

“Biochar Forensics” can functional properties be used to establish provenance?

Saran Sohi, Andrew Cross, Clare Peters

UK Biochar Research Centre, University of Edinburgh

APBC 2011, 16 September 2011, Kyoto

saran.sohi@ed.ac.uk www.biochar.org.uk

Principle

- Biochar is not comparable based on simple descriptions (pyrolysis is a complex process)
 - It is not always what is expected
- It is also not always what it is supposed to be
 - Outliers can appear in systematic sets
- Biochar could be instead described by its function, for example a “90–3–0.5” biochar
 - Retrospective
 - Compatible with non-instrumented pyrolysers
 - Partially obviates traceability
 - Quality control

Flexible specification (bespoke) research grade biochar (Edinburgh, since May 2011)



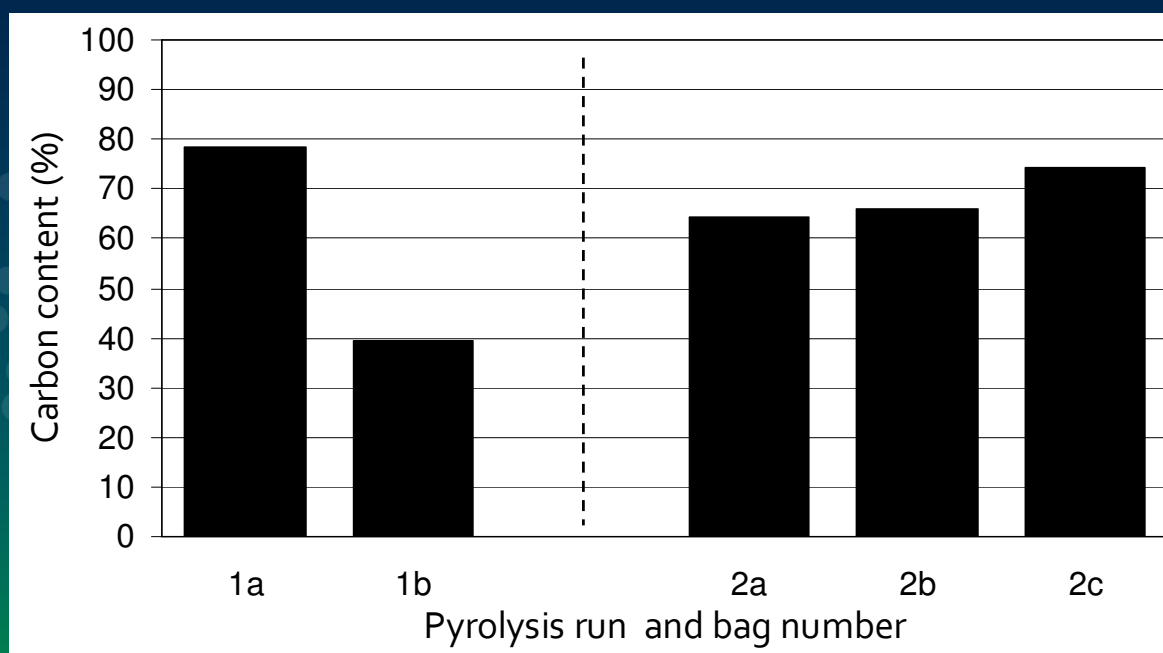
Hypotheses

- The material may not be as expected
- Biochar in each bag may be functionally different

Materials

- Five bags of Miscanthus biochar produced sequentially in continuous flow pyrolysis at 550°C
 - Two bags from one run and three bags from the second (different consignment of Miscanthus straw)
 - One sample from each bag assessed using the UKBRC Toolkit (Stable, Labile, Nutrients) n=5

