

Does compost and biochar interact on the stability of the mixture and does these interactions change after weathering ?

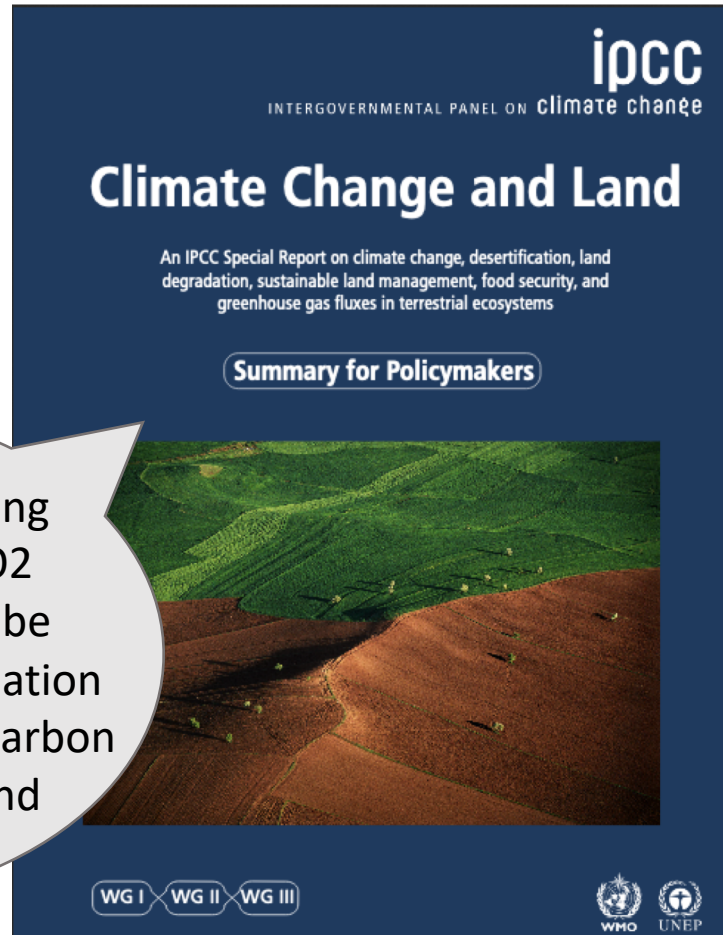


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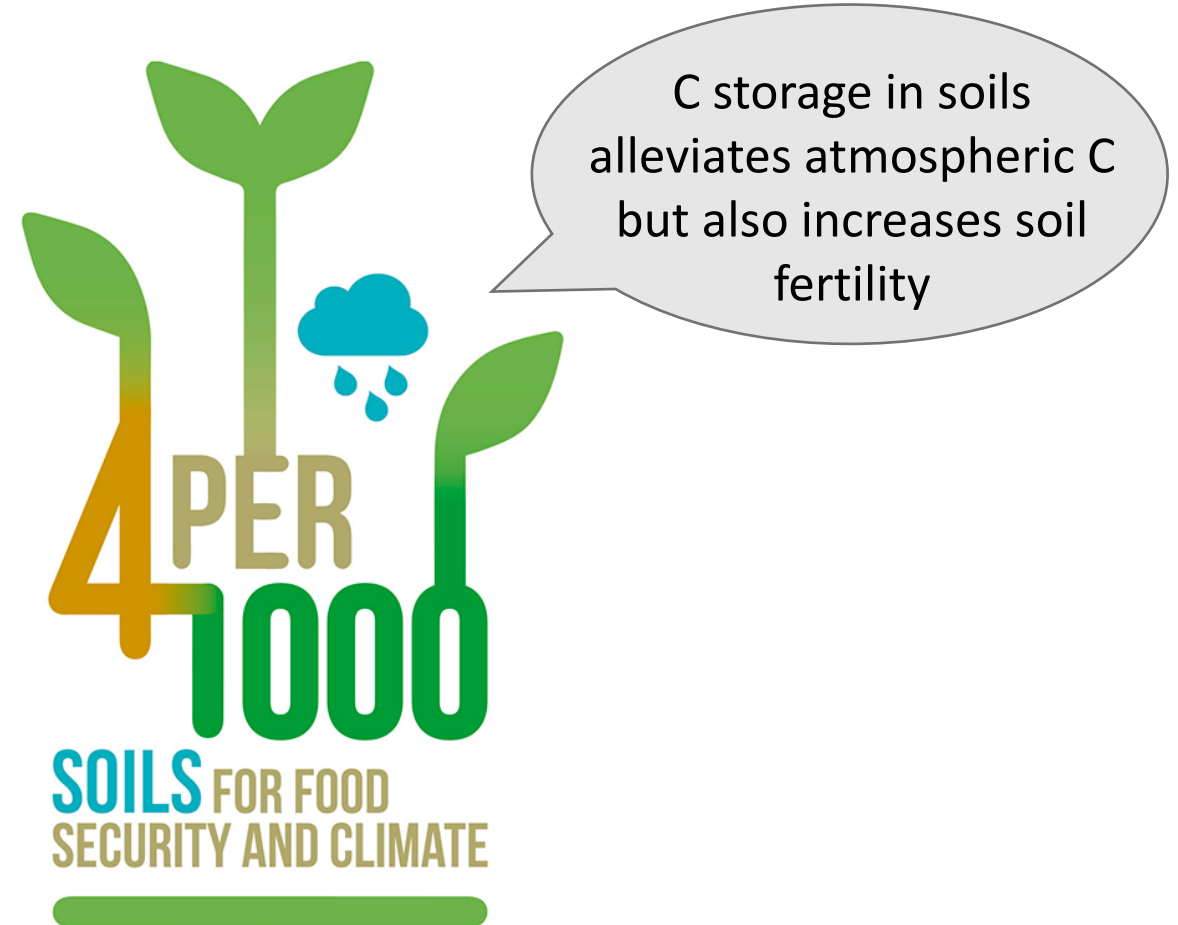
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We need to find negative emission technologies to mitigate climate change



Revised by the IPCC on January 2020



COP21

Biochar as a solution to store carbon in soil

Global Change Biology

Global Change Biology (2016) 22, 1315–1324, doi: 10.1111/gcb.13178

