

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

Agricultural Experiment Station

COLUMBIA, MISSOURI, OCTOBER, 1915

CIRCULAR NO. 78

THE CONTROL OF SOIL WASHING

M. F. MILLER

Soil washing is the greatest single source of loss on many rolling lands. It is greater than the loss of plant food thru cropping. The washing off of the surface soil during a single season may remove



Out in One Season

The uprooted tree on the reader's left stood on the right bank of a small gully. One season of exceptional rainfall cut so deep a ditch that only an expensive system of dams will stop it.

as much organic matter as will be replaced by the turning under of two or three clover crops. A single rain may form gullies which it will require years to repair. And the injury to the land itself is only a part of the story. The filling of our smaller streams with silt and the

great injury that is done navigation by the clogging of our large water courses with this eroded material is another very important phase of the subject, when the country as a whole is considered. The present season has certainly emphasized, in the minds of all observing farmers, the great havoc which may be caused by soil washing.

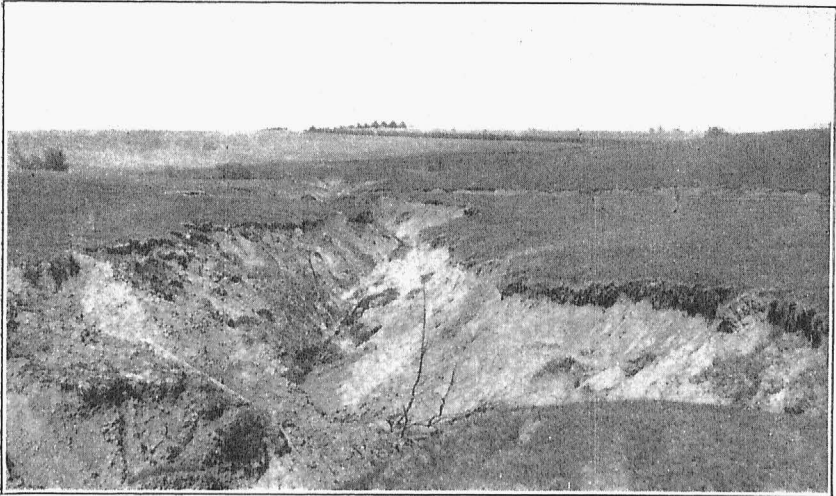


Fig. 1. *Neglected Gullies on Rolling Upland*

This could have been easily prevented. The soil here is good, but the value of the land on this field has depreciated many dollars per acre as a result of these gullies.

There would be little need of calling attention to these matters if it were not for the fact that a large share of such damage is preventable. The great need of soil conservation is more strongly emphasized each year and in no way is greater care needed than in the prevention of soil erosion. While it is a very serious national problem, it is a matter over which the government or the state has little control. It is a problem for the individual land owner. Public sentiment should be awakened to the seriousness of the problem and the land owner brought to realize the importance of persistent efforts of control.

KINDS OF WASHING

There are two kinds of soil washing—sheet washing and gullying. Sheet washing is the washing of the immediate surface soil without the formation of appreciable gullies. This is less noticeable than gullying, but almost as injurious, since it removes almost as large

amounts of soil of the best surface layers, including large quantities of organic matter. Gullying has the disadvantage of leaving the field rough and a gully once started continues to enlarge unless remedial measures are adopted. Sheet washing is most common in freshly tilled land, such as corn land, where on sharp slopes as much as an inch of the best surface soil may be removed during a single heavy rain. The gullying usually starts in tilled land but unless stopped continues indefinitely.

CAUSES OF SOIL WASHING

As long as land is kept in timber or in thick-growing vegetation, as in its virgin state, the rate of surface loss from the average soil by erosion, is less than the rate of accumulation by rock weathering.



Fig. 2. *Corn Ruined by Accumulation of Top Soil*

An accumulation of two or three feet of top soil on the lower ground of a cornfield, completely ruined the corn on the area covered. This means a large loss to the average soil on the field.

