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# Carbon stabilization in soil after organic amendment application – A comparison of two biomass use scenarios



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## Context and Objectives

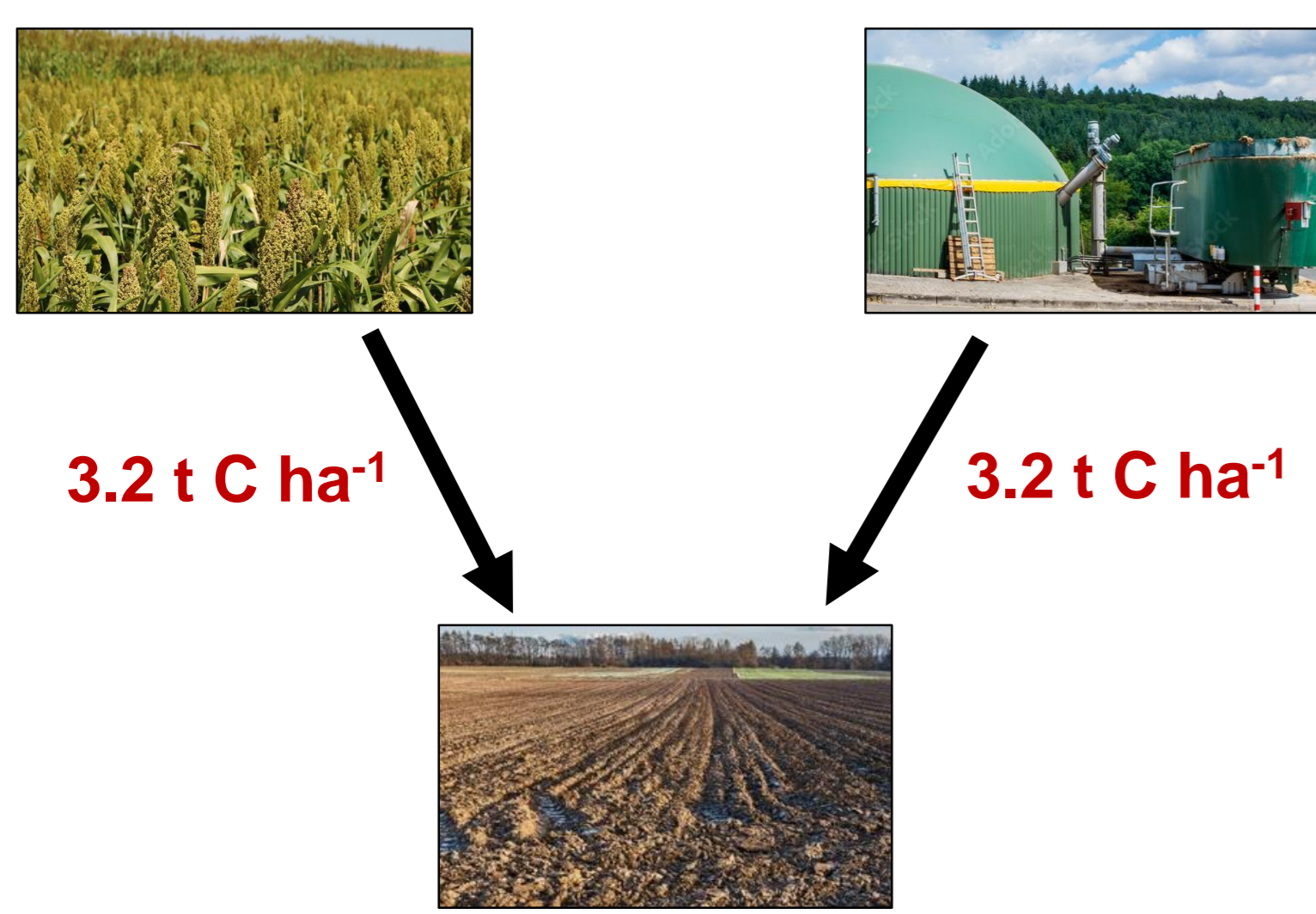
Organic amendments are used to maintain or increase soil organic carbon (C) in arable soil. Plant biomass can be directly applied to soil or processed prior its application, e.g. through anaerobic digestion.

