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Rainfall and wet and dry cycle's impact on ash thickness. A laboratory experiment

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Ash is the most important and effective soil protection in the immediate period after the fire (Cerda and Doerr, 2008; Pereira et al., 2015a). This protection can last for days or weeks depending on the fire severity, topography of the burned area and post-fire meteorological conditions. In the initial period after the fire, ash is easily transported by wind. However after the first rainfalls, ash is eroded, or bind in soil surface (Pereira et al., 2013, 2015a). Ash thickness has implications on soil protection. The soil protection against the erosion and the ash capacity to retain water increases with the ash thickness (Bodi et al., 2014). Ash cover is very important after fire because store water and releases into soil a large amount of nutrients, fundamental to vegetation recuperation (Pereira et al., 2014). Despite the importance of ash thickness in post fire environments, little information is available about the effects of rainfall and wet and dry cycle's effects on ash thickness. This work aims to fill this gap. The objective of this study is to investigate the impacts of rainfall and wet and dry cycles in the ash thickness of two different under laboratory conditions. Litter from Oak (Quercus robur) and Spruce (Picea abis) were collected to and exposed during 2 hours to produce ash at 200 and 400 C. Subsequently a layer of 15 mm ash was spread on soil surface in small boxes (24x32 cm) and then subjected to rainfall simulation. Boxes were placed at a 17% of inclination and a rainfall intensity of 55 mm/h during 40 minutes was applied. After the rainfall simulation the plots were stored in an Oven at the temperature of 25 C during four days, in order to identify the effects of wet and dry cycles (Bodi et al., 2013). Ash thickness was measured after the first rainfall (AFR), before the second rainfall (BSR) – after the dry period of 4 days – and after the second rainfall (ASR). In each box a grid with 57 points was designed in order to analyse ash thickness AFR, BSR and ASR. The results showed that AFR, ash thickness was reduced by 7.97% (±18.13) and 32.02 % (±37.44) in the Oak ash produced at 200 C (Oak 200) and 400 C (Oak 400), respectively. The spruce ash layer produced at 200 (Spruce 200) decreased 7.26% (±15.11) and 13.11 % (±18.40) in the ash produced at 400 C (Spruce 400). Before the second rainfall we identified that Oak 200 ash layer reduced approximately 15.95 (±15.81) while Oak 400 decreased 47.98% (±28.97). Spruce 200 ash layer was reduced by 14.52 (±14.57) and Spruce 400 by 18.68 (±17.54). In the last rainfall experiment, it was observed that Oak 200 ash layer decreased 14.88 (±14.09) and Oak 400 ash layer 44.52 (±28.85). Spruce 200 ash layer reduced 13.10 (±14.76) and spruce 400 18.33 (±21.69). The spatial pattern (assessed with Moran's I index) of the ash later of Oak 200 and Oak 400 AFR was significantly clustered ($p<0.001$). The spatial pattern of Spruce 200 was random ($p>0.05$) and Spruce 400 significantly clustered ($p<0.001$). Before the second rainfall, the spatial pattern of Oak 200 and Oak 400 was significantly clustered at a $p<0.05$ and $p<0.001$. The same situation was identified in Spruce 200 and Spruce 400 ($p<0.001$). Finally, ASR, the spatial pattern observed in Oak 200 and Oak 400 was significantly clustered at a $p<0.05$ and $p<0.001$. This was also identified in Spruce 200 and Spruce 400. Overall, the thickness decrease was higher in the ash layers produced at high temperature. The differences were mainly observed in oak ash. The dry cycle did not have an important impact on ash thickness in both species as the second rainfall cycle. The results from the Moran's I analysis showed that after the rainfall experiment the ash was mainly concentrated in a specific part of the plot. In this case it was located in the bottom of the experimental plot.

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