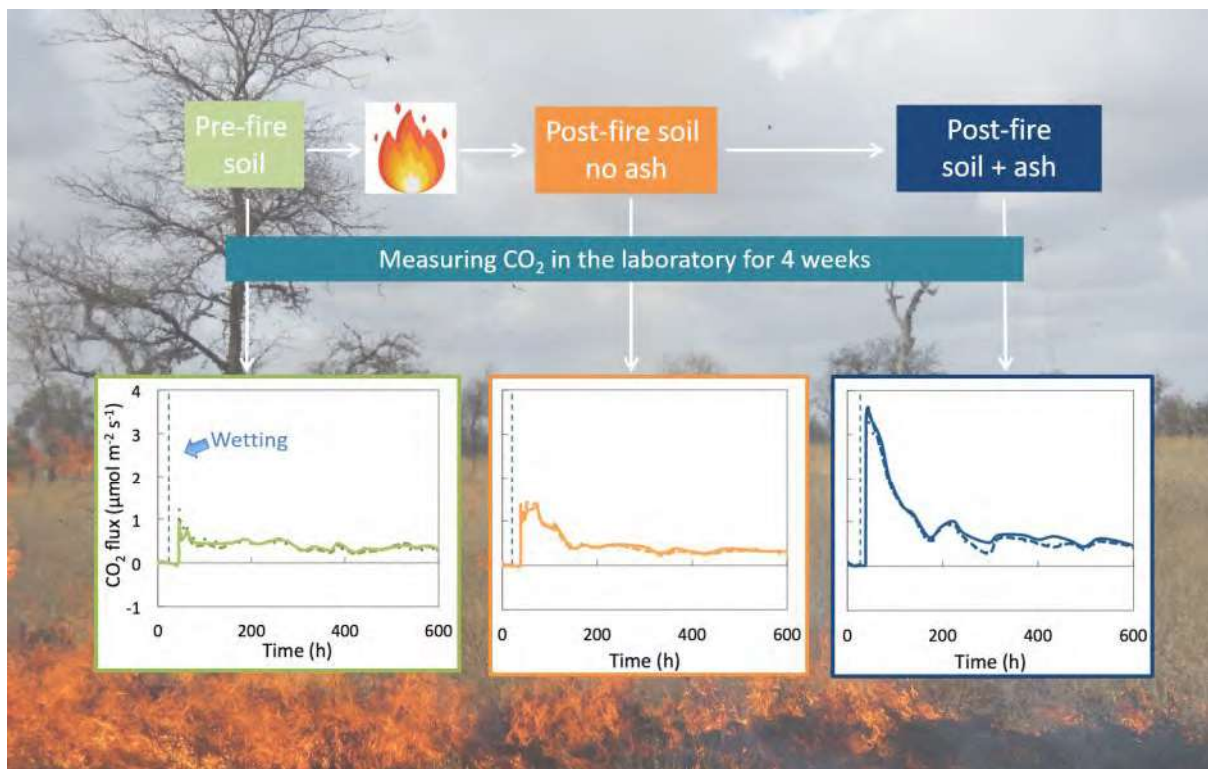


Unseen fire effects below our feet: how soil microbes kick ash after fire

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Photos by Tercia Strydom



Fires and savanna go hand in hand and vegetation and wildlife are known to be adapted to frequent burning. Whether soils and organisms living below ground cope with savanna fires equally well is less understood. In a recent study, we investigated how soil microbes responded to fire, with and without the presence of ash. The problem with ash is that although it is a direct product of fires, it is challenging to study. Ash is very light and loose, and wind and water can quickly transport it away from the soil surface of a

recently burned area, even before researchers arrive at the study site. Microbes are tiny but abundant organisms, with trillions of them residing under our feet, in the soil. They support several ecosystem processes vital for plant survival, including the transformation of nutrients present in the soil, making them available for plants to absorb.

For our study, we collected soil and ash samples from three locations in the Kruger National Park before and after experimental savanna fires (Fig. 1). In the laboratory, we measured carbon dioxide (CO₂) emissions from pre-fire soil, post-fire soil (without ash), and from post-fire soil mixed with ash. Microbes, like humans and other animals, respire CO₂ to the atmosphere, and this can be used as

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an indication of their activity levels. For instance, respiration tends to decrease when soils are very dry, which was the case at the start of our experiment (Fig. 1).

When we wetted the samples to simulate rain and reactivate microbial activity, we observed similar levels of CO₂ emissions from both the pre- and post-fire soils without ash. This means that microbes had similar activity levels before and after the fires (Fig. 1). The relatively low temperatures (<80 °C in most cases) registered in the first centimetres of the soil during the savanna fires, compared with those observed in more intense fires (for example, in forests) did not have a negative effect on microbial activity.

In contrast, adding ash to the soil increased soil microbial activity, as shown by the 2 to 3-fold increase in CO₂ from the burnt soil with ash (Fig. 1). This is because ash is rich in nutrients that, when mixed with water, can be easily used by microbes as a source of energy, boosting their activity, something akin to a soil energy drink. We also observed that a large proportion (up to 40%) of the total CO₂ respired over the four-week experiment, occurred over just a few hours after the soils were first wetted. This short but intense release of CO₂ can be easily missed in post-fire carbon studies.

To conclude, ash should be considered as a key player in studies looking at the effect of fire on soils, on microbes or even on ecosystem carbon fluxes. The boosting effect of ash on microbial activity is important in a post-fire environment. As microbes re-awaken and become active again, they make nutrients available to plants and help vegetation to recover after the fire, and they love using ash to do that.



Top: one of the three experimental fires used in the Kruger National Park to study the important contribution that ash makes to ecosystem functioning. **Bottom:** sampling ash after the fires.

● Sánchez-García C, Santín C, Doerr SH, **Strydom T** & Urbanek E. 2021. Wildland fire ash enhances short-term CO₂ flux from soil in a Southern African savannah. *Soil Biology and Biochemistry* 160: 108334.