### Two scenarios:

#### Scenario A – Exogenous organic matter

Application of organic amendments according to fertilizer recommendations using exogenous organic matter

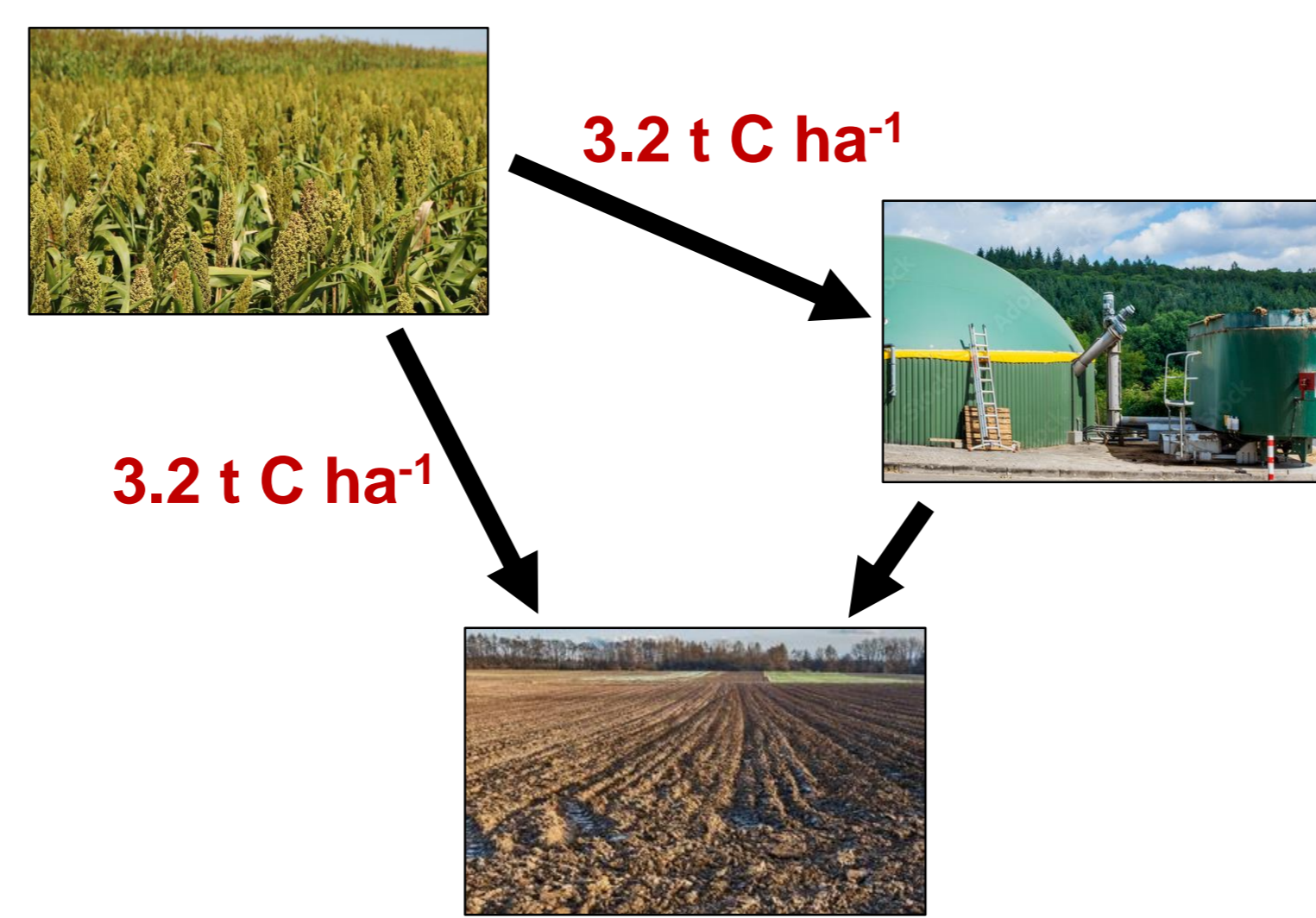
→ Equal application rates of C to soil



#### Scenario B – Farm internal recycling

Two possibilities: i) direct application of plant residues to soil, ii) prior use in anaerobic digester (biogas production)

→ Different application rates of C to soil



Soil organic C balance?

