IS CHARCOAL IMMORTAL?

MICROBIAL DECOMPOSITION OF BLACK CARBON PRODUCED FROM FOREST FIRES

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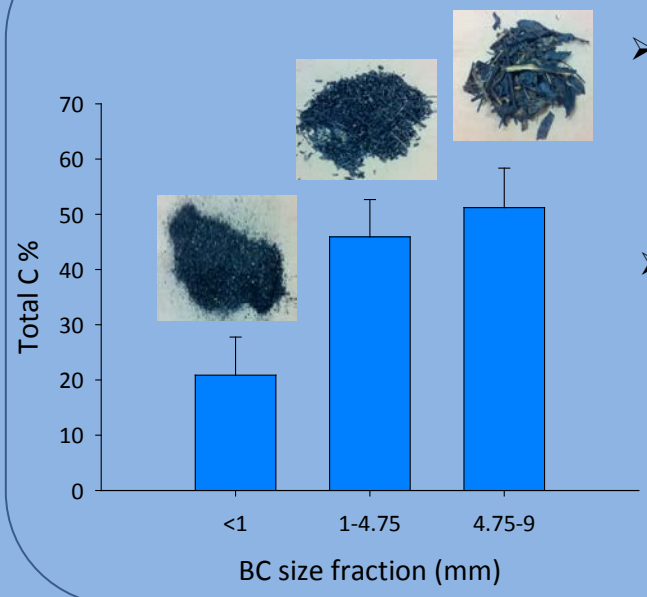
Significance:
To investigate the effects of deposition of black carbon after fire on soil carbon pools

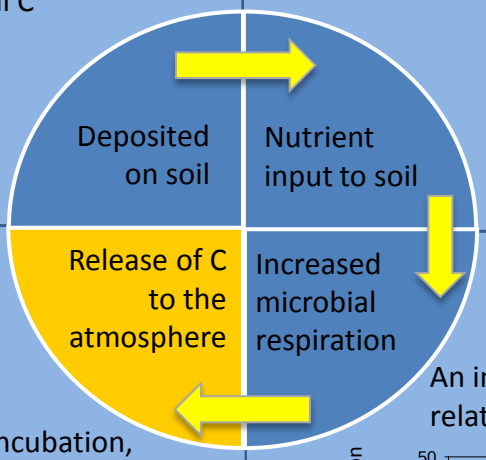
Background: In forests, fire is an important driver of carbon (C) storage in Australia. Although combustion of vegetation releases biomass C to the atmosphere, it also transforms biomass C to black carbon (BC). This can represent a significant amount of C. Large amounts of BC deposited on the soil surface is incorporated into the soil via biological activity of macro fauna. Due to its aromatic structure, BC is presumably resistant to microbial decomposition in soil.

Method: Soil was collected from unburnt sites in mixed species forests in East Gippsland, Victoria. Soil and BC was also collected after prescribed burning. Pre fire soil was incubated after addition of a range of (i) amounts and (ii) size fractions of BC and for varying times to measure changes in microbial respiration. Microbial respiration is an indicator of the rate of removal of C from soil by microbial decomposition.

The carbon content of BC varies widely

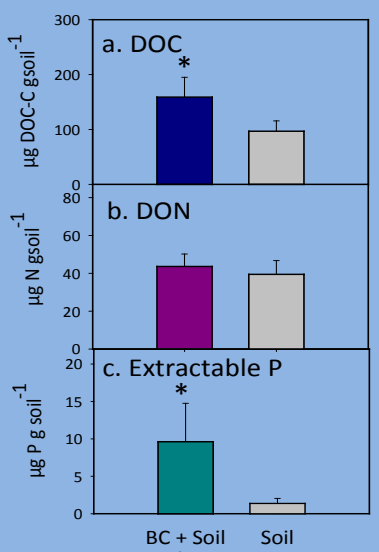


- Coarse BC is partially burned material with easily recognisable components, such as leaves and twigs
- Finer BC represents more complete combustion and loss of total C



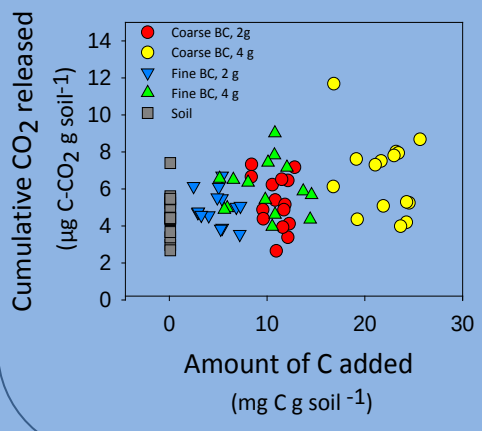
Adding BC to soil increases soil C and P

- Immediately after adding BC to soil, dissolved organic C (DOC) and extractable phosphorus (P) increased. There was no significant change in dissolved organic nitrogen (DON)
- Suggests BC has readily decomposable C. Burning releases P from original plant material



*T-test, n = 6. * represent p <0.05*

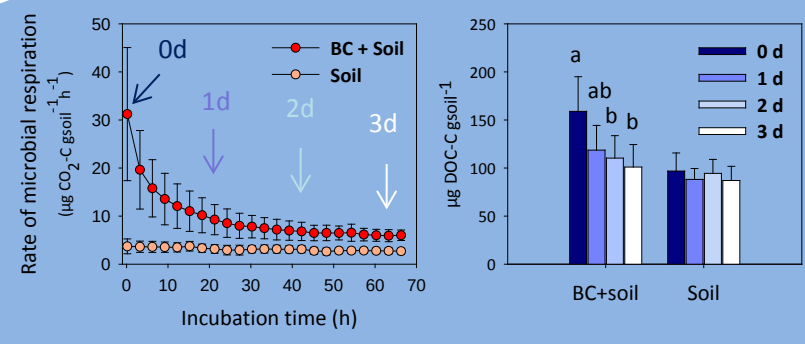
In the long term, decomposition of BC depends on soil type, size and amount of BC added to soil



- After 86 days of incubation, more CO_2 was released when C was added to soil as a greater amount of BC or a larger size fraction
- This suggests that if greater amounts of BC are produced (e.g. from higher intensity forest fire), there be an increase in soil C respiration

In the short term, adding BC increases microbial decomposition

An increase in microbial respiration was significantly related to the amount of DOC from the BC added



(Left) *Rate of microbial respiration , n = 6.* ***(Right)*** *Dissolved carbon change over incubation time (day), one-way ANOVA, n = 6*

End user statement: *Managing fuels in forests requires land managers to make decisions around trade-offs for other ecosystem values and carbon stocks are one of the values we need to consider in the context of climate change mitigation as well as ecosystem function and resilience. Fuel management has an implicit impact on some stores of carbon, particularly fine fuels and the role of charcoal, which is postulated to maintain longer residence times is a key carbon store in many fire-prone forests. Better understanding the role of charcoal in carbon cycling, and in particular the potential priming effect it may have on other nutrient cycling processes is critical in understanding the trade-offs we need to make when considering forest fuel management against bushfire mitigation.*
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