SR 733 / March 1985

STEEP
INFORMATION FOR LEADERS IN LAND MANAGEMENT
Research and Extension in land management technology for farm profits and conservation of soil and water.

Drainage for Erosion Control in Western Oregon

THE PROBLEM

Land of the margins of the valley is used for small grains, pasture, hay, and grass grown for seed, and increasingly, used for fruit and horticultural crops. Many of the soils contain a silty-clay or clay layer at a depth of 2 to 3 feet. If the underlying layers have a high clay content they can restrict the percolation of rainwater, resulting in "perched" water tables. We now know that water tables at the soil surface lead to increased rates of runoff and erosion.

Tile increases the ability of the soil to absorb rainwater: For the last five years, the Department of Soil Science at Oregon State University has been measuring erosion rates in western Oregon with the help of the federally funded STEEP program. Since 1976, STEEP (Solutions to Environmental and Economic Problems) funds have been available to Oregon, Washington, and Idaho through the efforts of wheat growers organizations and the Associations of Conservation Districts.

The major emphasis of STEEP research at Oregon State University has been the measurement of erosion rates on the hilly western margins of the Willamette Valley in cooperation with the USDA/SCA and the Polk Soil and Water Conservation District. One outcome of this work has been an understanding of the way high water tables increase runoff and erosion on these lands. When water tables are high, rain falling on hillslopes moves quickly downslope as runoff and can cause serious erosion (Figure 1A). When water tables are absent and the soil is drier, for example during the early fall or after dry spells, rainfall does not become runoff unless the rainfall intensity is great; it is stored on the hillside in puddles and furrows until it infiltrates (Figure 1B).

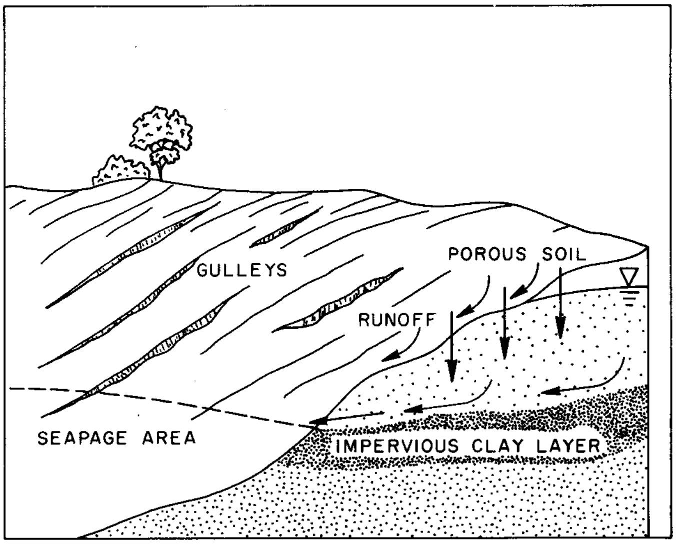

Fig. 1a. When infiltrating water reaches a relatively impervious layer, the temporary water table may rise to the soil surface. Then runoff occurs even when there is no concurrent rainfall.

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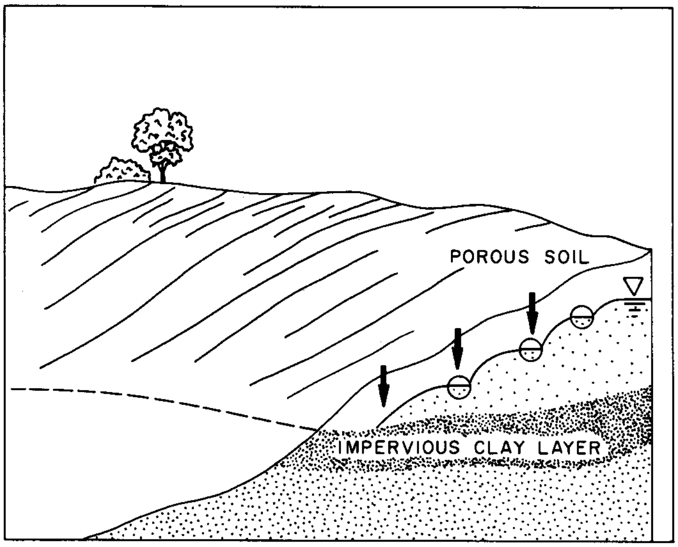

Fig. 1b. A more rapid lowering of the water table can prevent saturation induced runoff.

