Photo by Doug Palen.

Understanding Water Infiltration

by Rolf Derpsch

SCIENCE

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It is astonishing that often the process of water infiltration into the soil is not well understood by farmers, but also extension workers and scientists. Pictures showing the raindrop's impact on a bare soil surface and information explaining the mechanisms of water infiltration into the soil go back to the 1940s. Despite scientific and empirical evidence explaining these processes, many people still think that the soil has to be loosened by tillage to increase water infiltration and reduce runoff.

Precipitation runoff is often accepted as a largely unavoidable phenomenon associated with agriculture on sloping land. But this is not an unavoidable result; it is merely a symptom of land misuse for that ecological environment. In other words, inappropriate farming practices have been used. It is not the properties of nature (slope and rainfall intensity), but rather the irrational farming methods used by man, which are responsible for the large quantity of runoff and its negative consequences. The farmer can, through the utilization of adapted farming systems and management practices, effectively reduce or eliminate runoff by increasing water infiltration into the soil. Runoff water is lost as far as cropping is concerned, while infiltrated water can be effectively used by plants, which is very important in drier climates.

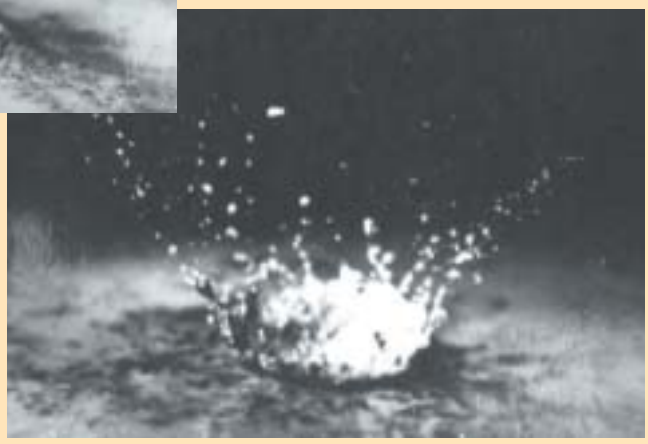
Conventional farming practices have had negative consequences in terms of soil and water preservation, as well as on the conservation of the environment as a whole. This is due to improper soil use, monoculture, burning, and the use of tillage tools that leave the soil bare and pulverize it excessively, leaving it in such a condition that heavy rains cannot infiltrate. The utilization of inappropriate methods not adapted to local conditions (slope, rainfall intensities) results in runoff.

The Process

Runoff starts with raindrop impact on a bare soil surface. Soil splash seen on fence posts, or on stakes in a field or plot of bare soil, is evidence of the force of large raindrops striking bare soil.[1] Other scientists have reported that in one year, raindrops deliver to an acre of land an impact energy equivalent to 20 tons of TNT (50 t/ha).[2] The impact of falling raindrops disaggregates the soil into very fine particles, which clog soil pores and create a surface seal that impedes rapid water infiltration.

Research shows that the percentage of soil covered with plant residues is the most important factor influencing water infiltration into the soil.

Due to surface sealing, only a small portion of rainwater can infiltrate the soil; most of it runs off over the soil surface, therefore is lost for crop use, and causes erosion damage when flowing down the slopes.



Photos by USDA.

The impact of raindrops on a bare soil surface. When it rains, drops up to 6 mm (0.24 inch) in diameter bombard the soil surface at impact velocities of up to 32 km per hour (20 mph). This force throws soil particles and water in all directions on a distance of up to 1 m (3.3 feet). The photos date from the 1940s.

[1] L.L. Harrold, 1972, Soil erosion by water as affected by reduced tillage systems, in Proceedings: No-tillages Systems Symp. (21-22 Feb. 1972), Ohio State University.

[2] L.L. Meyer & J.V. Mannering, 1967, Tillage and land modification for water erosion control, in Proceedings: Amer. Soc. Agric. Eng. Tillage for Greater Crop Production Conference (11-12 Dec. 1967).

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