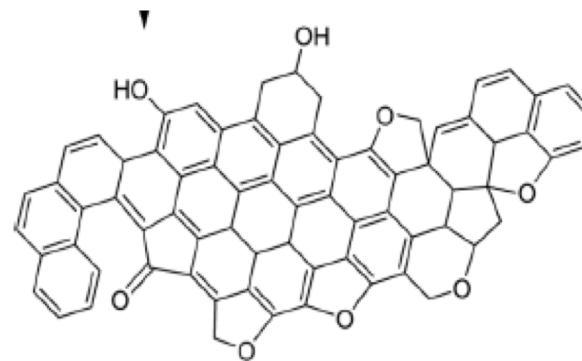
Soil carbon sequestration and biochar as negative emission technologies

PETE SMITH

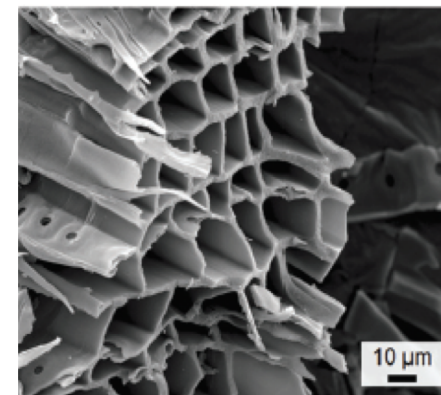
Institute of Biological and Environmental Sciences, Scottish Food Security Alliance-Crops & ClimateXChange, University of Aberdeen, 23 St Machar Drive, Aberdeen AB24 3UU, UK

Biochar : pyrolyzed biomass

- Stable carbon (polycyclic aromatic carbon)
- High porosity
 - water retention, aeration, microorganisms shelter, nutrient absorption