Overall C balance?

## Materials and Methods

### Plant residue and Digestate

- *Sorghum bicolor* (C4 plant)
- Experimental anaerobic digester



### → C balance during digestion

#### Incubation experiment

- *Luvisol* with C3 plant history (Closeaux, Versailles France)
- 85 days, 20 °C, 64 % water holding capacity
- Four treatments:

- Plant residue plus nitrogen (scenario A + B) (nitrogen addition to reach C:N ratio of digestate) } 1.03 mg C g<sup>-1</sup> soil = 3.25 t C ha<sup>-1</sup>
- Plant residue (scenario A + B)
- Digestate scenario A
- Digestate scenario B } 0.37 mg C g<sup>-1</sup> soil = 1.17 t C ha<sup>-1</sup>

#### Analysis of soil respiration

- Mineralization of organic amendments
- Priming of SOC
- Fitting one compartment, first-order model:

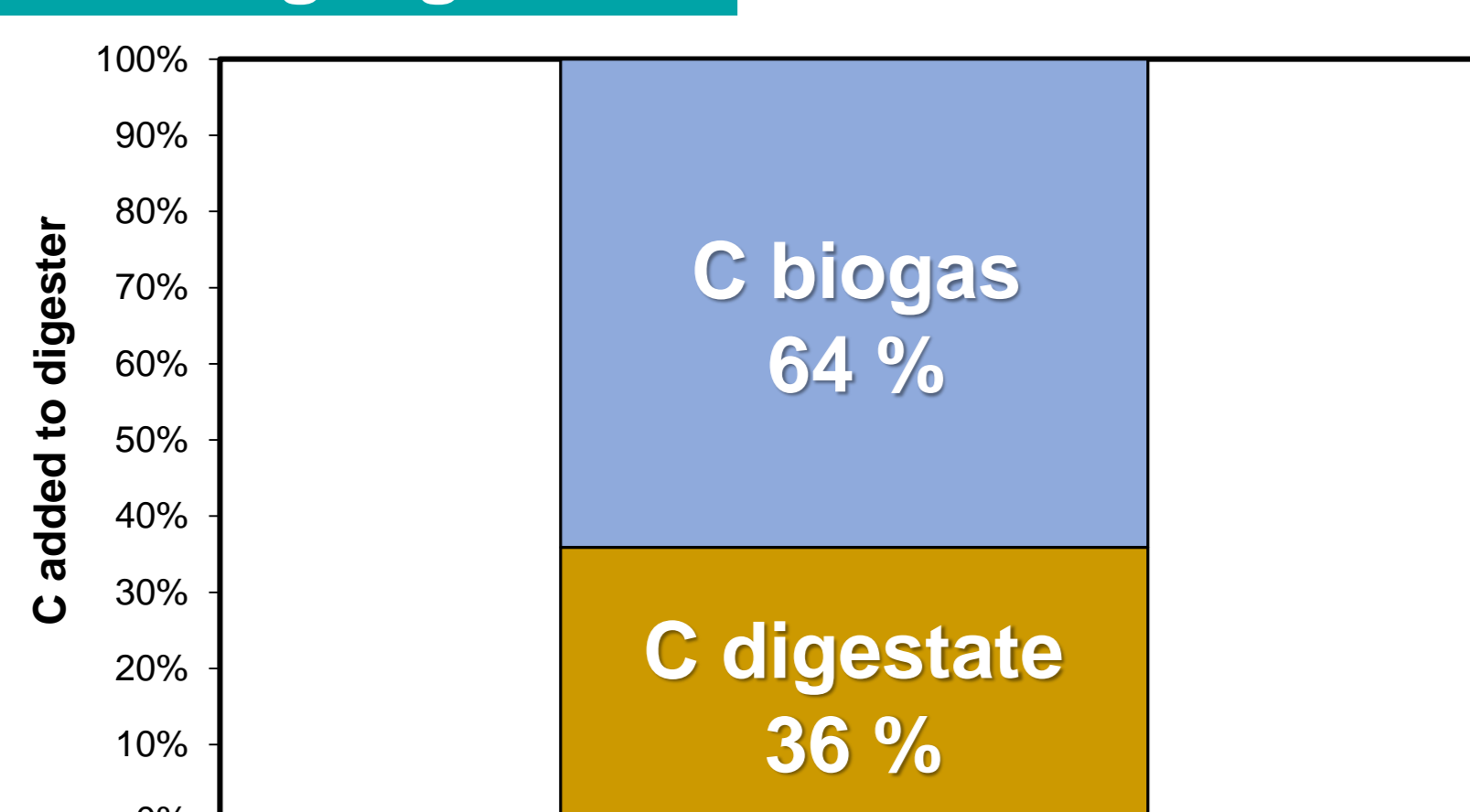
$$CO_2 - C_{amendment} = C_{fast} * (1 - e^{-\alpha * t})$$

