

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

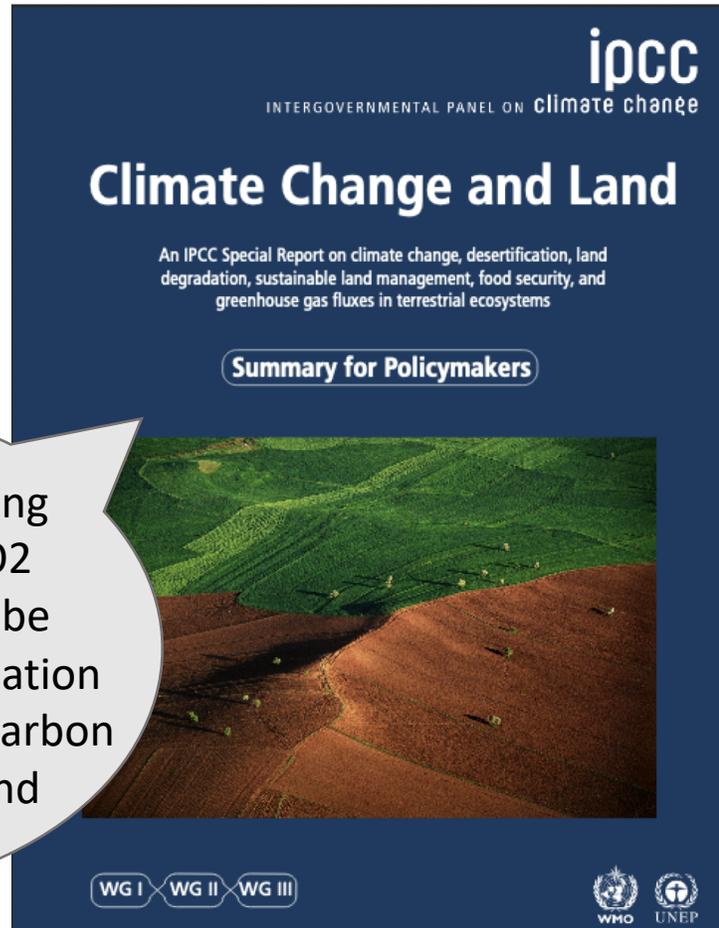


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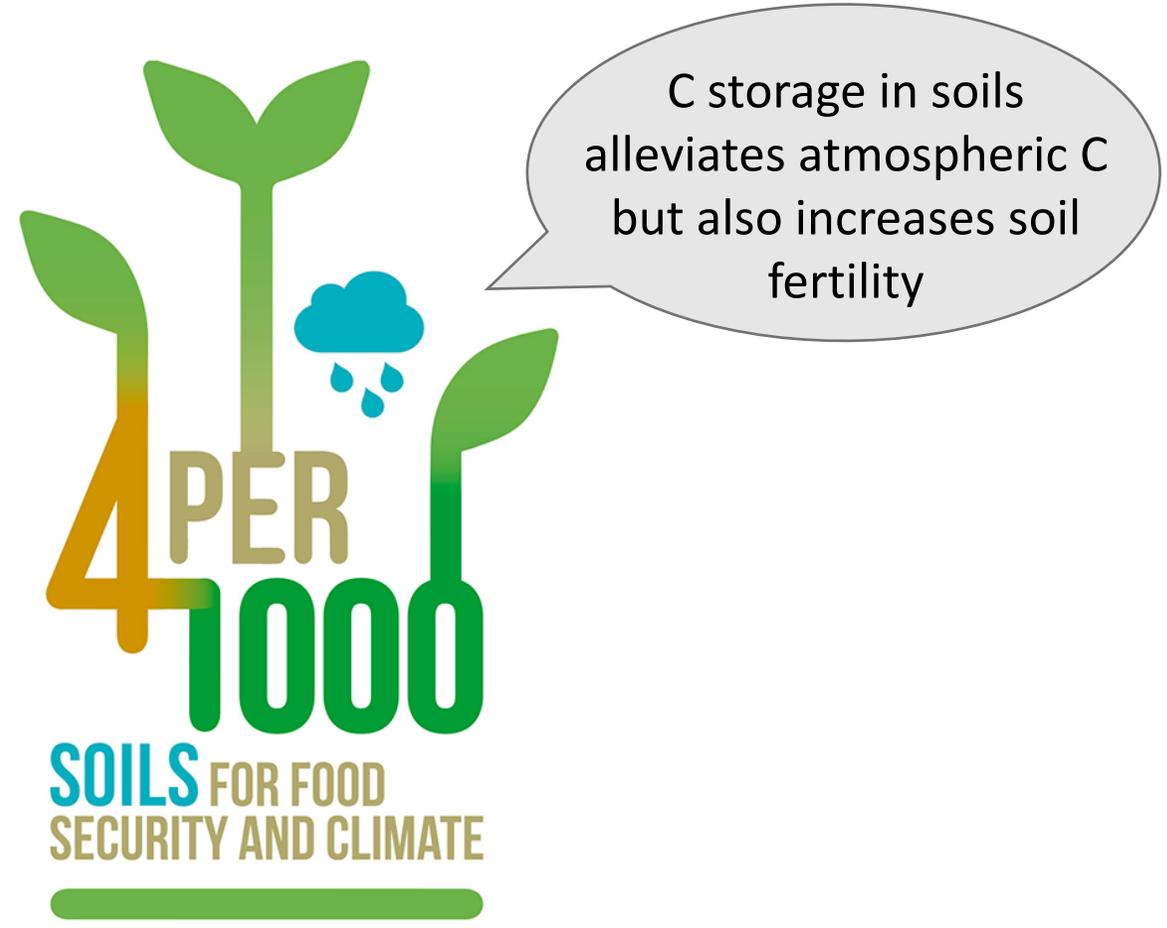
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We need to find negative emission technologies to mitigate climate change