Erosion plot measurements show that areas of high water tables (near the soil surface) can produce significantly greater amounts of runoff than areas of low water tables (Figure 2).

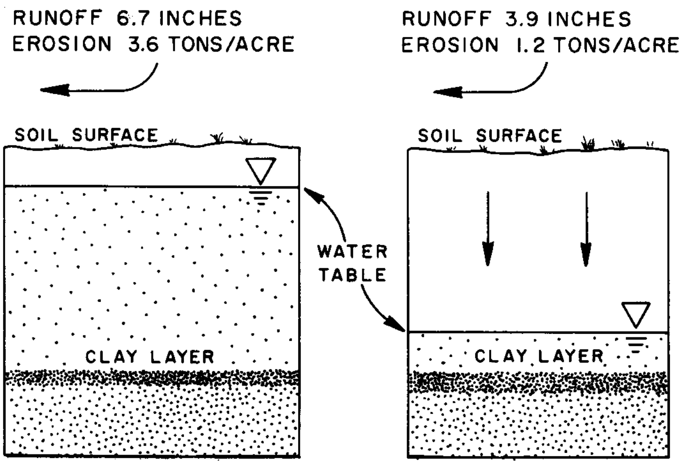

Fig. 2. Measurements in Polk county have demonstrated enhanced runoff and erosion associated with high (near the soil surface) perched water tables.

These observations and measurements suggest that tile drainage, by controlling soil water tables, can result in decreased rates of erosion. To test this idea, data were collected over a two-year period on paired watersheds. Then one watershed was drained, and the measurements were repeated for two years.

THE RESEARCH

Elkins Road drainage experiment: This experiment was conducted on the Elkins Road Experimental Watershed. The 704 acre Elkins Road Watershed contains three smaller watersheds which will be referred to as Watersheds 1, 2, 3 (1.1, 3.5, and 14.8 acres, respectively). The southern Polk County site is on rolling terrain typical of the western margin of the Willamette Valley. Total relief in the watershed (which has an average elevation of 262 feet) is about 33 feet, with slopes ranging from near zero to 15 percent. The annual precipitation is 40 inches, with approximately 70 percent of this total occurring from November through March.

The principal soil series on the study area is Willakenzie silt loam; a moderately deep, well drained deposit of silty material overlying either a clayey buried soil or weathered sandstone.

Rainfall, watershed runoff, and suspended sediment concentrations were measured continuously during the winter rainfall seasons from October 1977 to June 1981. In August 1979, after two winters of data collection, tile drains were installed on Watershed 2. Flexible plastic drain tubing (4 inches in diameter) was installed at a depth of 3 to 4 feet and a spacing of 40 feet (Figure 3).

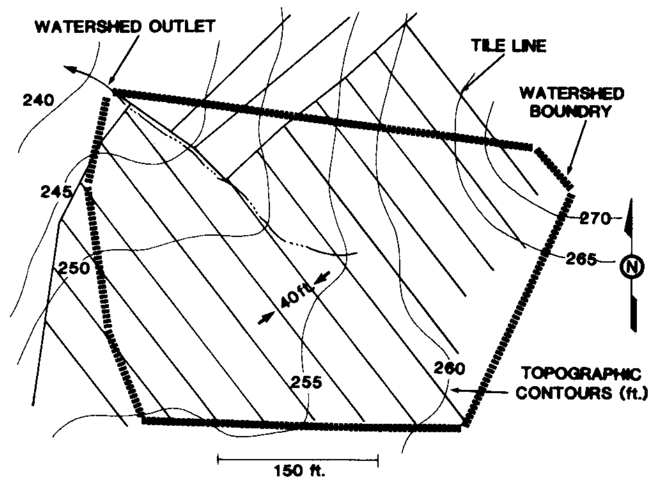

Fig. 3. Perforated plastic drain tube was installed at forty foot spacing covering a 2.3 acre sub-watershed.

The tubing was installed with a drain plow; grade control was maintained by the laser-plane method (Figure 4).

Fig. 4. Appreciable disturbance of the soil above the tube occurs with this method. Under the right soil conditions, topsoil mixing into the "backfill" to maintain sustained high infiltration potential is appreciable.

A hydrologic technique of comparison was performed on the flow records for Watersheds 1, 2, and 3 to estimate the amount of reduction of runoff and sediment yield. This method plots the cumulative amounts of runoff for one watershed against another so the relationship between the two may be seen and plotted as a straight line. Any treatment that changes the way one watershed responds is clearly seen in the slope of the line.