**Assumption:** Model compartment ( $C_{fast}$ ) represents fast decomposing C  
→ remaining C considered 'stabilized C'

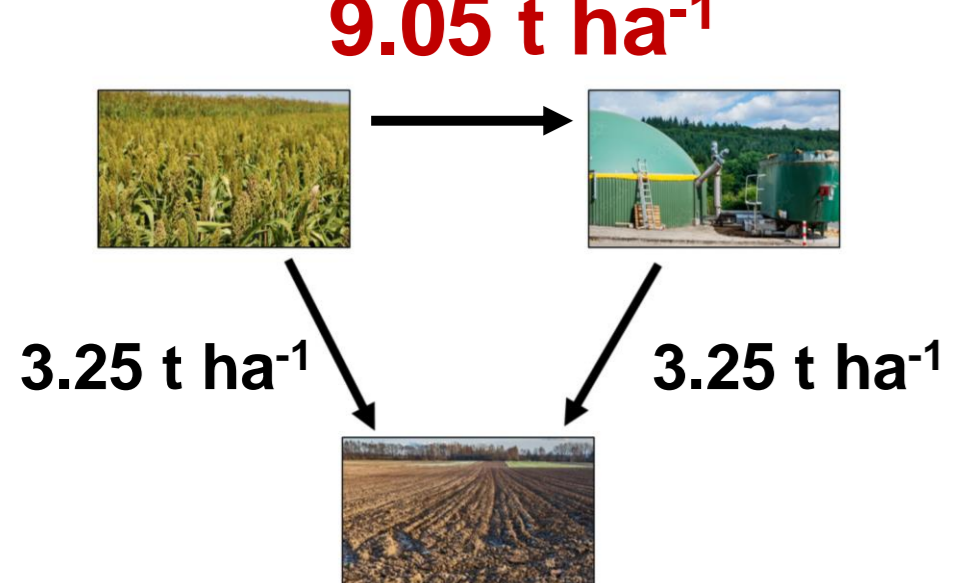
### → Soil C balance

## Results

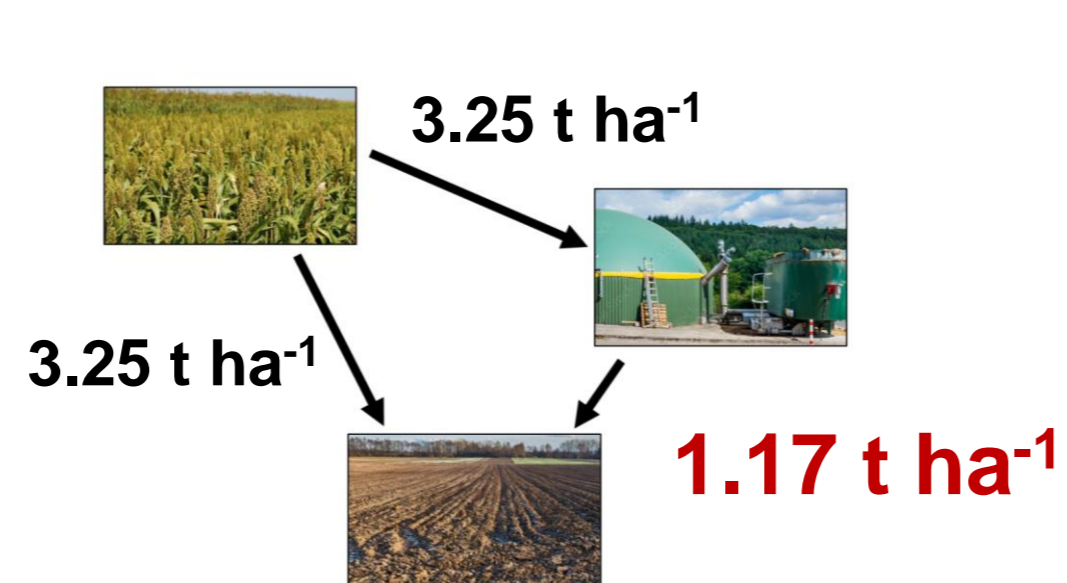