Revised by the IPCC on January 2020



COP21

Limiting global warming requires reducing CO2 emissions, which can be achieved through combination of technologies such as carbon capture, utilization and storage

Biochar as a solution to store carbon in soil

Global Change Biology

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

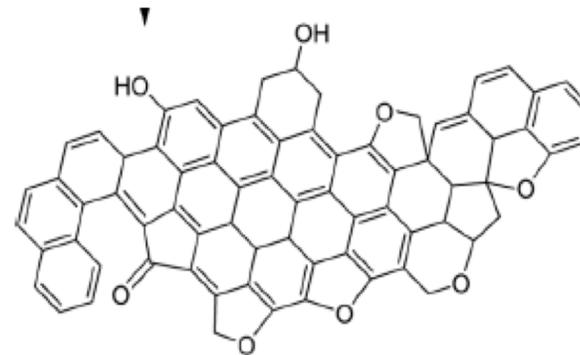
Soil carbon sequestration and biochar as negative emission technologies

PETE SMITH

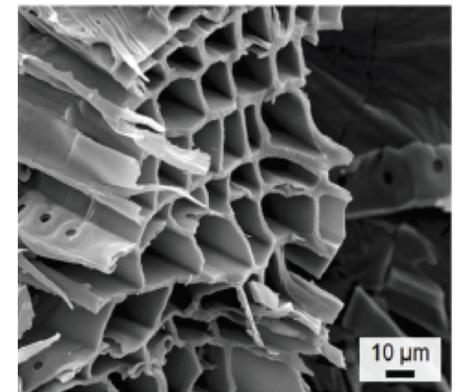
Institute of Biological and Environmental Sciences, Scottish Food Security Alliance-Crops & ClimateXChange, University of Aberdeen, 23 St Machar Drive, Aberdeen AB24 3UU, UK