When the land is put in cultivation, erosion is greatly increased and the rate of loss is then far greater than the rate of soil formation. It is, however, when the land is in tilled crops that the greatest loss occurs. Every farmer realizes the washing which accompanies corn-growing.

Careless Culture. Careless culture is undoubtedly productive of the greatest losses. Where washes once start they invariably become worse rather than better if the land is kept in cultivation.

Shallow Plowing. Shallow plowing is one of the causes of washing which usually accompanies careless farming. Where land is plowed shallow the water quickly penetrates to the depth of this loose soil and if the rain continues to fall more rapidly than it can be absorbed by the compact soil beneath, the run-off will carry with it some of this loose surface soil. If the rainfall is very heavy the shallow surface soil may be entirely removed on the steeper slopes. If the plowing is deep, most, if not all, of the water will be absorbed and washing greatly decreased.



Fig. 3. *Opened with Road Scraper*

This rock road had been covered several inches deep with the good top soil from adjoining fields.

Insufficient Organic Matter. One of the important causes contributing to washing is a low supply of organic matter in the soil. Soils with much organic matter absorb the water more rapidly and the organic matter also tends to bind the particles together and prevent washing. For this reason old lands, low in organic matter, wash worse than new lands. Likewise corn land prepared from stubble ground washes worse than corn land prepared from sod.

Clay Soil Absorbs Water Slowly. The texture of the soil is also an important factor in determining the amount of washing. A sandy soil absorbs water rapidly and washes very little. A clay soil, on the other hand, absorbs water slowly and is particularly subject to gully-ing. The intermediate soils such as fine sandy loams and silts are most affected by sheet washing but they will also gully badly.

Frequent Heavy Rains. Probably the most important single cause of soil washing is the occurrence of frequent torrential rains, particularly when the land is being cultivated. A continental climate, such as that found in Missouri, must invariably have a rainfall of unequal distribution, with many torrential rains and therefore a greater amount of serious soil erosion than occurs in those regions more favorably situated in this respect.

CONTROLLING WASHING

In controlling washing, as in controlling disease, preventive measures are more important than remedies. Where washing has already taken place, of course remedial measures alone are left. If the washing has been long continued, however, the remedies are costly and it is rare that the land can be put into as good condition as it was in originally, even with great expense. There are few cases where the old saying that "a stitch in time saves nine" is more applicable than in the handling of land to prevent washing.

PREVENTIVE MEASURES

A crop rotation which leaves the land bare as short a time as possible is the most fundamental preventive measure. Naturally corn must be grown on most farms but there are very few where corn must be grown over one-third of the time on the individual fields and where all the stalk land must lie bare during the fall, winter, and spring.

Winter Cover Crops. The use of winter cover crops such as rye will go a long way in preventing the washing of the fall, winter, and spring rains. The man who has never tried a crop like rye will be surprised at the effect of the fibrous roots of this crop in holding the soil. Other crops which may be used to advantage are wheat, barley, and—in the southern half of the state—crimson clover. The use of such crops not only means a saving of soil but also the addition of organic matter or humus—a substance badly needed in most lands which are inclined to wash.

Deep Plowing. The second general principle of prevention is that of deep plowing, the object being to provide a deeper water reservoir

to hold the heavy rains and to cause a rapid absorption of the water. Fortunately, in Missouri, plowing is generally deeper than in the southern states where washing is most destructive. There is, however, still much room for improvement in many cases. Rolling land should rarely be plowed less than five inches deep and from seven to nine inches is usually better. Land plowed eight inches deep can be expected to absorb practically twice as much water as that plowed

