

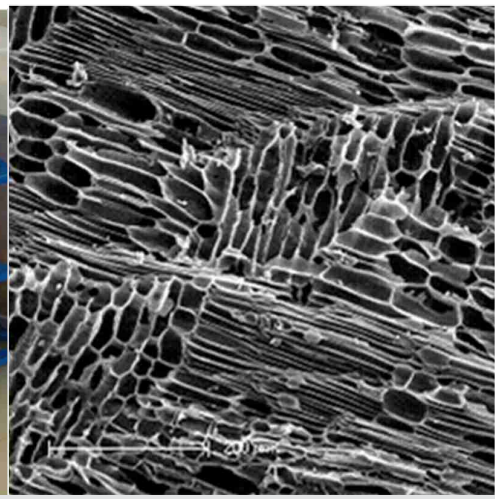

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Nutrient dynamics following biochar application to soil

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Background

- Objective:
  understand how a) inherent biochar nutrient content and b) added nutrients (fertiliser) applied to different soil types affect nutrient retention dynamics

- Implications:
  If differences in response are a function of soil type rather than biochar type, the application of biochar may need to be limited to specific soil types

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Background

• Soils:
Acidic sand (WA)
Fe- and Al-rich ferrosol (NSW)

• Biochars:
450˚ C wheat straw
450˚ C chicken manure

• Nutrients:
P (as phosphate)
S (as sulfate)
N (as nitrate)

• Approaches:
Adsorption and desorption experiments of pure biochars and biochar-soil mixture and measurements of the proportion of nutrients in solution after 48 hours

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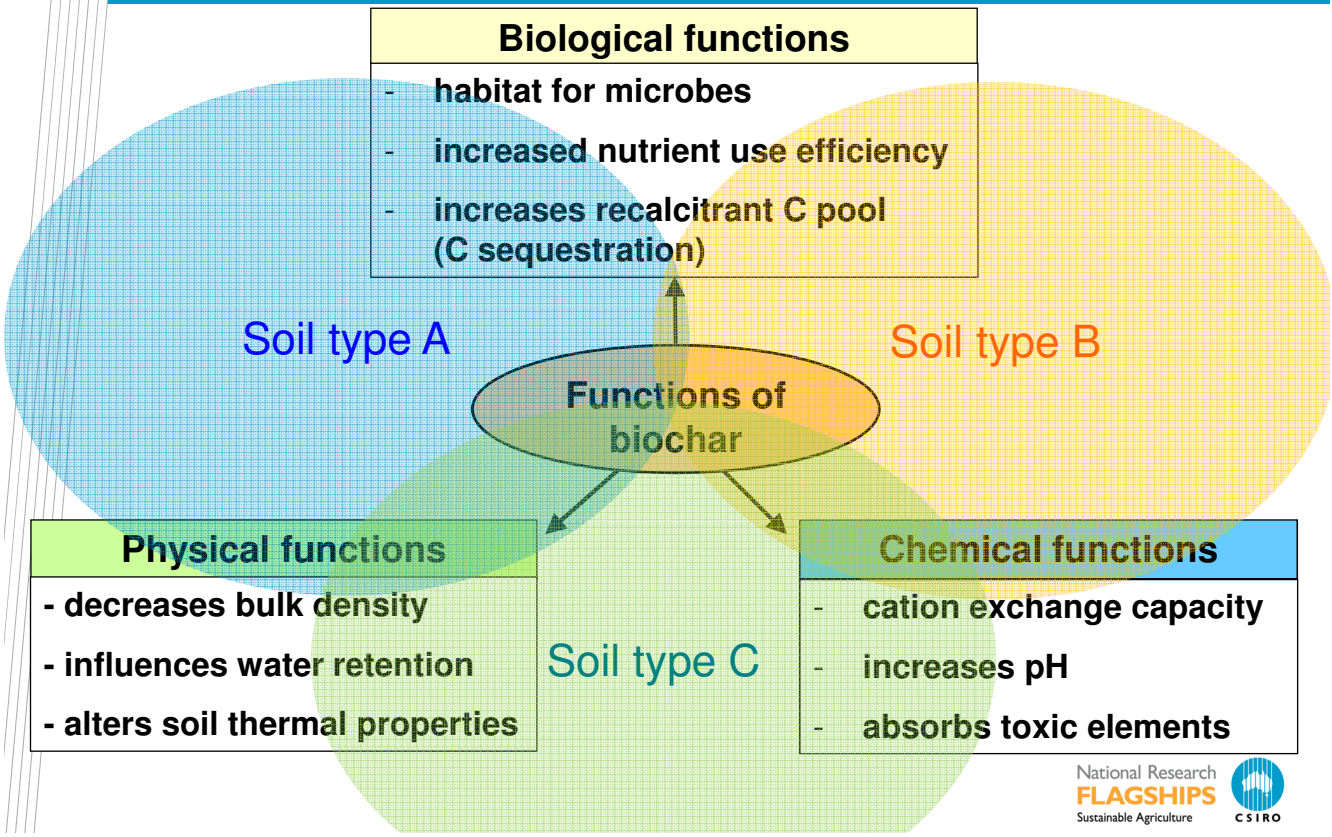
Possible biochar functions in soil