Biochar : pyrolyzed biomass

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

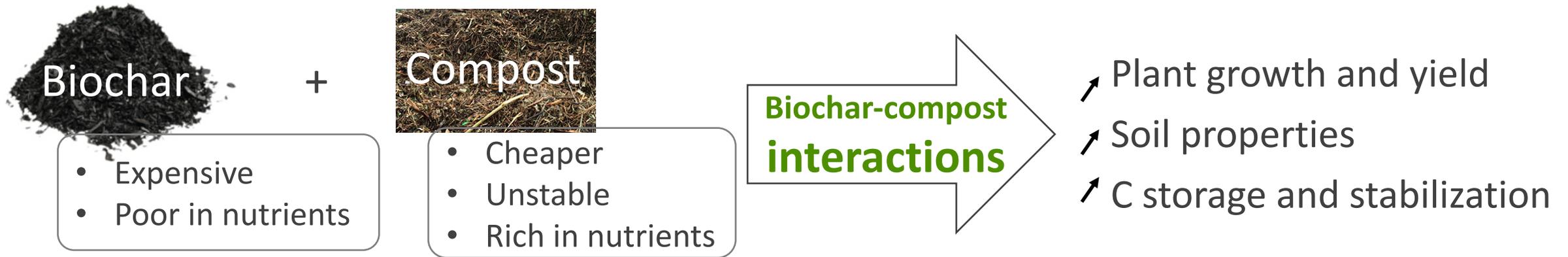


Biochar network. Liu et al. 2015



Biochar, SEM. Thompson et al. 2014.

Biochar combined with compost for a better performance ?

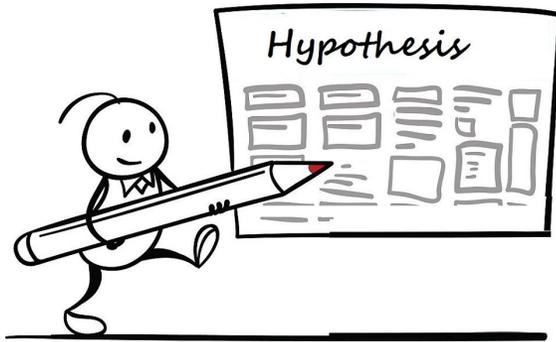


And what about the effects of **interactions** ...

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

... in **longer term** ?

... on **plant growth** ?



Biochar-compost interactions ...

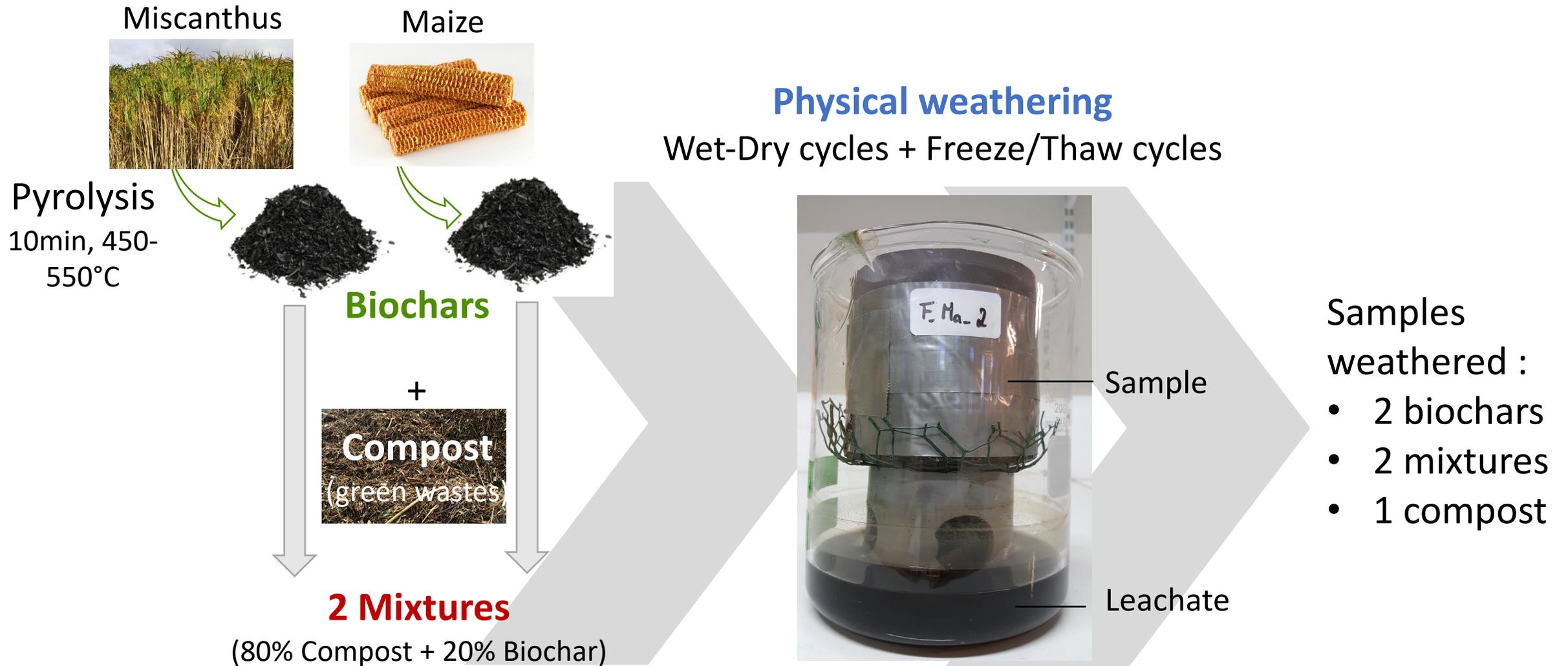
- depend on initial feedstock
- induce synergistic effects on biological stability and plant growth
- is alleviated with time

