Does ash contribute to post-fire soil sealing and increased runoff rates?

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Abstract. Runoff rates often increase by an order of magnitude after high severity wildfires. The increase in post-fire runoff has been attributed to soil water repellency, loss of surface cover, decreased surface roughness, and soil sealing by sediment or ash particles. The objective of this study was to determine whether a surface ash layer induces soil sealing and increases runoff from burned soils. Simulated rainfall was applied to 0.15 m^2 plots in the laboratory using two soils and three ash treatments: 1) a high ash treatment of 6.3 kg m^{-2} or ~15 mm depth; 2) a low ash treatment of 2.9 kg m^{-2} or ~7.5 mm depth; and 3) bare soil. Three simulations were conducted for each treatment on a coarse-textured granitic soil and a slightly finer-textured micaceous soil. Rainfall was applied at 45 mm h^{-1} for 45 minutes and the runoff rates were used to assess the treatment effect.

For the granitic soil the mean final runoff rate for the high ash treatment was 1.0 mm h^{-1}, and the respective values for the low ash and bare soil treatments were 2.1 and 3.5 times higher. For the micaceous soil the trend was similar to the granitic soil but the runoff rates were 2-3 times lower. For both soils the runoff rate from the bare soil treatments greatly increased over the duration of the simulations, and the mean final runoff rate was significantly higher than either ash treatment ($p \leq 0.05$). These results suggest that raindrop impact on the bare soil induced soil sealing, whereas the ash protected the underlying soil and sustained higher infiltration rates. These controlled experiments compliment our field studies, which have shown that surface cover is a dominant control on post-fire erosion rates.

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