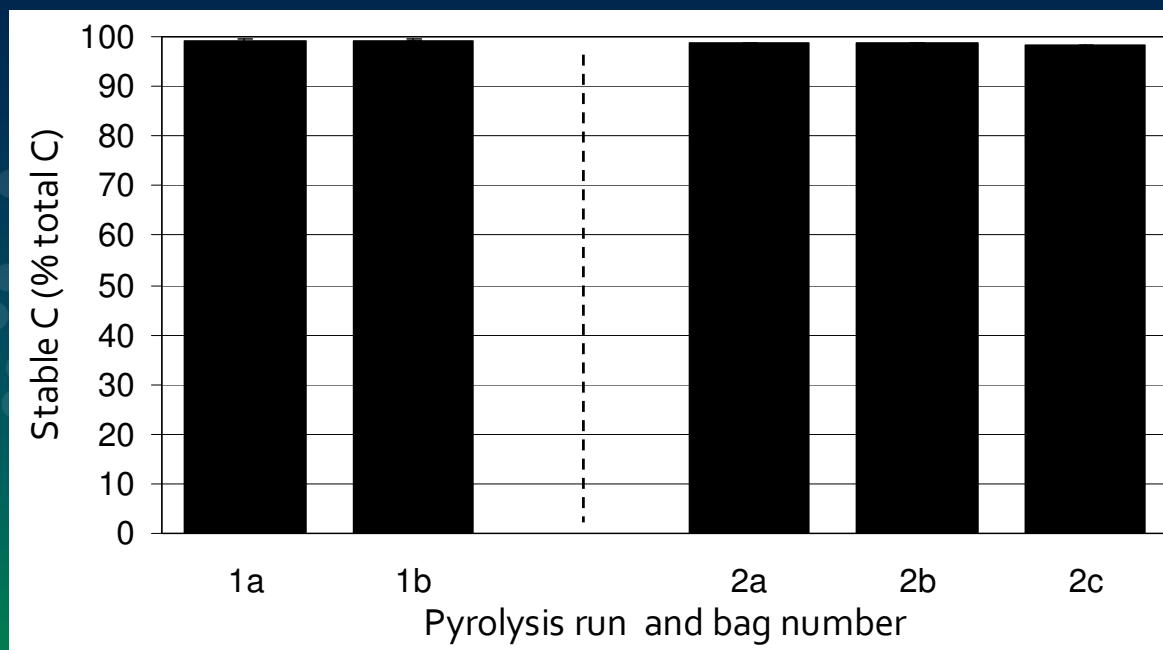
Total C



Stable C

- Proportion of biochar C stable over 100 years in temperate conditions
 - Measured by accelerated thermal-chemical ageing and expressed as %total C