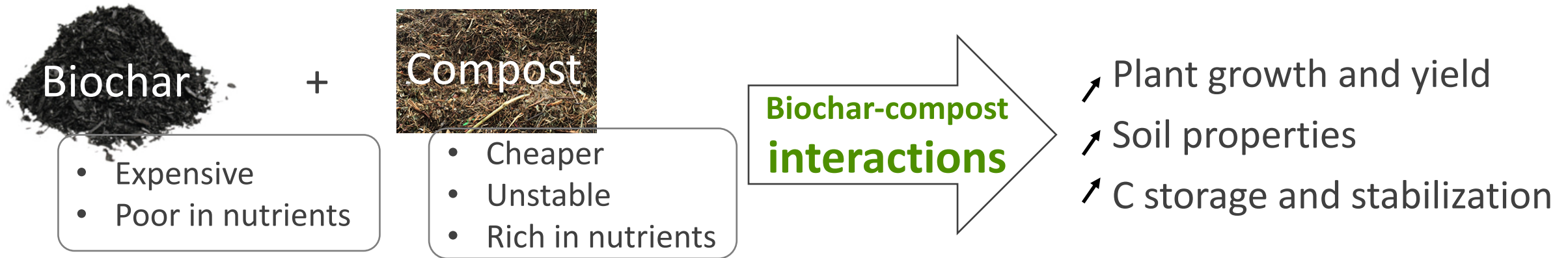


Biochar network. Liu et al. 2015



Biochar, SEM. Thompson et al. 2014.

Biochar combined with compost for a better performance ?

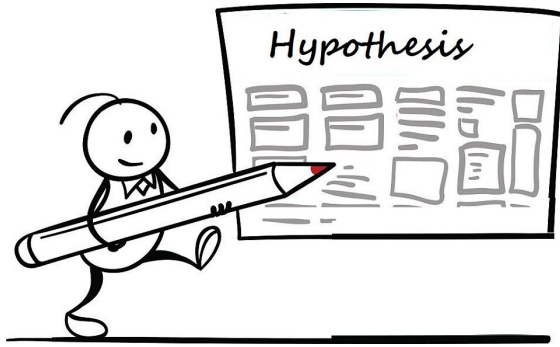


And what about the effects of **interactions** ...

... on **biological stability** of the mixture ?

... in **longer term** ?

... on **plant growth** ?



Biochar-compost interactions ...