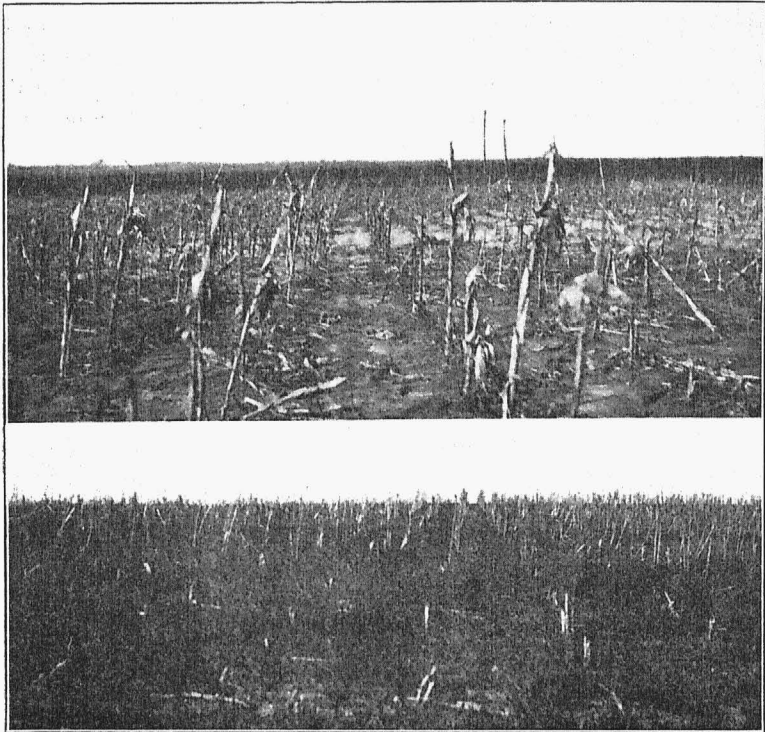


Fig. 4. Use of Rye to Prevent Washing

The bare condition of the soil shown in the upper picture is common everywhere in the corn sections of Missouri. The lower picture shows how this may be remedied and washing prevented by the use of rye as a winter cover crop. Other fall-sown cereals will also answer. In addition to reducing washing, much valuable pasture is secured.

four inches deep, at least for the first few weeks after plowing, and the rains which will be heavy and torrential enough to cause washing with the deeper plowing will be much less frequent.

Contour Farming. A preventive measure which the Missouri farmer on rolling land must sooner or later learn to apply is that of

contour farming, that is, farming the land around or across the slope, rather than with the slope. Where furrows run up and down the slope washing is greatly increased. In the southern states this principle is almost universally practised in the rolling sections. Where land washes badly, it is more important to cultivate corn across the slope only, than it is to check the corn and plow both ways. The man who drills his corn with the slope because the field is somewhat longer in that direction and therefore increases very materially the washing of the land is certainly not doing all he can to maintain soil productiveness. Of course on many rolling fields, of considerable size, the land may slope in different directions in different parts of the field

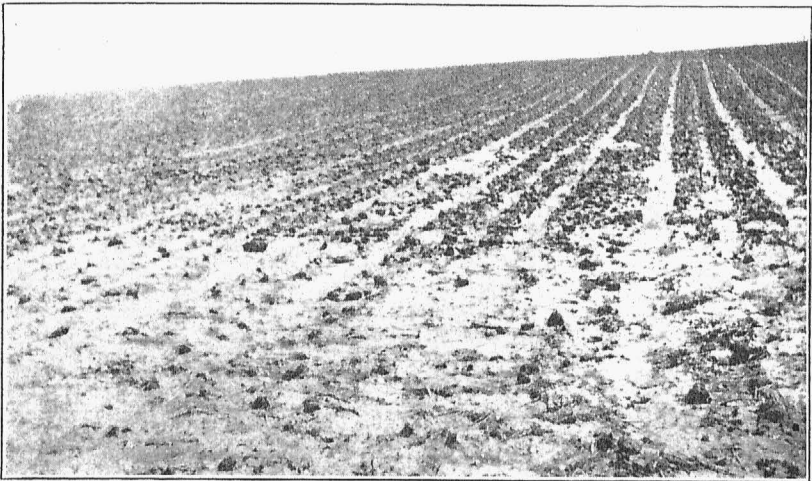


Fig. 5. *Washing Increased by Direction of Rows*

Land should be planted and cultivated across the slope or around the hill, if practicable, especially where the soil is of a nature to wash badly.

and under extensive systems of farming it is difficult to divide such fields so that this so-called "contour farming" may be practised. As agriculture becomes more intensive, however, more and more attention should be given to this practise. It is unlikely that the terracing of lands which is so common in the southern states will have a very important place in Missouri agriculture but there are many farms in the rolling sections where such a system would be economical under more intensive systems of farming.