### C balance during digestion



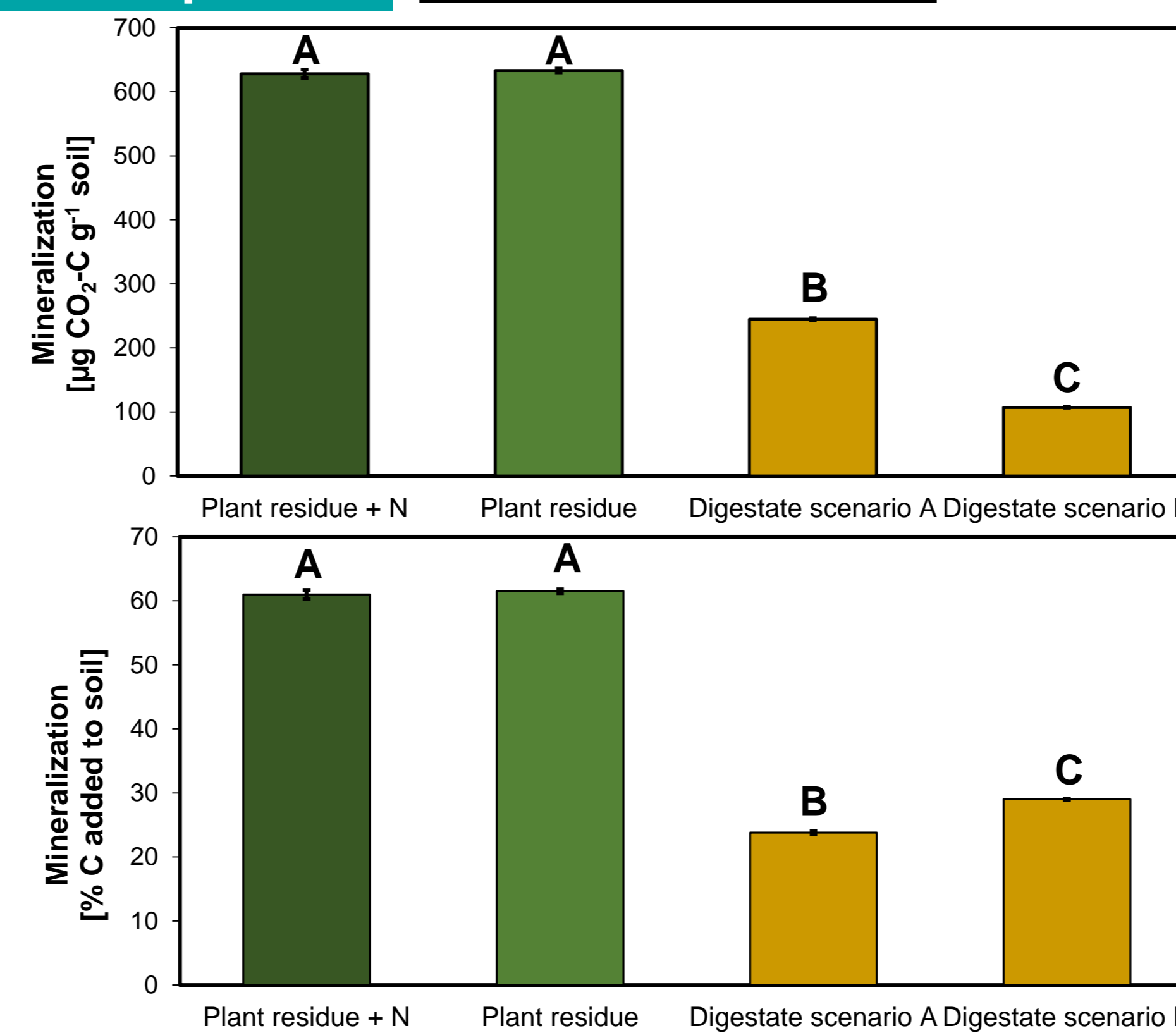
#### Scenario A



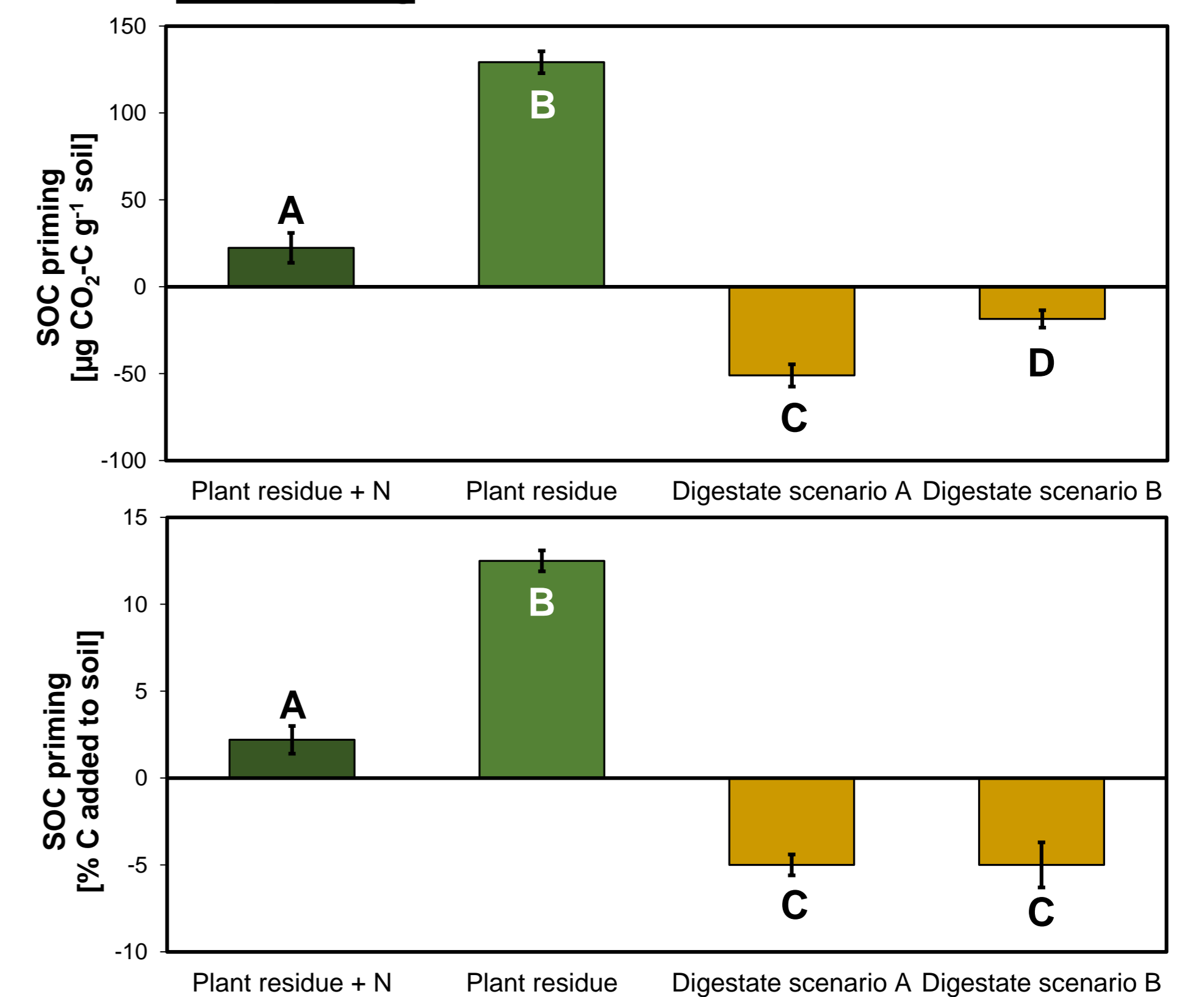