RESULTS

<u>Tile drainage reduced erosion</u>: Perched water tables were lowered and seepage was reduced on Watershed 2 after tile drainage. Plots of cumulative watershed runoff and sediment yield for Watersheds 2 and 3 are shown in Figure 5. After two rainfall seasons, Watershed 2 had 12.5 inches of runoff, or an average of 6.3 inches/year; Watershed 3 had a total of 20 inches of runoff, or an average loss of 10 inches/year (Figure 5A). For the two years after drainage, Watershed 2 had an additional 2 inches of runoff, or 1 inch/year, and Watershed 3 had 9 inches of runoff, or 4.5 inches/year. From this we can conclude that runoff from Watershed 2 was decreased by about 65% relative to Watershed 3 after drainage. For the two years before drainage, the average sediment yields from Watersheds 2 and 3 were 4 and 6 tons/acre/year, respectively (Figure 5b).

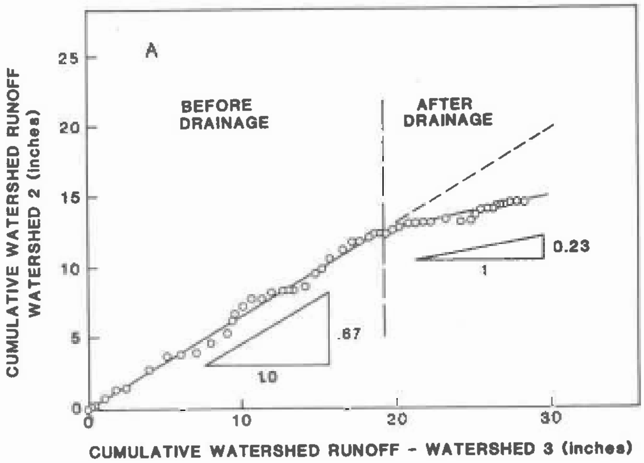

Fig. 5a. Relative water runoff was reduced 65% by drain installation.

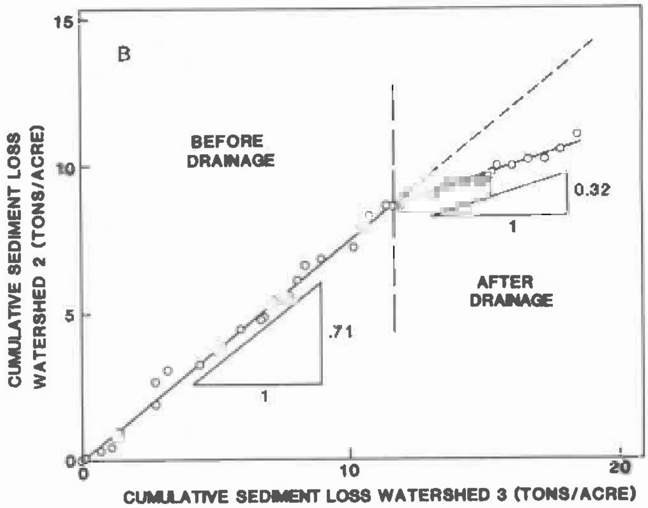

Fig. 5b. Relative erosion was reduced 50% by drain installation.

After drainage, the average sediment yields were 1.5 tons/acre/year for Watershed 2 and 4.5 tons/acre/year for Watershed 3. This means that sediment yield from Watershed 2 was decreased by about 55% relative to Watershed 3 by installing subsurface drains. Similar comparisons with Watershed 1 gave reductions of about 50% and 40% for watershed runoff and sediment yield, respectively. The reductions in runoff and sediment yield occurred because the tile drains, by lowering water tables, gave the soil a larger rainfall absorption and storage capacity.

CONCLUSIONS

Tiling for erosion control: We must remember that the results of this experiment were measured at only one location. Additional erosion research is continuing to determine if the results apply to a wider area than the one studied. Other tile spacings and layouts are being examined at a Columbia County site to find the best combination for economical erosion control. But based on results from Polk County, it is apparent that tile drains should be considered when planning conservation practices for western Oregon lands. More complete information is contained in a research paper. If you are interested in further information, write to the author for a copy of the reference listed below (1).

LITERATURE

(1) Istok, J. D. and G. F. Kling. 1983. Effect of subsurface drainage on runoff and sediment yield from an agricultural watershed in western Oregon. J. Hydrol. 65: 279-291.

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