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After the Fires: Hydrophobic Soils

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Fire is a natural and important environmental factor that has affected virtually all western U.S. forests at one time or another. However, there are situations where fire can be catastrophic. Aside from property and aesthetic loss, this can include situations where highly erodible soils are exposed by burning the organic material on the soil surface. The burning of litter and organic material can reduce infiltration, increase surface runoff and erosion, and lead to hydrophobicity, or hydrophobic soils.

Hydrophobic soils repel water. A thin layer of soil at or below the mineral soil surface can become hydrophobic after intense heating. The hydrophobic layer is the result of a waxy substance that is derived from plant material burned during a hot fire. This waxy substance penetrates the soil as a gas and solidifies after cooling, forming a waxy coating around soil particles. The layer appears similar to non-hydrophobic layers.

Why is hydrophobicity important? Fire induced water repellency can affect the soil and the watershed in the following ways:

- Hydrophobic soils repel water, reducing the amount of water infiltrating the soil.
- Decreased soil infiltration results in increased overland and stream flow.
- Erosion increases with greater amounts of runoff and fertile topsoil can be lost.
- Increased runoff carries large amounts of sediments that can clog stream channels and lower water quality.
- Depending on the intensity of the fire, hydrophobic layers can persist for years, especially if they are thick.

Very high temperatures are required to produce the gas that penetrates the soil and forms a hydrophobic layer. Soils that have large pores, such as sandy soils, are more susceptible to the formation of hydrophobic layers because they transmit heat more readily than heavy textured soils (clays). Coarse textured soils also have larger pores that allow deeper penetration of the gas.

Hydrophobic layers are generally ½ inch to 3 inches beneath the mineral soil surface and are commonly up to 1 inch thick, though some layers can be several inches thick. The thickness and continuity of the layer varies across the landscape. The more continuous the layer, the greater the reduction in infiltration.

To detect these layers, scrape away the ash layer and expose the mineral soil surface. Place a drop of water on air-dry soil and wait one minute. If the water beads, the soil layer is hydrophobic. The upper few inches are generally not hydrophobic. In these cases, it is necessary to scrape away a layer of soil ½ to 1 inch thick and repeat the test until you find the upper boundary of the water repellent layer. Once the layer is found, you can determine its thickness by continuing to scrape and use the water drop method until the water no longer forms a bead.

Thicker hydrophobic layers will persist for more than a year and will continue to impact infiltration and plant growth during that time. Plant roots, soil microorganisms, and soil fauna help break down hydrophobic layers. However, reduced water infiltration will decrease the amount of water available for plant growth and soil biological activities that break down hydrophobic layers.

CONTINUED ON PAGE 2

To treat hydrophobic layers you can:

- Place fallen logs or fall trees across slopes to slow runoff and intercept sediment.
- On level or gentle slopes, rake or hoe the upper few inches of soil to break up water repellent layers, allowing water to infiltrate soils for seed germination and root growth.
- On gentle to steep slopes, scatter straw mulch to protect soils from erosion. If possible, anchor straw to hold it in place.
- Use seeding, straw bale check dams, silt fences, and other practices that control erosion and reduce runoff.

For more information on erosion control, contact your local County Extension Office or Natural Resources Conservation Office.

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