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Vegetative ash: an important factor in the short term response to rainfall in the post-fire environment

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The formation of a surface ash layer during wildfires may accentuate surface sealing by providing an additional source of fine material. Alternatively, it may reduce runoff by storing rainfall and by protecting the soil surface from raindrop impacts. We used simulated rainfall experiments to assess the effect of ash formation on post-fire runoff at two forested sites in western Montana USA, one with sandy loam soils formed out of granodiorite and the other with gravelly silt loam soils formed out of argillite. At each site we measured the runoff from simulated rainfall in replicated 0.5 m^2 plots before and after application of the following treatments: 1) manual removal of the litter and duff layers, 2) burning with a fuel load of 90 Mg ha^{-1}, and 3) addition of 0.5, 2.5 and 5 cm of ash to plots from which the litter and duff had previously been removed. Manual removal of the litter and duff layers reduced the mean final infiltration capacity in the sandy loam plots from 64 mm hr^{-1} to 40 mm hr^{-1}, but had no significant effect on the gravelly silt loam plots. In the burned plots the surface litter and duff layers were completely consumed and a 0.6 to 1.2 cm layer of black and gray ash and char was formed, indicating a moderate severity burn. The mean soil temperature in the upper 1 cm of the mineral soil was less than 100^oC, and there was no detectable increase in water repellency. Burning reduced the mean final infiltration capacity of the burned sandy loam plots to 35 mm hr^{-1} compared to a pre-fire mean of 91 mm hr^{-1}, but had no significant effect on the gravelly silt loam plots. Decreases in infiltration in the sandy loam plots due to the duff removal and burning treatments can be attributed to rainsplash induced surface sealing. Micromorphological analysis of the soil profiles indicated that burning had a greater effect on infiltration than duff

removal because the thin ash layer provided an additional source of fine material that clogged soil pores. In contrast with these results, the addition of 2.5 and 5.0 cm of ash increased the time to ponding by as much as a factor of 4 and reduced the total runoff, indicating that while thin ash layers can promote sealing thicker ash layers reduce the runoff rate by providing additional storage for rainfall and by protecting the soil surface from sealing due to raindrop impacts. Ash can significantly affect the short-term response to rainfall in burned soils, but the nature of the effect depends on both the soil texture and the ash thickness.