Organic Matter in Soil. A fourth general preventive measure in controlling washing is that of maintaining organic matter in the soil. Soils low in organic matter wash much more than those high in organic

matter. This is due to the fact that soils high in organic matter absorb water more rapidly than those which are low in this material, while the presence of organic matter also aids in binding the soil particles together, thus preventing washing. The farmer who maintains organic matter by crop rotation, manuring, and the growing of cover crops will suffer little from soil-washing.

STOPPING WASHES

The remedies for soil washing are mostly included under the various methods of filling gullies. Many means are employed, different



Fig. 6. *Straw Saves Soil*

The soil is deposited in the straw and the gully gradually filled.

methods being applicable under different conditions. Whatever method is adopted, however, constant care is necessary if the best results are to be secured.

Straw for Small Gullies. In the case of certain soils where small gullies persist in starting in corn fields, wheat fields, and even in pastures and meadows during the fall and winter, the immediate use of straw or similar material is necessary to stop them. In such cases constant attention is required and these small gullies should never be allowed to reach any considerable size. This is particularly true in

pastures or meadows, where it is often considered that the land is protected by the grass and no attention need be given it. Gullies starting in drainage ways or in cattle paths on such fields often develop to tremendous size.

Drag Dirt and Sow Sorghum. In cultivated fields where gullies start in the spring or early summer, a very good plan is to drag in some dirt and sow sorghum thickly. If the sorghum gets started before a heavy rain comes it will hold the soil and make it possible to harrow and cultivate across these gullies during the season, thus dragging in dirt which will entirely fill them. Gullies a foot deep and two or three feet wide may be quite effectively filled in this way.



Fig. 7. *Sorghum Stops Washes*

It is especially efficient where rather large gullies are first worked in and sorghum sown on the loose soil.

Fill, Plow, Harrow, Seed. Gullies a foot or two in depth and from two to four feet wide can well be stopped with straw or debris, and dirt plowed on top of this during the late winter or spring months so as to fill them as nearly as possible. They should then be harrowed over and top dressed with manure containing timothy hay or barn floor sweepings, or if these are not available sow timothy seed with the manure. Some alfalfa, bluegrass, and red top seed may often be added with the timothy to advantage. Where straw or debris is not available such gullies may be merely plowed in, harrowed, manured, and seeded to grass, as mentioned above, with good results. Sorghum may also be seeded on this filled-in soil to hold the land during the summer and fall and the grass seeded the following spring.

Brush, Logs, Stumps for Large Gullies. Gullies which are too large to plow in easily, offer a very serious and expensive problem in filling. Brush, logs, and stumps may be used in filling them and where properly handled these prove very effective. Stones are also sometimes used but they are of little value. Brush should always be piled with the tops up stream. In the case of fine brush, particularly, it is best to stake it down at intervals. Where available, osage orange and cedar furnish the best of brush to use.