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



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



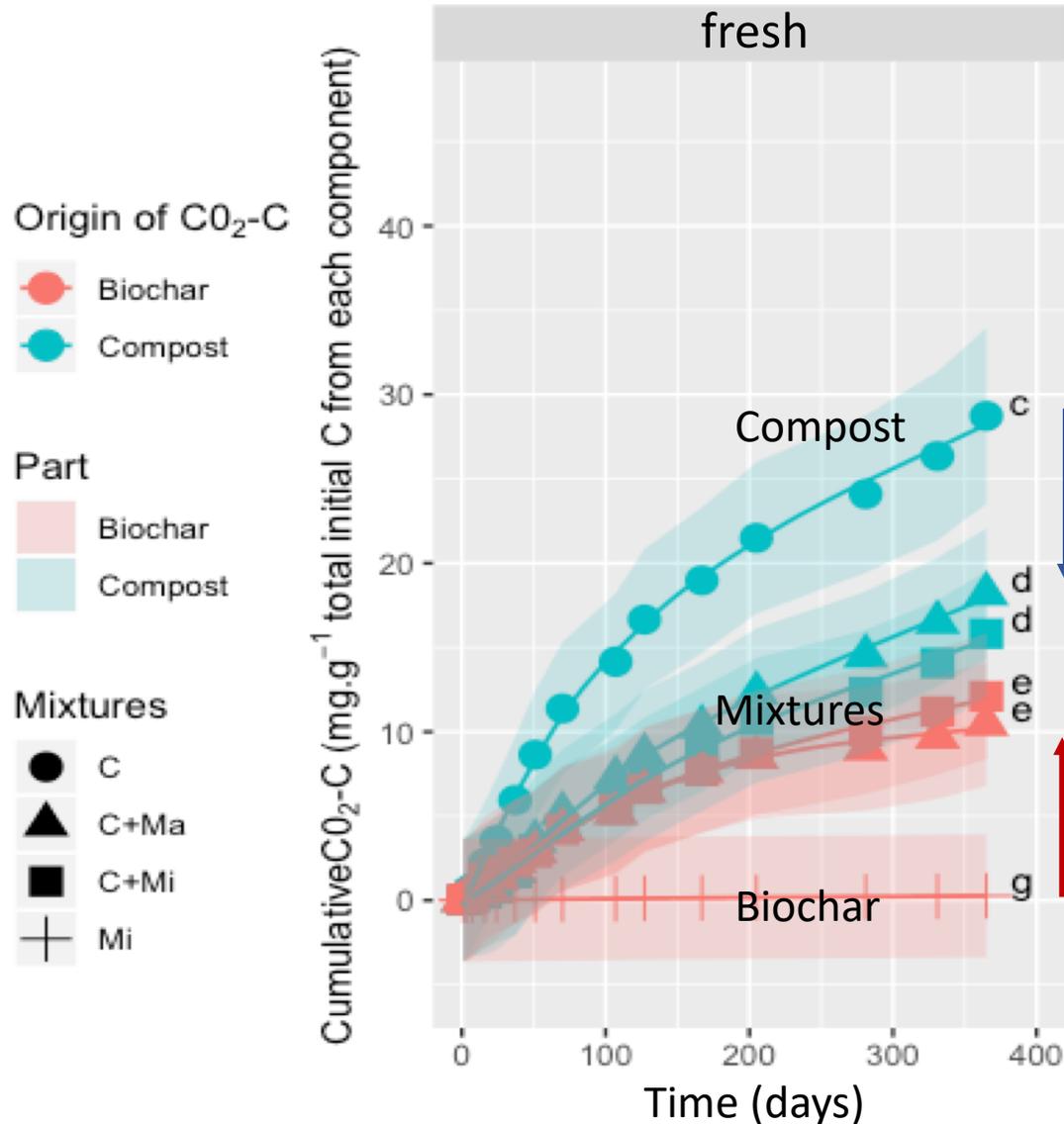
Weathering induced leaching of basic compounds and salts