Stable C

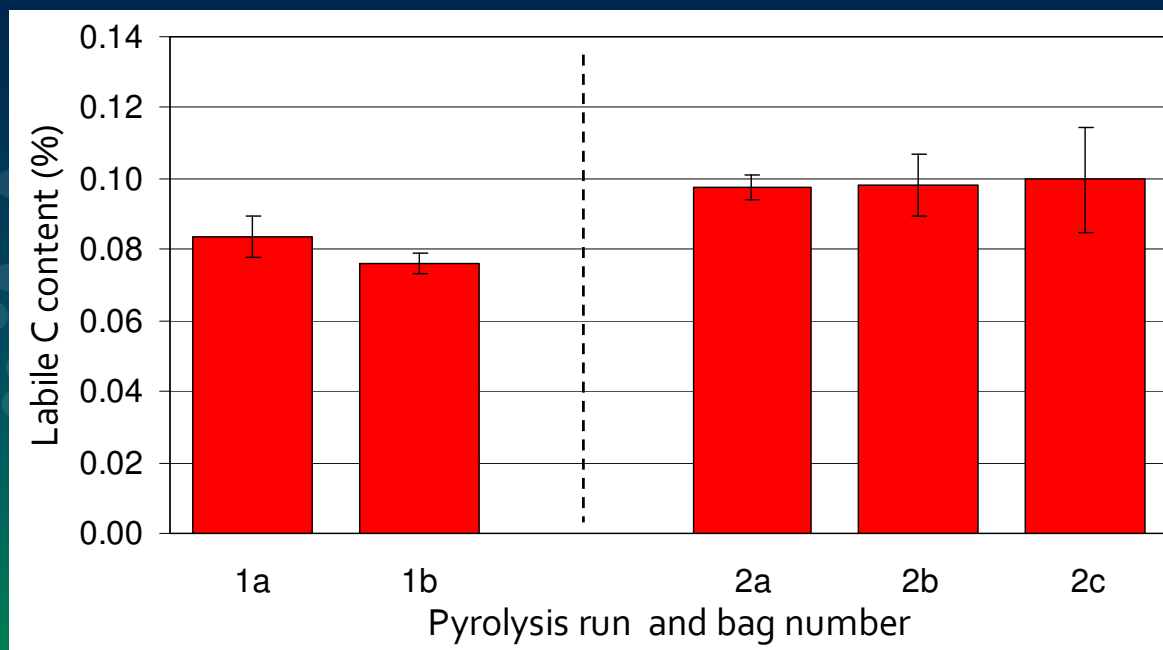


- Range in other samples from 40%-99%

Labile C

- *Index* for screening purposes that is based on the *ex-situ* evolution of CO₂
 - Not a measure of absolute amount of labile C (which must account for proliferation of microbial biomass, asymptotic release, etc.)