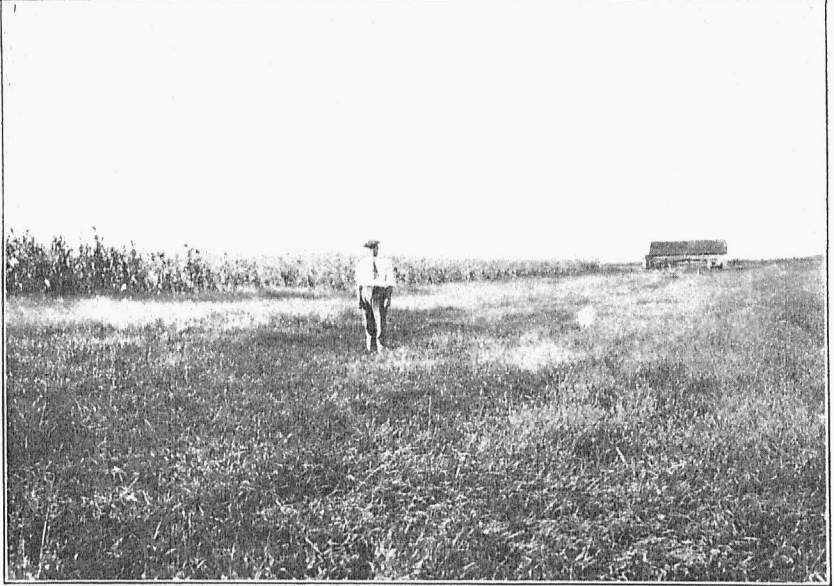


Fig. 8. *Once a Deep Gully, Now Level Enough to Farm Over*

There are few washes which proper measures of handling will not completely fill.

If brush is mixed with straw it is usually more satisfactory than where used alone and the more compact it can be made the better. Loose brush is of little value.

Brush Dam. The use of various sorts of dams in the stopping of gullies is becoming common. For small gullies a row of stakes driven across and straw piled above answers in some cases, but these must be continually watched. For larger gullies a dam of brush gives fair results when properly built. It is best to build it of green brush with leaves on it, if cedar is not available, laying the longer pieces on the bottom with the tops up stream, then piling the shorter pieces on top.

For best results the brush should be mixed with straw and staked down. It should be tightly packed and left lowest in the middle to prevent cutting around the edges.

Concrete Dams. Reinforced concrete dams are quite satisfactory for particular locations, especially for those large gullies which are deep and narrow. Such dams should be from six to twelve inches thick, depending on the size and depth of the gully. The proper reinforcing of such a dam is very important, iron rods of good weight being essential in the larger dams and heavy wires in the smaller ones. The middle should be left lower than the edges and a spillway provided with a concrete, stone, or brick apron placed in the bottom of the gully to prevent cutting by the falling water. The ends of a concrete dam should extend well back into the ditch banks on either side to prevent the water cutting around. Any such dam will gradually allow the gully above to fill with sediment.

Dickey System. The use of earth dams for filling large gullies is very common in some parts of the state. A system known as the Dickey system has recently come into some prominence. It consists of a dam, usually of earth, at the bottom of which is placed a large sewer tile with the upper end turned upward by means of an elbow joint. The water must rise behind the dam to the height of the upturned tile before it can pass on. The sediment is largely deposited in this standing water. Extra joints are then placed on the upturned tile as the dirt accumulates until the gully is entirely filled. In order to remove the standing water above the dam a tile is often laid in a shallow ditch made in the bottom of the gully for a short distance, covered well to prevent washing out, and this is then either run into the sewer pipe or thru the dam.

Sewer of Good Size. The most important point in handling this system of filling gullies is to have the sewer large enough to carry the water of the heaviest rains, thus preventing an overflow which will cut out the dam. Of course the large reservoir for water above the dam allows considerable storage, until the gully is nearly filled, which decreases the danger of the dam overflowing. Such a system is especially applicable to wide and rather shallow gullies such as commonly occur near the lower side of a slope but it may be used on any large gully. Of course where the slope is steep and the gully long, a number of such dams must be installed.

Fill Hillside Gully With Debris. For large hillside gullies it is usually much better to fill with debris of various kinds and plow or scrape in. Repeated backfarrowing over the gully will gradually fill it. After it is filled, cover heavily with manure and work thoroly into

the surface, seeding down to grass with rye, oats, or other quick-growing cereal which will help to hold the soil until the grass gets started. Such filling of large gullies is expensive, but it can be done if proper efforts are put forth. Land so gullied is practically worthless and one can afford to put a large amount of work into filling them. Such a plan is often followed in the South with good results.

Plant Willow or Bushes. The planting of willows or bushes along the edge of a gully is often done for the purpose of stopping further erosion. Where they get a good hold and a good growth in the ditch sides and bottom, they aid greatly in filling it. This planting is best done in late winter or early spring and those washing out should be replaced until a permanent stand is secured.