Biomass	pH	EC ($\mu\text{S}/\text{cm}$)
<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

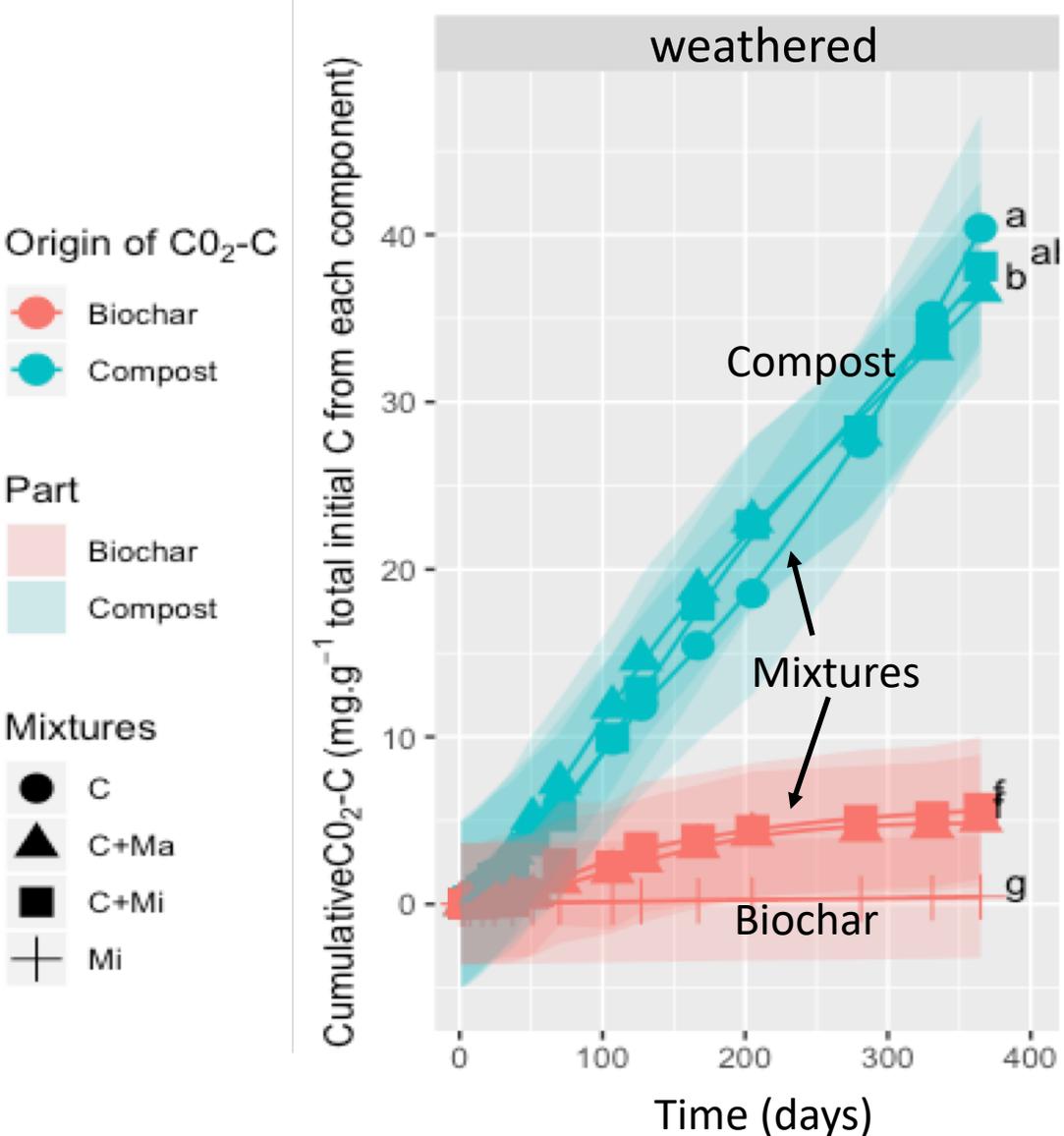
Biochar-C mineralization increased when mixed with compost