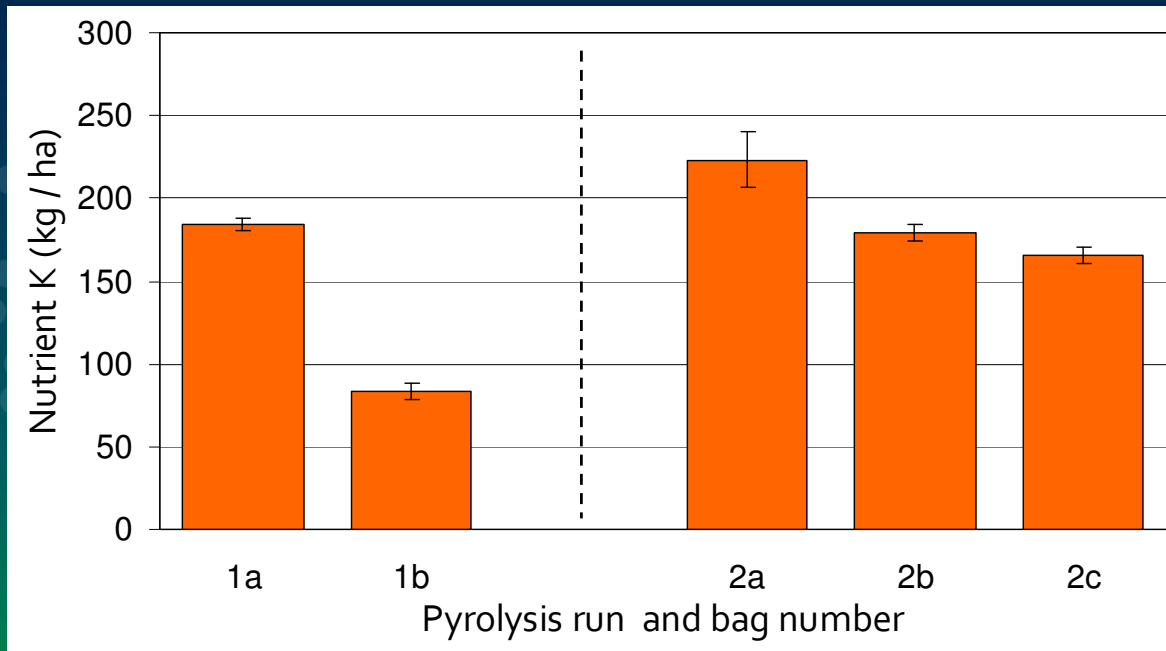
Labile C



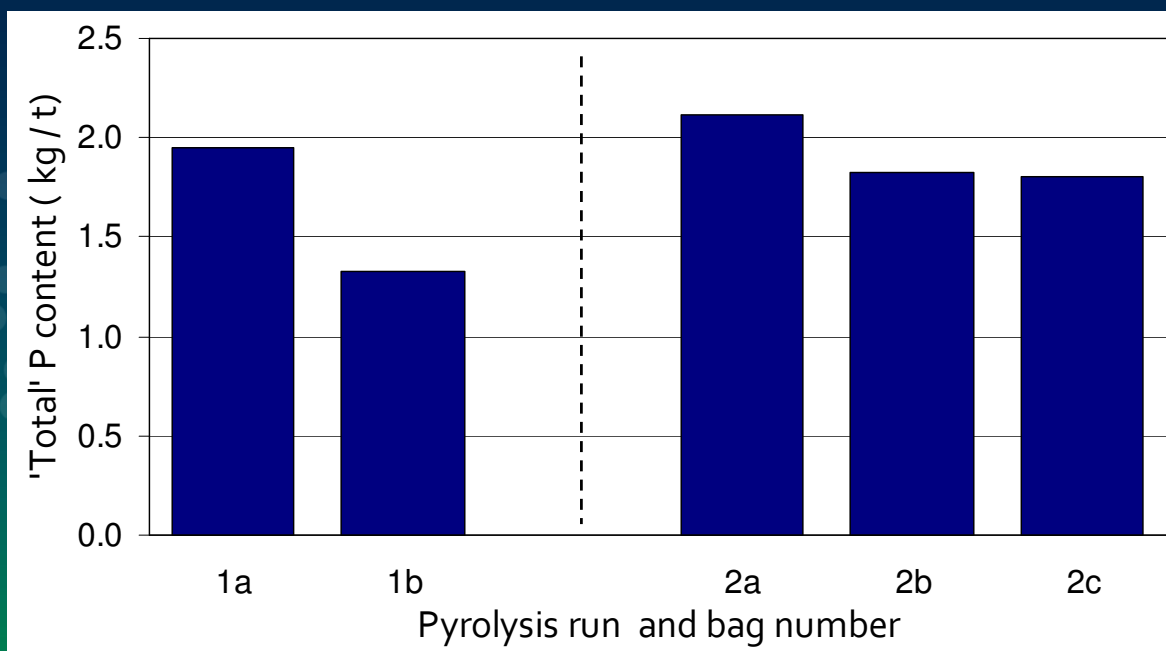
Nutrient

- Relative measure of nutrient value (kg/ha) over timeframe of 1–2 seasons (30 t biochar / ha)
 - Projection based on release decay pattern for repeated water extraction as limited by physical factors but not short-term hydrophobicity

