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Impact of a prescribed fire on soil water repellency in a Banksia woodland (Western Australia)

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INTRODUCTION

The Swan Coastal plain of Western Australia is dominated by fire-prone banksia woodland (Burrows and McCaw, 1990). In these areas, prescription burning is often used to reduce the risk of wildfires, by reducing available fuels (Boer et al., 2009). Little research has been conducted on the effects of prescription burning on Banksia woodlands, and, in particular, information on the impacts on soil properties and soil water repellency (SWR) is scarce. Here, we have studied the impact of fire on SWR in a Banksia woodland and monitored its evolution in the medium-term. It is expected that results are useful for management and restoration of fire-affected Banksia woodlands.

METHODS

An experimental fire was conducted on May 7th 2015 in Kings Park, Perth, Western Australia. The fire affected an area of 6 ha of mixed Banksia/Allocasuarina woodland under moderate fire intensity. At the time of ignition, the wind speed below the canopy was 1.2 km/h. During the prescribed burning, air temperatures were on average 20 ± 1 °C and relative humidity ranged between 45 and 55% (measured using a Kestrel portable weather station). Fuel moisture averaged 11.8% (measured using Wiltronics moisture meter) and soil moisture at 1 cm deep ranged from 0.1% to 8.6% (measured with a PR2 soil profile probe attached to a HH2 data logger). Temperatures greater than 120 °C were measured 1 cm below the soil surface using iButton temperature sensors. SWR was measured under lab conditions in oven-dry samples (48 h, 105 °C) with the water drop penetration time (WDPT) test. Soil microbial activity was determined with the 1-day CO_2 test that is based on the measurement of the CO_2 burst produced after moistening dry soil (Muñoz-Rojas et al., 2016).

PRELIMINARY RESULTS AND DISCUSSION

SWR was severe in the control (mean WDPT = 2608 s) and pre-burned areas (2722 s). One week after the prescribed fire, persistence of soil water repellency remained stable in the burned area (2402 s). In contrast, extreme SWR was observed in the burned area (3750 s). This may be explained by a reduction of water repellency by burning (Zavala et al., 2009; Jordán et al., 2014), as environmental conditions led to an increase in control areas. Although prescribed burning usually do not produce high severity fires, evidences of high severity were found, due to prolonged smouldering caused by subsurface Banksia root clusters. In some cases, this led to release of iron oxides, observed as red spots in the surface.

Fire in Mediterranean and semi-arid environments has a significant effect on microbial biomass and the composition of soil microbial communities during the post-fire period, when soil nutrients become available (Bárcenas-Moreno et al., 2011; Muñoz-Rojas et al., 2016). In our study, microbial activity increased sharply in the burned area and most likely contributed to a decrease of organic hydrophobic substances in the first centimetres of the soil profile. Bárcenas-Moreno et al. (2011) observed that bacterial activity increases immediately after fire, while fungi decreased and recovered slowly. These processes may contribute to explain differences in SWR following fire, since this soil property may be influenced by fungal activity (Lozano et al., 2013).

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REFERENCES

Bárcenas-Moreno G, García-Orenes F, Mataix-Solera J, Mataix-Beneyto J, Bååth E. 2011. Soil microbial recolonisation after a fire in a Mediterranean forest. Biology and Fertility of Soils 47: 261-272. DOI: 10.1007/s00374-010-0532-2.

Boer MM, Sadlet RJ, Wittkuhn RS, McCaw L, Grierson PF. 2009. Long-term impacts of prescribed burning on regional extent and incidence of wildfires—evidence from 50 years of active fire management in sw australian forests. Forest Ecology and Management 259: 132-142. DOI: 10.1016/j.foreco.2009.10.005.

Burrows ND, McCaw WL. 1990. Fuel characteristics and bushfire control in banksia low woodlands in western australia. Journal of Environmental Management 31: 229-236. DOI: 10.1016/S0301-4797(05)80036-2.

Jordán A, Gordillo-Rivero AJ, García-Moreno J, Zavala LM, Granged AJP, Gil J, Neto-Paixão HM. 2014. Post-fire evolution of water repellency and aggregate stability in Mediterranean calcareous soils: A 6-year study. Catena 118:115-123. DOI: 10.1016/j.catena.2014.02.001.

Lozano E, Jiménez-Pinilla P, Mataix-Solera J, Arcenegui V, Bárcenas GM, González-Pérez JA, García-Orenes F, Torres MP, Mataix-Beneyto J. 2013. Biological and chemical factors controlling the patchy distribution of soil water repellency among plant species in a Mediterranean semiarid forest. Geoderma 207-208:212-220. DOI: 10.1016/j.geoderma.2013.05.021.

Muñoz-Rojas M, Erickson TE, Martini D, Dixon KW, Merritt DJ. 2016. Soil physicochemical and microbiological indicators of short, medium and long term post-fire recovery in semi-arid ecosystems. Ecological Indicators 63:14-22. DOI: 10.1016/j.ecolind.2015.11.038.

Zavala LM, Jordán A, Gil J, Bellinfante N, Pain C. 2009. Intact ash and charred litter reduces susceptibility to rain splash erosion post-wildfire. Earth Surface Processes and Landforms 34: 1522-1532. DOI: 10.1002/esp.1837.