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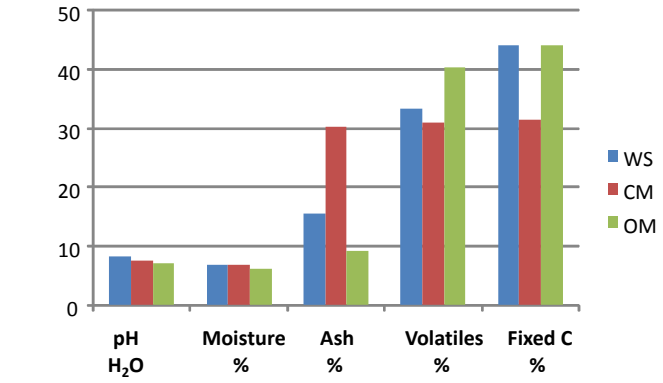
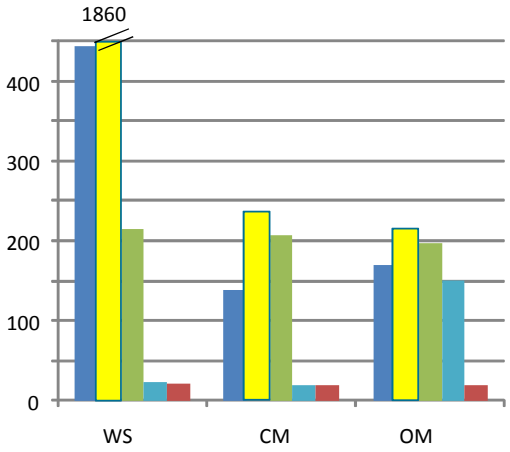
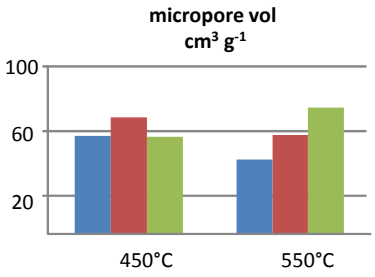
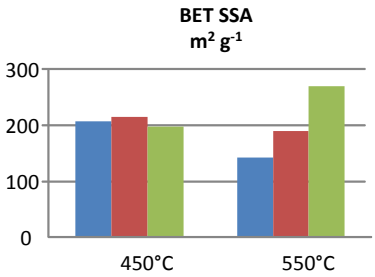
Some biochar characteristics

