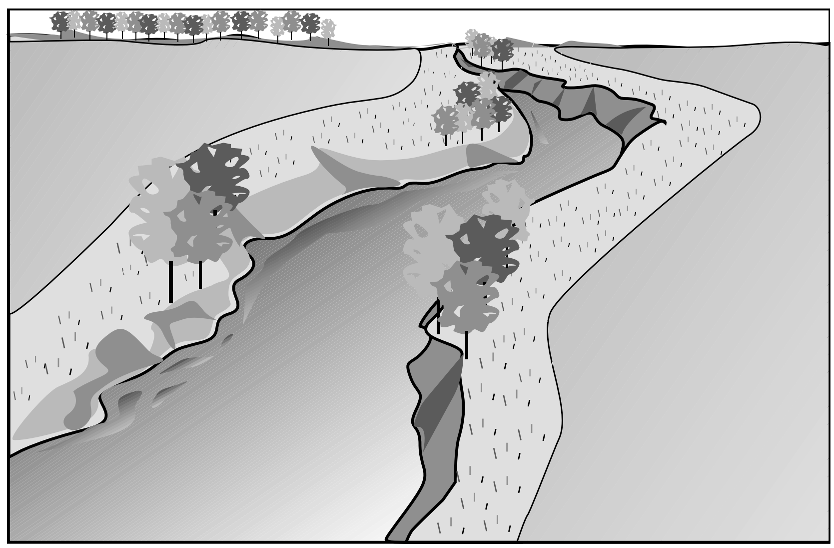

Figure 4. ***Riparian Strips****, along stream banks, intercept surface runoff water from crop fields.*

key to sediment deposition is to slow the water flow.

The extent to which buffer strips and riparian strips remove dissolved pesticides depends on the retention time of the water in the strips, and the amount of water infiltration into the soil. At KSU's Foster Site Field near Rossville, surface runoff water from a corn field was uniformly distributed over a 33-foot grass buffer area, planted to smooth brome, at the edge of the field. The grass buffer reduced the loss of herbicides by 50 percent. This demonstration system was designed to achieve very uniform distribution of the runoff water, a key to these high levels of pesticide reduction.

4. Settling Basins (figure 5) around inlets to tile-outlet terraces are especially effective at reducing soil sediment loads. These basins are usually planted as part of the field, but they could be planted to grasses and act as the setback zone for herbicides such as atrazine. Such basins are designed to retain water for up to 24 hours, giving most of the larger sediment particles time to settle out. Their effect on pesticide removal would be proportional to the amount of runoff water that infiltrates into the soils of the settling basin.

Summary

Well-designed and maintained vegetative filter strips of all types can be very effective in trapping and removing soil sediments from surface runoff waters. Simply reducing surface runoff velocity is sufficient to settle out larger sediments. On average, about 75 percent of soil sediments are removed in this way.

Removal of dissolved pesticides

requires that the runoff water infiltrate into the soils of the filter strips. For minor runoff events, the removal rate may be 100 percent if all runoff infiltrates into the soil of the filter strip. During prolonged rainy periods, infiltration may not occur at all after the soils become saturated. Data indicates that on average, only about 25 percent of the pesticide load is removed by filter strips designed for that purpose. Therefore, crop producers must use practices that retain the pesticides at the application site, and minimize pesticide loss through surface water runoff.

For more information on practices to reduce atrazine runoff, see K-State's Extension publication *Reducing Atrazine Runoff from Crop Fields* MF-2208 available at county Extension offices. For more information on grass waterways, see K-State's Extension publication *Grass Waterways Maintenance* MF-1064.

References: Marsh, B.H. 1994. *Conservation Tillage Research 1994*. Kansas State University Report of Progress 705, pg. 1-4.

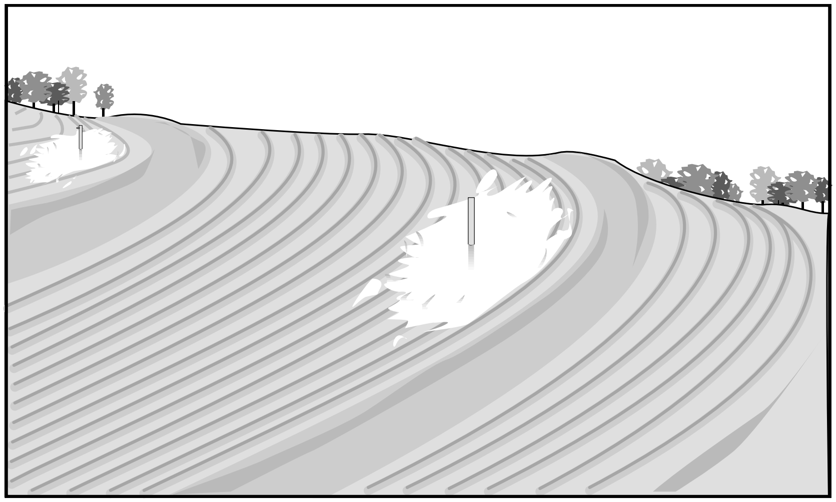

*Figure 5: **Settling Basins** around inlets to tile-outlet terraces are especially effective at reducing soil sediment loads.*

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