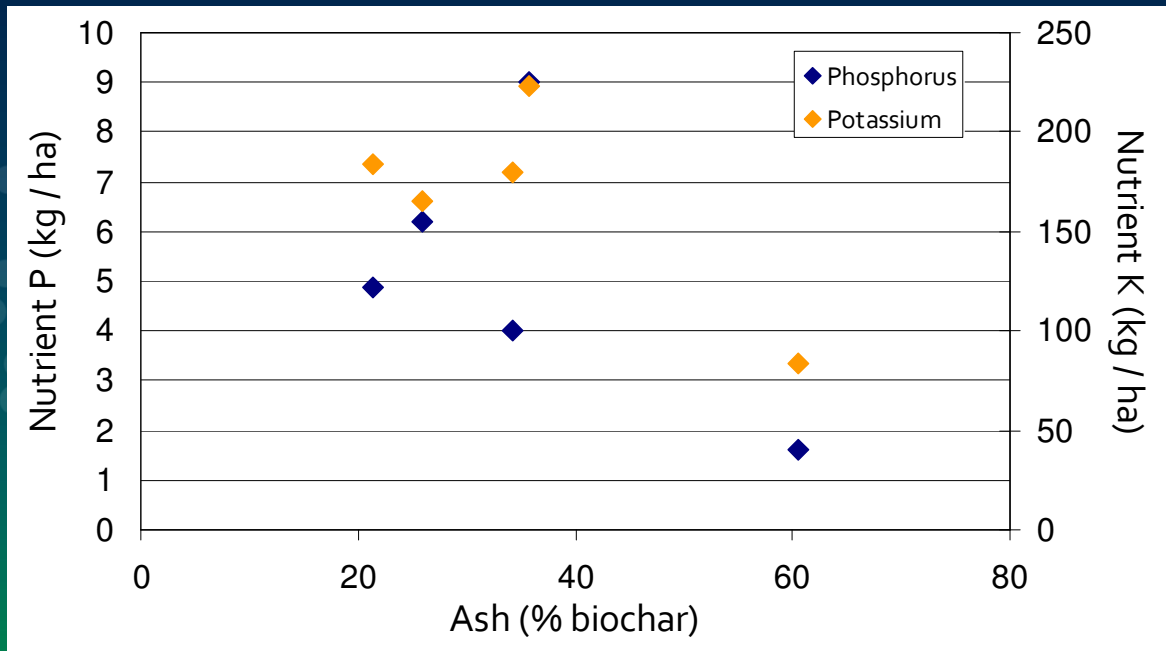
Nutrient K



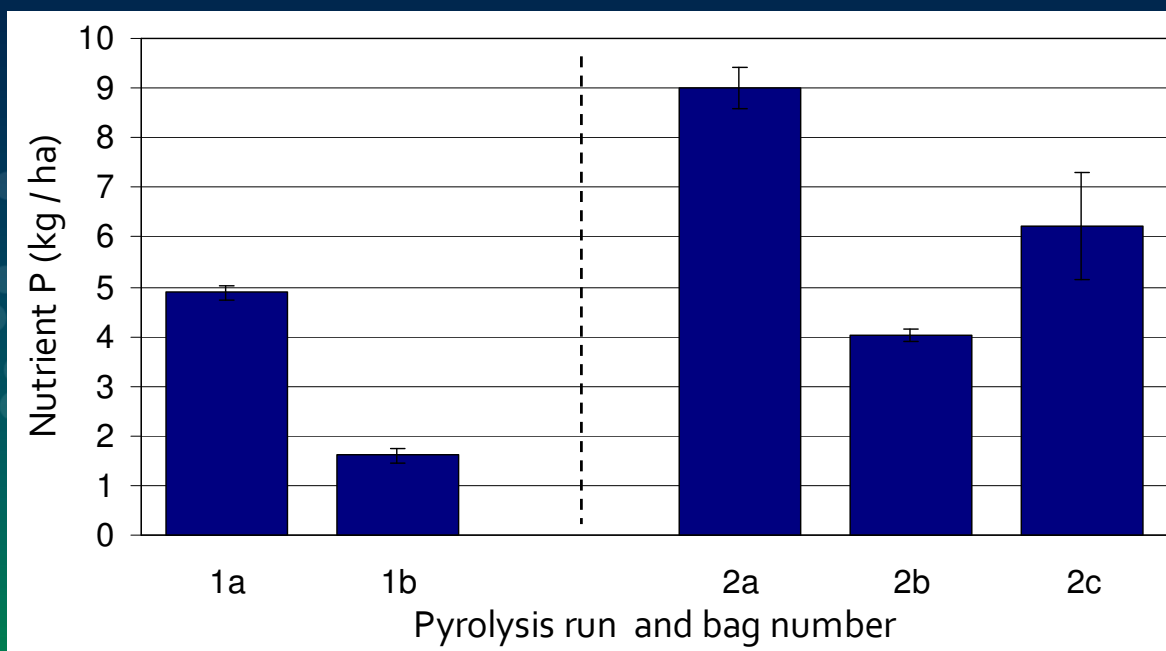
Nutrient P



Nutrient-ash relationship



Total P



Forensics report

- Biochar created under the same process parameters was consistent in Stability regardless of batch or point in 'run'
 - Stability resembled that of biochar created elsewhere under very different nominal conditions
- Labile C markedly different between runs (different batch of Miscanthus feedstock)
- Large differences in Nutrient result mainly related to considerable range in ash content
 - Agronomic importance

Implications and conclusion

- Biochar will be defined by users by its provision of desired function in soil and this must be reliable
- Meaning of “temperature” in pyrolysis does not translate between units or equipment and may not be even in the heating zone or feedstock particle
 - Difficult to translate between technologies such as microwave pyrolysis (or hydrothermal chars?)
- Rather than define temperature and configuration better it may be best to calibrate production to delivery of specified function

Acknowledgements

- EPSRC (Science and Innovation Award)
- Natural Environment Research Council
- EU Inter-reg project “Climate Saving Soils”
- Stuart Haszeldine and UKBRC colleagues

www.biochar.org.uk