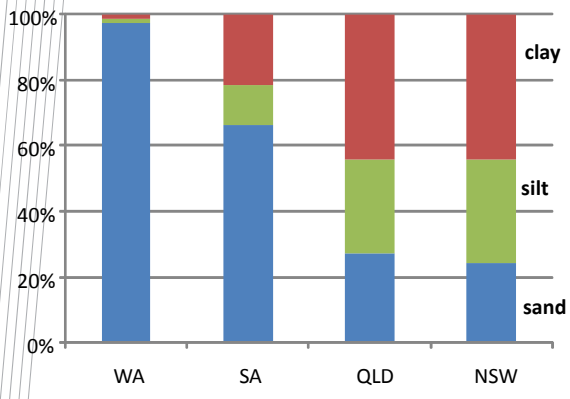


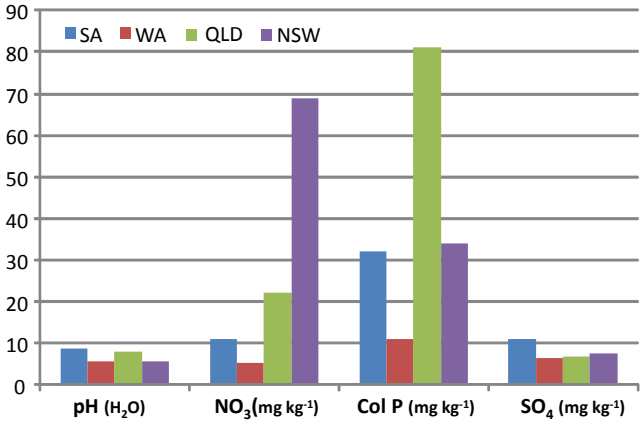






Some soil characteristics





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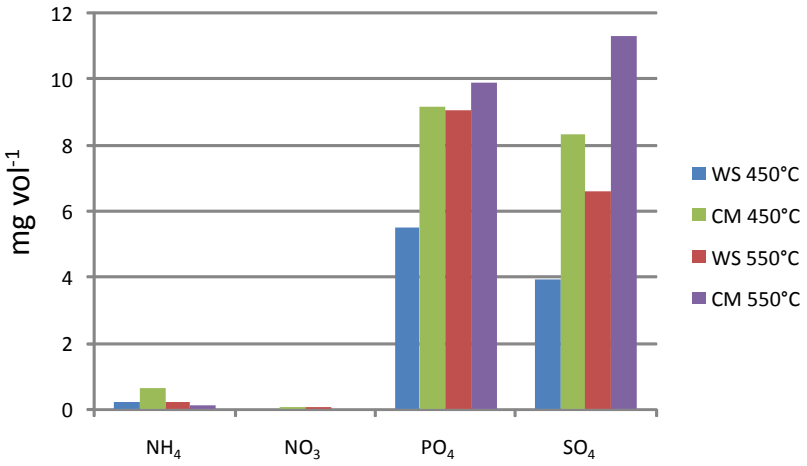
Nutrient release in pure biochar materials



- water-extracts
- extracts averaged over 6 sampling times to max of 240 hours

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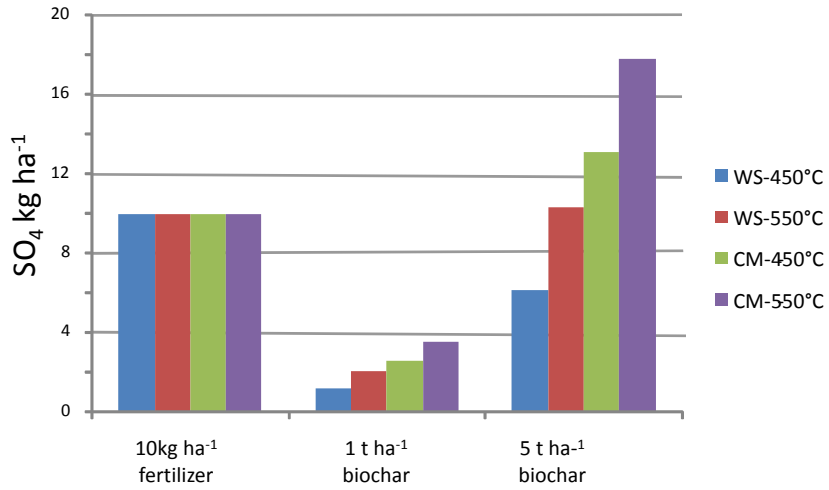
Nutrient release in pure biochar materials: S fertiliser equivalents



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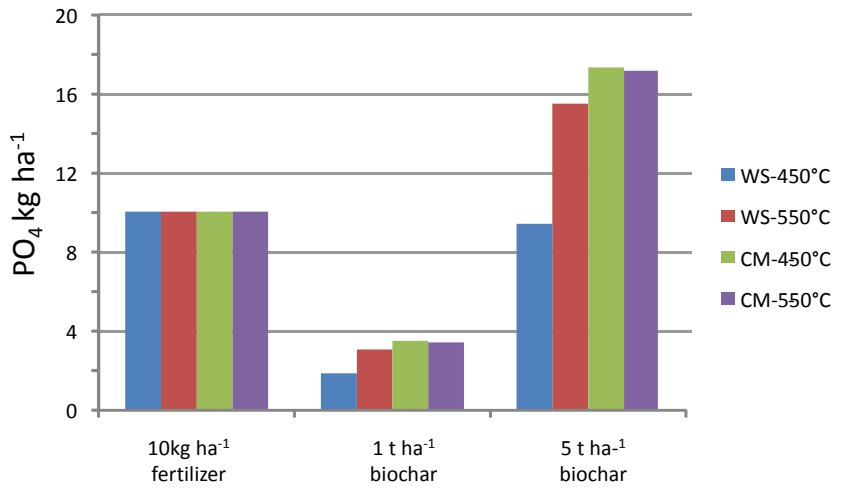
Nutrient release in pure biochar materials: P fertiliser equivalents