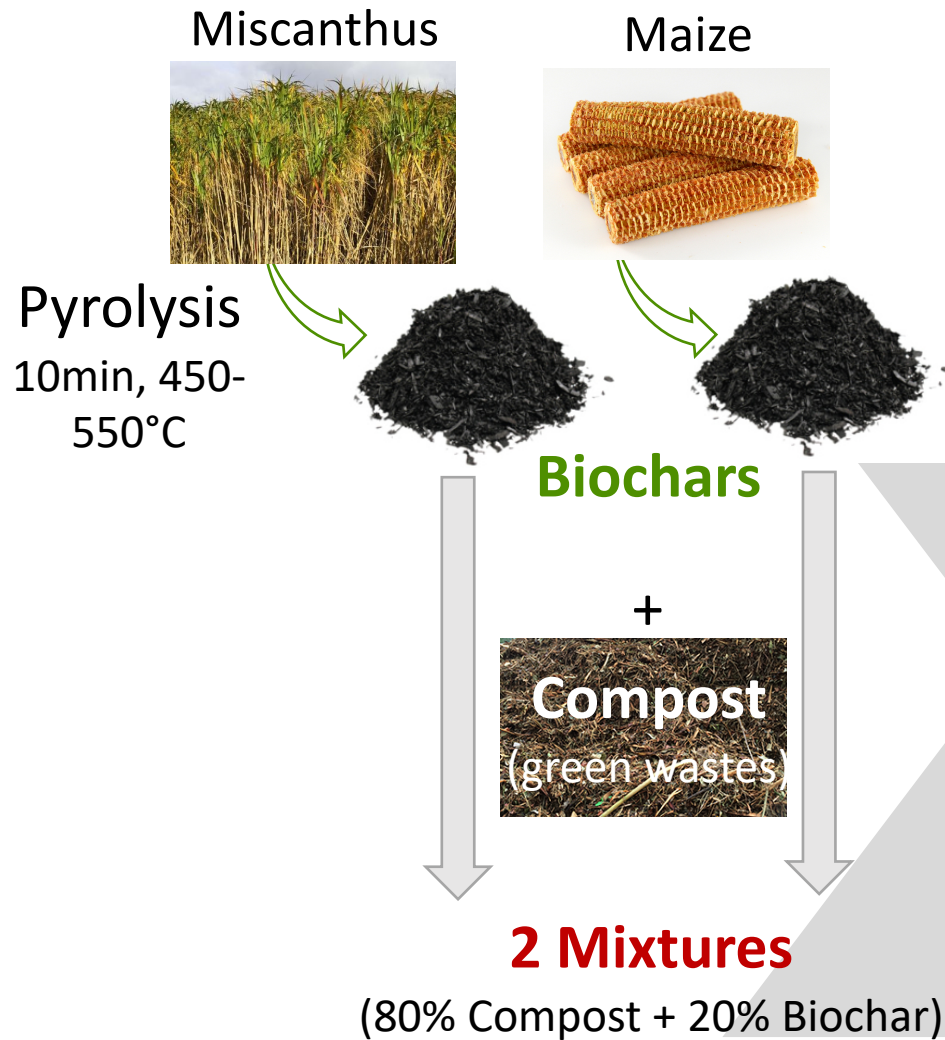
- ☐ depend on initial feedstock
- ☐ induce synergistic effects on biological stability and plant growth
- ☐ is alleviated with time

Experimental setup

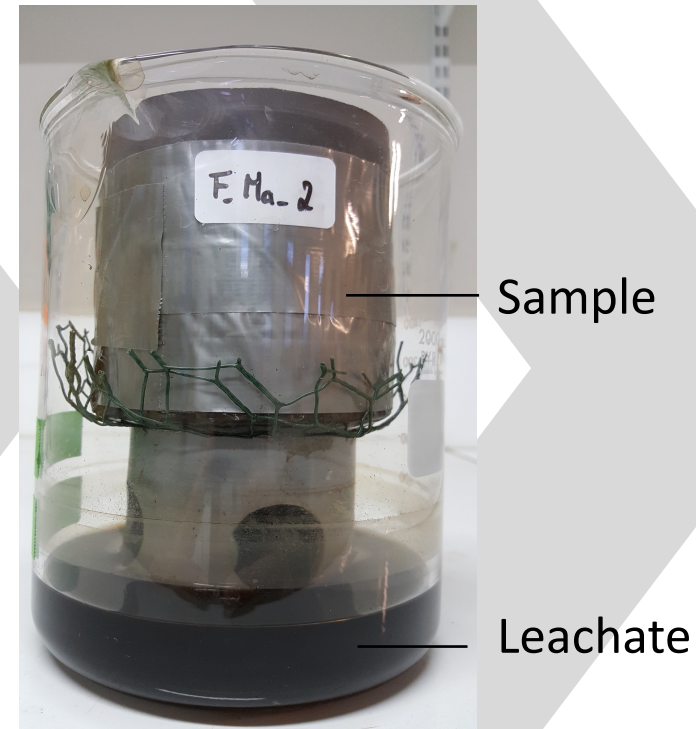


- Study on **2 mixtures** differing by initial biochar feedstock
- **Artificial physical weathering** to simulate ageing
- Analysis of **biological stability** of both mixtures
- Analysis of **plant growth**

Preparation of fresh and weathered samples



Physical weathering
Wet-Dry cycles + Freeze/Thaw cycles



- Samples weathered :
- 2 biochars
 - 2 mixtures
 - 1 compost

Analysis of mixtures stability and plant growth

Weathering effect

pH, EC



CO₂-C analysis with micro-GC

Biological stability

Incubation

Compost, biochar and 2 mixtures with soil inoculum 205 days, 20°C

- Mineralization kinetic (CO₂-C release)
- Stable C isotope signature of CO₂ to differentiate emissions from biochar (C₄) and compost (C₃) by isotopic mass balance calculation

