United States Department of Agriculture

NRCS Natural Resources Conservation Service

South Dakota Fact Sheet

Soil Health

Predicting Infiltration rates for Grazing lands and Cropland

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What is infiltration?

The process of water soaking into the soil is infiltration. "Infiltration rate" is simply how fast water enters the soil and is usually measured in inches or millimeters per hour. This rate depends on soil structure, and soils in good condition have well developed structure and continuous pores (macropores) to the surface. As a result, water from rainfall or snowmelt readily enters these soils.

Why is infiltration important?

Soil is a reservoir that stores water for plant growth. The water in soil is replenished by infiltration. The infiltration rate can be restricted by poor management. Under these conditions, the water does not readily enter the soil and it moves downslope as runoff or ponds on the surface, where it evaporates. Thus, less water is stored in the soil for plant growth, and plant production decreases (an inch of water that enters the soil is equivalent to roughly 150 pounds per acre of grass production), resulting in less organic matter in the soil and weakened soil structure that can further decrease the infiltration rate.

Runoff can cause soil erosion and the formation of gullies. It also carries nutrients and organic matter, which, together with sediment, reduce water quality in streams, rivers, and lakes. The sediment reduces the capacity of reservoirs to store water. Excessive runoff can cause flooding, erode streambanks, and damage roads. Runoff from adjacent slopes can saturate soils in low areas or can create ponded areas, thus killing upland plants. Evaporation in the ponded areas reduces the amount of water available to plants.

What factors affect infiltration?

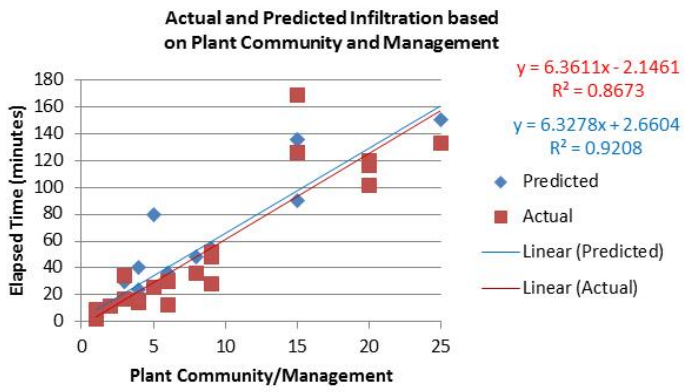
The proportion of water from rainfall or snowmelt that enters the soil depends on "residence time" (how long the water remains on the surface before running off) and the infiltration rate. These are affected by vegetation and many soil properties. Primary factors affecting infiltration are plant community (relative to the ecological site) and grazing system for rangeland, and plant community (i.e. rotational diversity/cover crops) and tillage system for cropland.

Predicting Infiltration rate

The prediction of infiltration rate for grazing land or cropland is determined by the plant community (i.e. diversity) and the type of management (i.e. grazing system or tillage system) being employed. Each land use is rated on a five-tier scale in a factorial arrangement such that the value for the interaction is the product of the multiplication.

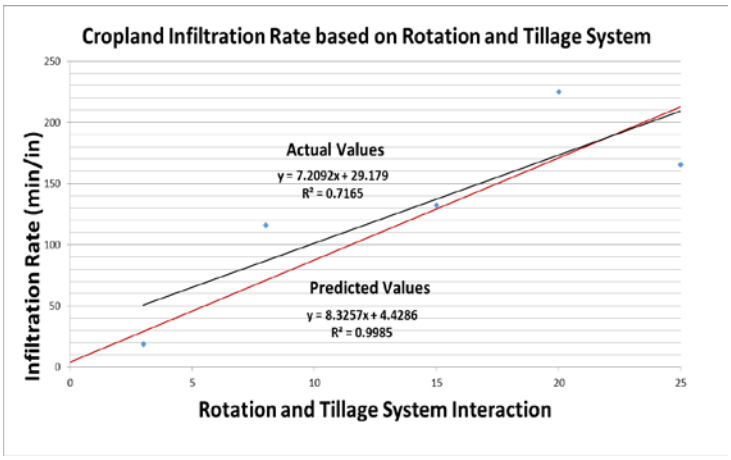
An example of this prediction system would be a Loamy ecological site dominated by non-native cool-season grasses, with moderate stocking rates and grazed for most of the growing season. The prediction would suggest infiltration rates of 80 min. or greater; whereas, moving to a rotational grazing system closer to the Prescribed Grazing Standard (528) may provide rate reductions of 50 to 60% from the initial value.

Rangeland Predicted Rates



A cropland examples of this interaction might involve reviewing a field with a corn/soybean rotation with a reduced-till system (full-width tillage -15-30% surface residue cover) providing an infiltration rate of 120 min. whereas a no-till system with the same rotation may have rates at 40 minutes or less.

Cropland Predicted Rates



The length of time that water remains on the surface depends on the slope, the roughness of the soil surface, and obstructions to overland flow, such as plant bases and residue cover /litter. Consequently, plant communities with large amounts of basal area cover, such as grasslands, tend to slow runoff more than communities with small amounts of basal cover, such as tilled row crop fields.

Infiltration rate

The infiltration rate is generally highest when the soil is dry, has a well-developed plant community/ microbial community and an intact residue /litter cover on the soil surface. As the soil becomes wet, the infiltration rate slows to the rate at which water moves through the most restrictive layer, such as a compacted soil layer.

Management strategies to increase water infiltration include:

- Increase the amount of plant cover, especially of plants that have positive effects on infiltration. This usually means increasing the composition of native grasses and can be accomplished through improved grazing strategies or in cropland rotational diversity and cover crops.
- Decrease the extent of compaction by avoiding intensive grazing and the use of machinery when the soils are wet.
- Eliminate or severely reducing soil disturbance. Tillage decreases aggregate stability, plugs existing macropores, and decreases critical surface residue cover.
- Decrease the formation of physical crusts by maintaining or improving the cover of plants or litter/residue and thus reducing the impact of raindrops.
- Increase aggregate stability by increasing the amount of organic matter added to the soil through residue decomposition and vigorous root growth. This is accomplished by leaving adequate plant cover to allow for plant recovery and improved nutrient cycling.

For more information. Check the following: http://www.nrcs.usda.gov/wps/portal/nrcs/main/sd/soils/health/

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