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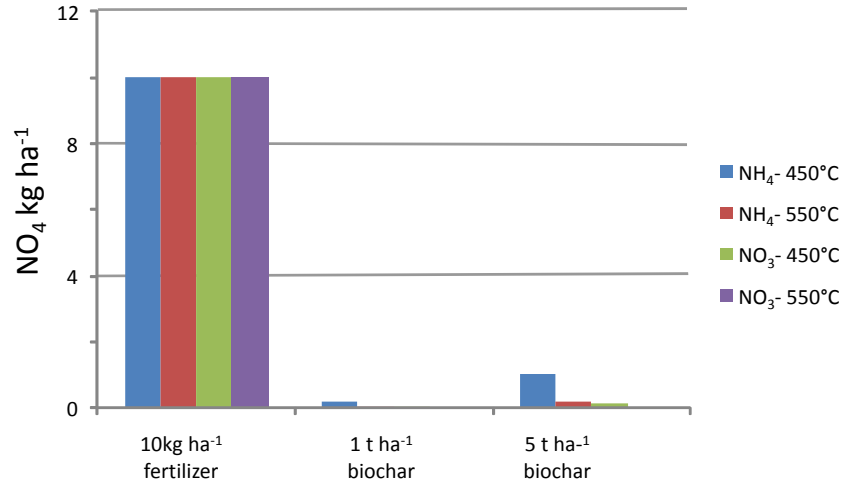
Nutrient release in pure biochar materials: N fertiliser equivalents

CM only
(no significant NH_4 and NO_3 in WS)