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

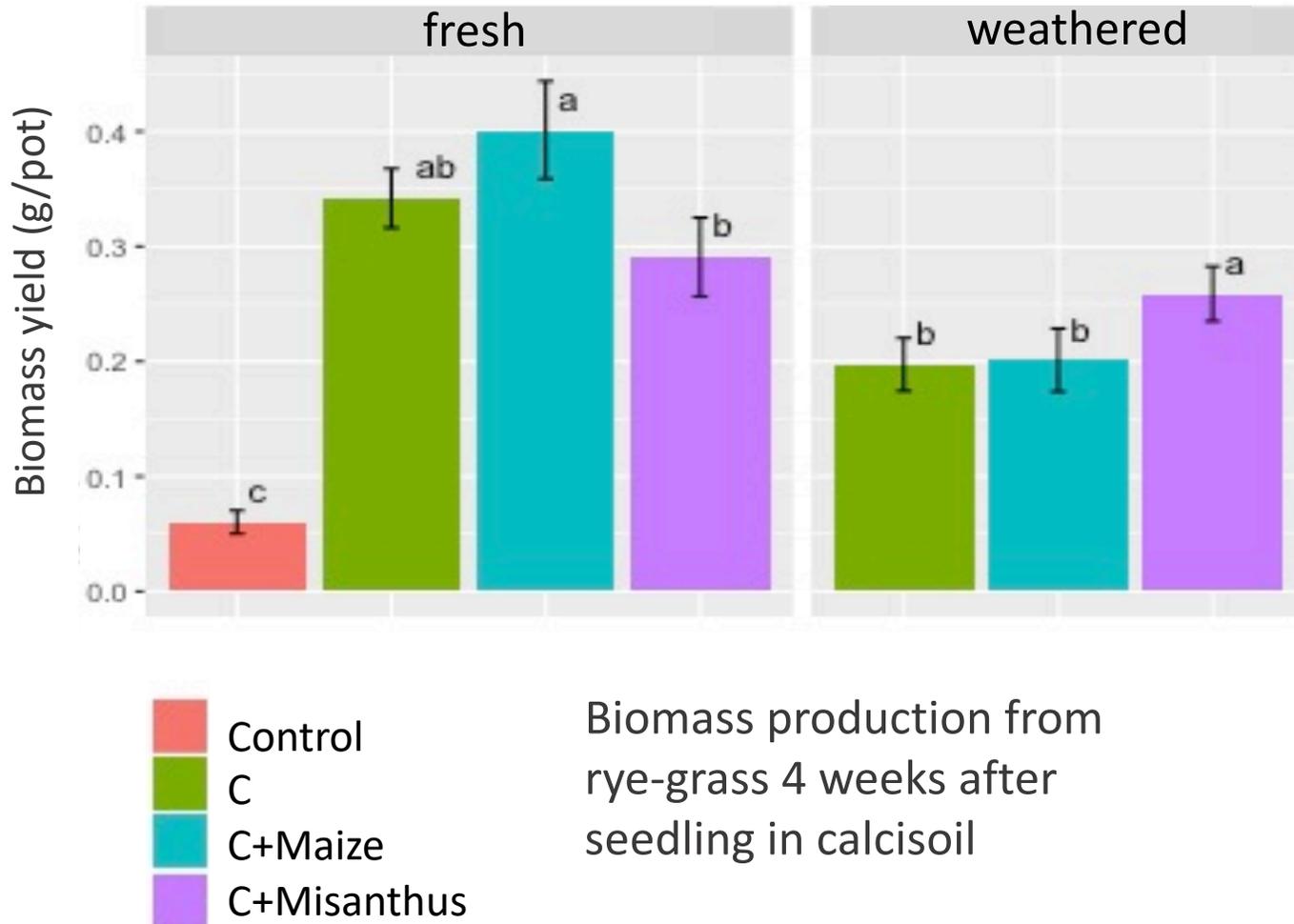
Interpretation

➤ 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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