Plant growth

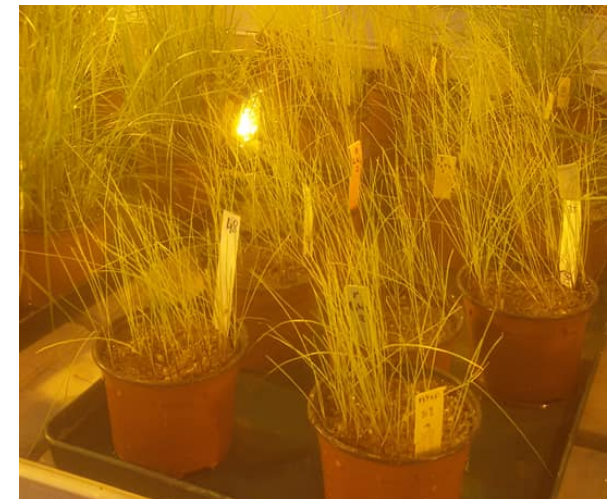
Pot experiment

Soil : calcisol

Mixture addition : 20 t.ha⁻¹

Compost addition : 16 t.ha⁻¹

Rye-grass (*Lolium multiflorum*)
biomass, 4 weeks growth



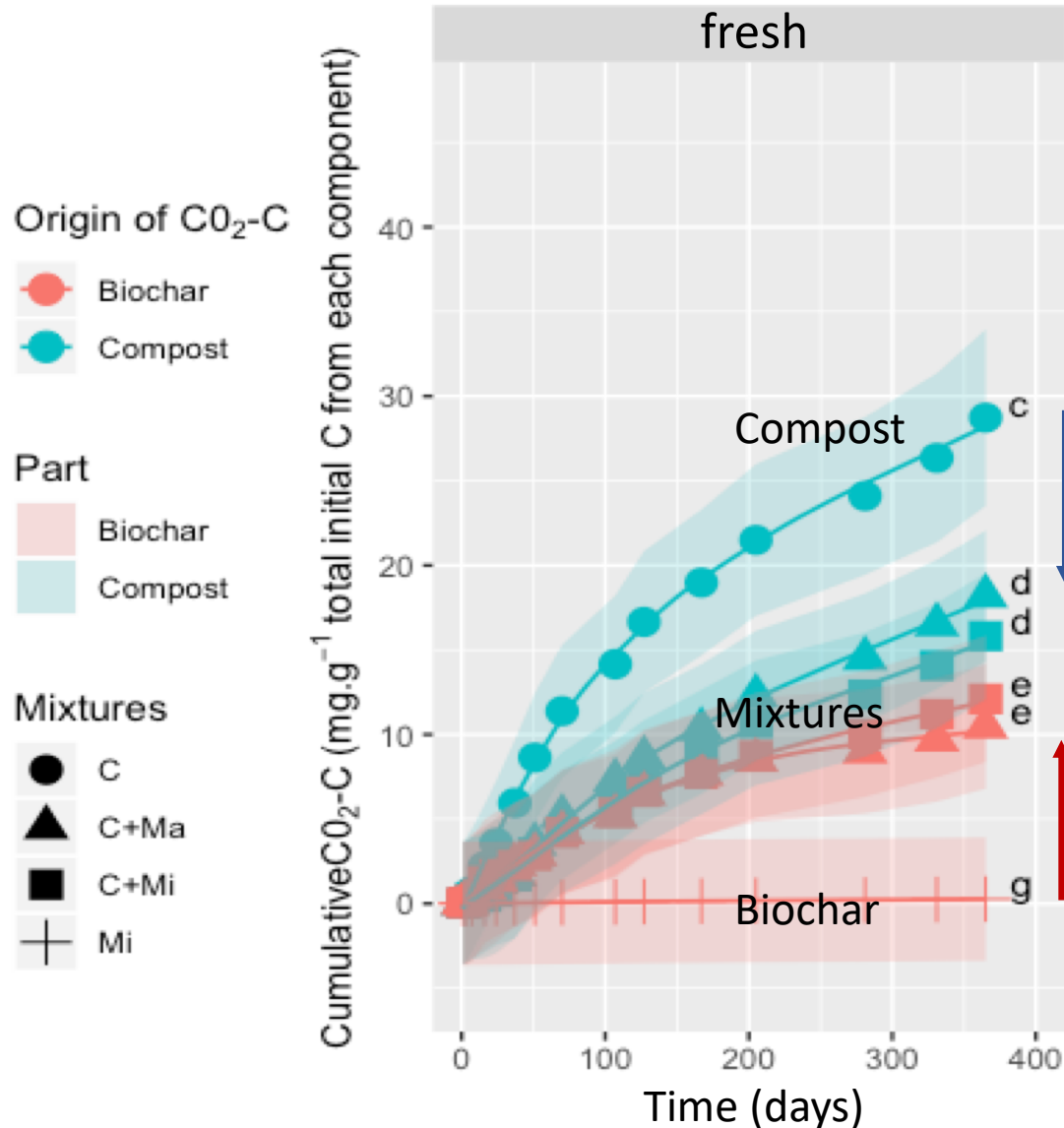
Weathering induced leaching of basic compounds and salts