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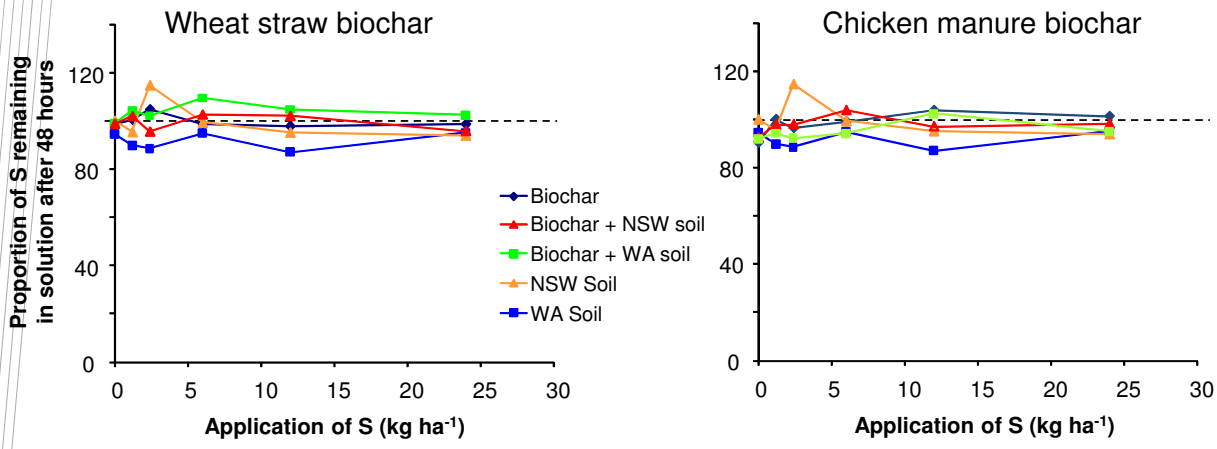
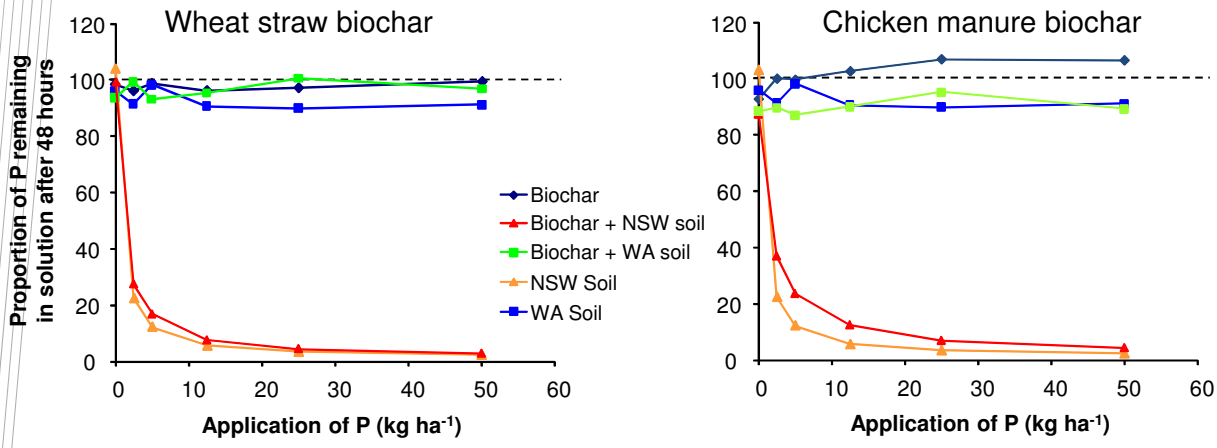
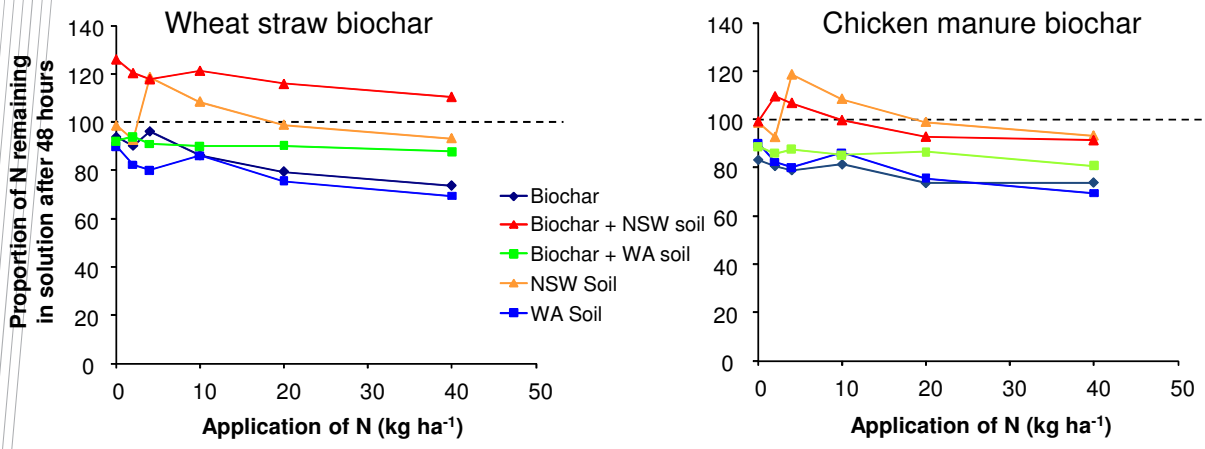
Nutrient dynamics in soil-biochar mixtures: S



Nutrient dynamics in soil-biochar mixtures: S



Nutrient dynamics in soil-biochar mixtures: N



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Summary and conclusions

- **Biochars can provide significant nutrients to soil:**
  As a function of biochar type and temperature and nutrient
  S = WS_{450}< WS_{550}< CM_{450}< CM_{550}
  P = WS_{450}< WS_{550}< CM_{450} = CM_{550}
  N = CM_{450}

- **Different sorption dynamics exist for different nutrients:**
  S = indifferent to biochar and soil type
  P = strongly influenced by soil type, moderated by biochar
  N = strongly influenced by both soil and biochar type

Nitrogen + soil:
- WA soil: retains ≥20% of the supplied N
- NSW soil: does not retain any of supplied N

Nitrogen + biochars:
- CM biochar: retains ≥20% of the supplied N
- WS biochar: retains ≥25% of the supplied N

Nitrogen + soil + biochars:
- WA soil + CM biochar: retains ≥15%
- NSW soil + CM biochar: all + more
- WA soil + WS biochar: retains ≥10%
- NSW soil + WS biochar: all + more (20%)

BUT:
Biochar + soil without added N:
- WS biochar: released up to 70% in WA and 40% in NSW soil
- CM biochar: released up to 40% in WA and 46% in NSW soil

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Acknowledgments

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GRDC Grains Research & Development Corporation

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Biochar project factsheets:
http://www.csiro.au/science/Biochar-Overview.html

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