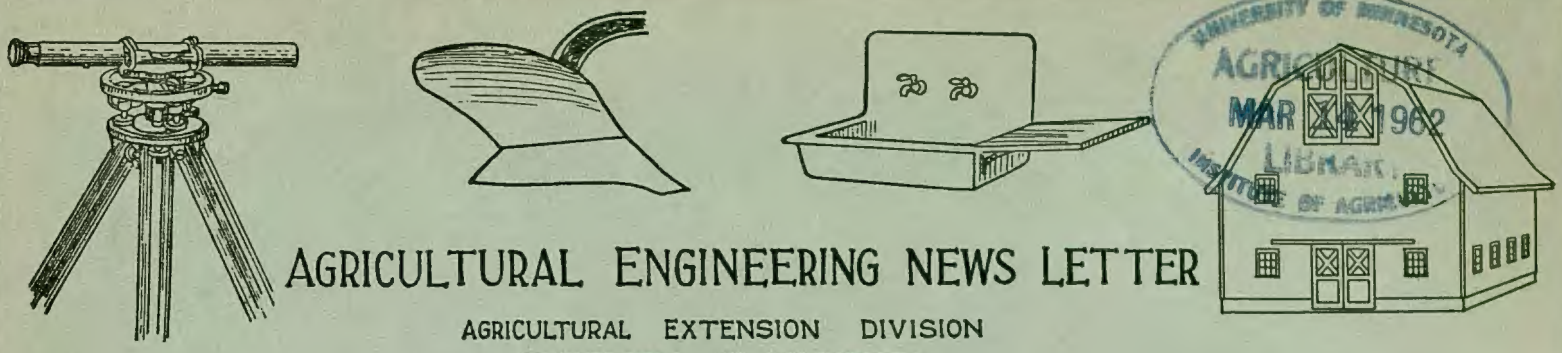

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Relation of Rainfall to Soil Erosion

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The character and the distribution of the rainfall are influential factors in determining the amount of runoff and soil erosion. Rainfall characteristics are so varied that the erosion caused by one rain can seldom be compared with that produced by another. The moisture condition of the soil at the time of a rain, the soil structure, the surface condition and the vegetative covering are constantly changing. As these changes occur, they all influence the erosive action of falling rain on the soil.

The Moisture Condition of the Soil at the Beginning of a Rain. Any given soil varies from any other in its ability to take up and hold water. Some soils have a few large pore spaces which take up the rainfall quickly but do not hold it, but the water percolates through the soil into the deeper groundwater levels. Other soils have many very small pore spaces which absorb the rainfall very slowly but retain nearly all they take up until transpiration by the plants or evaporation from the surface removes the water. If the precipitation occurs as frequent light rains, the finer textured soils will absorb it, but if the precipitation occurs as torrential rains, most of the water is lost as runoff. Our best agricultural soils lie in between the above mentioned groups. Their granular structure provides large pores to absorb the water rapidly and the small pores in the granule hold sufficient water to supply the plant needs for several weeks.

For light to medium rainfall intensities the drier the surface soil, the less the runoff and soil loss, while for torrential rains, the drier the surface soil, the greater the soil loss.

When rain falls on a dry soil, the soil slakes. If the rainfall intensity is medium to light, the soil absorbs practically all of it, while if the rainfall intensity is high, there is sufficient water to pick up and carry away the soil particles from this slaked top layer. After the soil slakes, if not carried away, it settles down and packs into a pavement-like surface from which the water runs off but does not carry as much soil as at the beginning of a heavy rain. After a rain has continued for an hour, it requires from 1½ to 2 times as much runoff water to remove a pound of soil as at the beginning of the rain.

The Soil Structure. The more granular a soil, the more rapidly it will absorb water. A soil high in organic matter usually has a good structure while one low in organic matter has a poor structure (i.e., the soil is tight and sticky). Since soils with good granular structure do not slake as much as soils with poor structure, they are less subject to erosion.

The Surface Condition of the Soil at the Time of the Rain. The condition of the surface of the soil at the beginning of the rain has an important influence on runoff and soil loss. The writer conducted some experiments in which two inches of rain were applied in one hour on an 8 per cent slope under the following conditions:

(a) Soil plowed 4 to 5 inches deep and left rough.

(b) Soil cultivated and harrowed into a smooth mellow sedbed.

(c) Soil left in a smooth, hard, baked surface as a result of a previous hard rain.

The results of these experiments are given in Table 1.

Table 1
Effect of the Condition of the Soil Surface on Runoff and Soil Loss

Surface Treatment	Time—beginning of rain to start of runoff, minutes	Runoff, per cent	Erosion, tons per acre	Pounds of runoff to remove one pound of soil
Rough, plowed	26	39	1.87	49
Good seedbed	7	65	3.80	70
Smooth, hard, baked	4	84	8.34	23

The rough, plowed field absorbed nearly 1.0 inch of rain, the good seedbed about 0.2 inch, and the smooth, hard, baked surface only 0.1 inch of rain before runoff started. Although less runoff was required to remove a pound of soil from the rough, plowed than from the good seedbed, the latter lost about twice as much soil since the total runoff was so much greater.

If soil erosion is to be controlled, it is imperative not to leave the surface of the soil in a smooth condition during the season when rainfall of high intensities occur, since bare soil in a smooth, hard condition will lose about five times as much soil as a similar soil in a rough condition.

The Effect of the Vegetative Covering. Additional experiments applying two inches of rain in one hour on a seedbed of barley at different stages of its development showed the following results: (See Table 2)

Table 2
Effect of Vegetative Covering on Runoff and Soil Erosion from an 8 Per Cent Slope

Stage of Growth	Coverage, per cent	Runoff, per cent	Erosion, tons per acre	Pounds of runoff to remove one pound of soil
Freshly prepared seedbed	0	65	3.80	70
Barley 5 inches high	2	65	3.38	82
Barley 10 inches high (soil wet)	5	80	1.28	126
Barley 18 inches high (lodged)	95	16	0.02	1176

The results of experiments conducted under a wide variation of soil and climatic conditions show conclusively that erosion can be controlled by adequate vegetative cover. The large soil losses occur when the bare soil is exposed to heavy rains during seedbed preparation and seeding and when row crop cultivation is practiced.

To reduce erosion losses to a minimum, the steep slopes should be left in permanent cover crops as hay, pasture, and forest, the intermediate slopes in small grains and hay while the flat areas can be put into row crops. In case it is necessary to plant row crops on slopes of more than 3 per cent the rows should be planted on the contour. In addition the field should be terraced or planted in alternate strips of row crop and hay crop.

The average annual soil losses, where a good crop rotation (as corn, small grain, and legume hay) is practiced, are from one-third to one-sixth of the annual losses where corn or small grain is grown continuously. Even during the year when the corn is grown in the rotation, the soil loss is only about one-fourth of the loss from a similar field where corn is grown continuously.

Methods of erosion control are discussed more fully in Minnesota Special Bulletins 170 and 171, "Soil Erosion Control in Farm Operation" and "Soil Erosion Control by Engineering Methods."

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