Biomass	pH	EC (μS/cm)
<i>Compost</i>		
C	8,4 0,01	943,7 18,1
W*/C	7,9 0,01	215,3 3,8
<i>Biochars</i>		
Maize	10,5 0,02	1639,7 61,7
W*/Maize	na na	na na
Miscanthus	10,4 0,01	1516,3 14,0
W*/Miscanthus	9,4 0,02	129,3 3,1
<i>Mixtures</i>		
C+Maize	9,1 0,03	1588,0 11,8
W*/C+Maize	8,6 0,01	224,0 2,6
C+Miscanthus	8,9 0,03	1598,3 20,3
W*/C+Misc	8,5 0,01	238,3 14,6

- Biochar increased liming potential and salinity of the mixtures
- Weathering induced a strong leaching of salts

W* : weathered
Na : not available

Biochar increased biological stability from compost



Incubation → calculation of CO₂-C emission from compost (C3 plant) and biochar (C3 plant) using their different isotopic signatures.

Results

Compost-C mineralization decreased when mixed with biochar

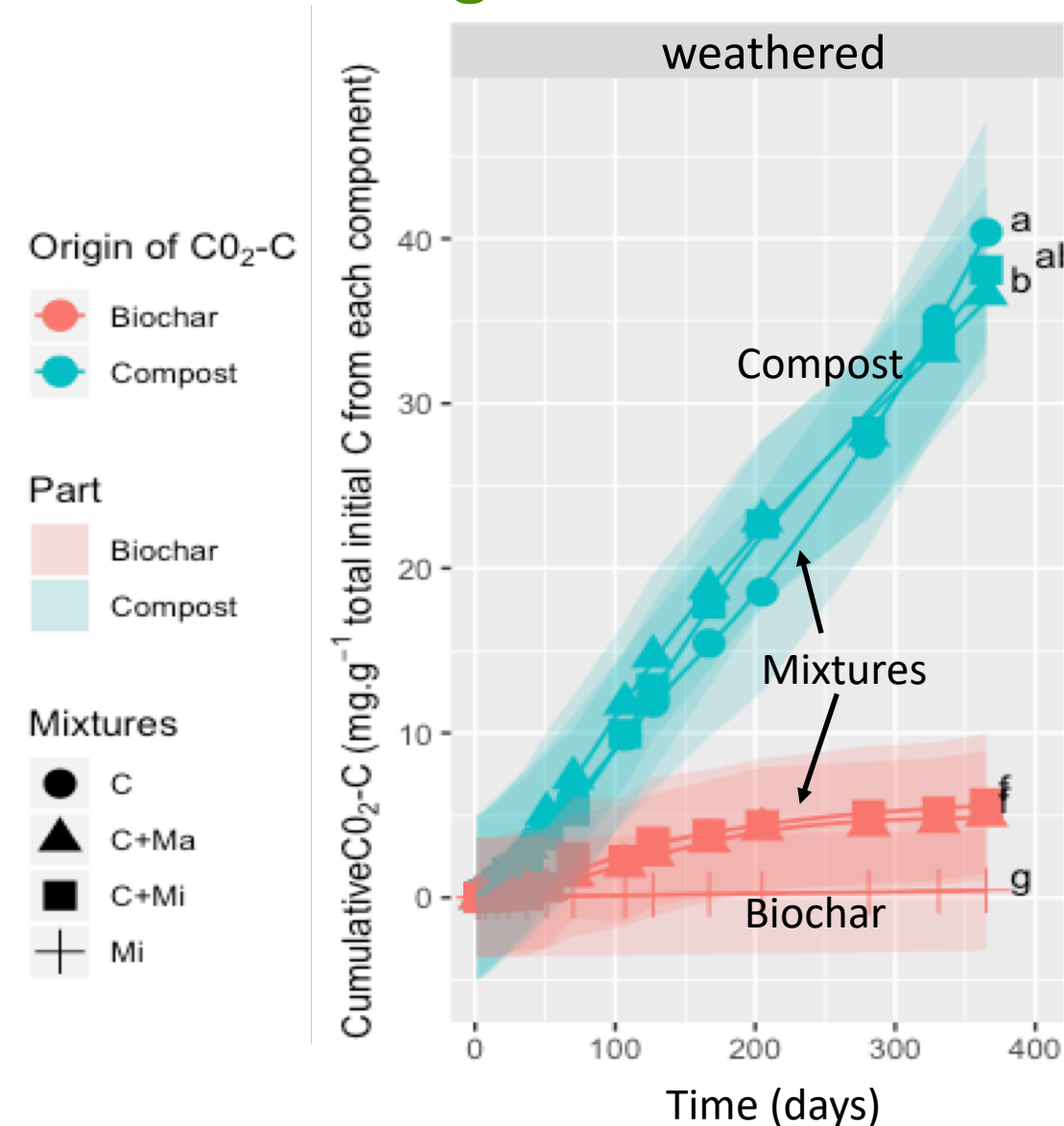
Biochar-C mineralization increased when mixed with compost

Interpretation

➤ Biochar inhibited compost-C mineralization within the mixture

➤ Priming effect on biochar mineralization from the mixtures due to nutrients from compost.

Weathering alleviated biochar-compost interactions on compost-C



Results

Compost-C mineralization increased as compared to fresh samples

No differences anymore between compost-C mineralization from compost and mixtures

Lower priming effect on biochar after weathering than for fresh samples

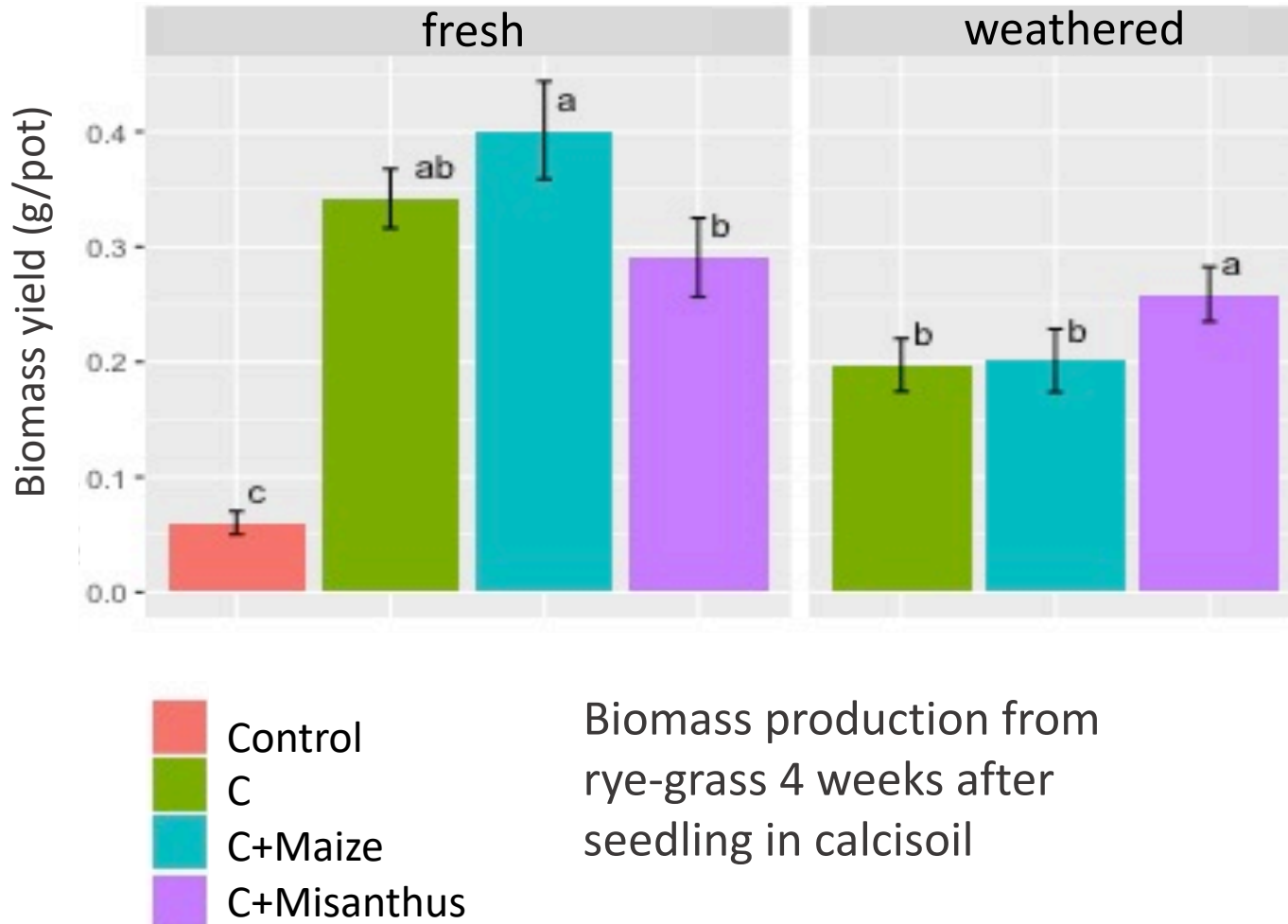
Interpretation

➤ Weathering alleviated compost-C mineralization due to salts leaching

➤ Weathering alleviated biochar effect on compost-C mineralization

➤ Weathering alleviated priming effect on biochar-C mineralization

Interactions on plant growth depended on biochar feedstocks



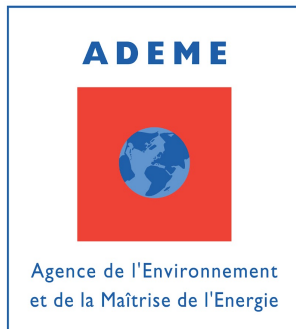
- Both compost and mixtures increased plant growth as compared to the control. This effect was persistent when weathered material was added to soil
- Biochar induced neutral effect or antagonism on plant growth for fresh mixtures
- After weathering, mixtures showed synergistic or neutral effects on plant growth
- Biochar-compost interactions on plant growth are dependent upon biochar feedstock

Conclusion

- ❑ Biochar-compost interactions depend on initial feedstock especially regarding interactions on plant growth
- ❑ The fresh mixtures induced :
 - Synergistic effects on biological stability for compost-C
 - Neutral or antagonisms effects on plant growth
- ❑ Weathering showed :
 - Alleviated effects on biological stability
 - Neutral or synergistic effects on plant growth

Acknowledgements

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Biochar 2021

Collaborations :



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