#### Scenario B



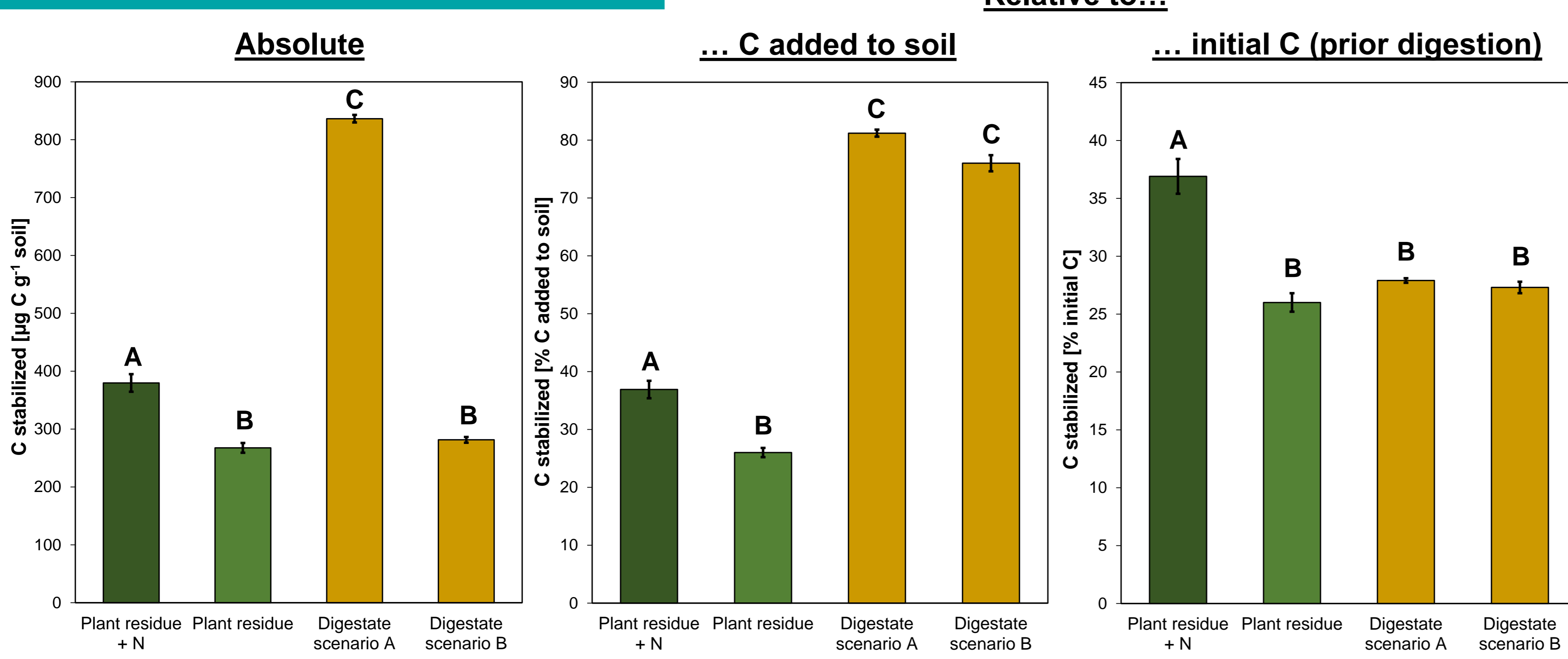
### Soil respiration Amendment mineralization



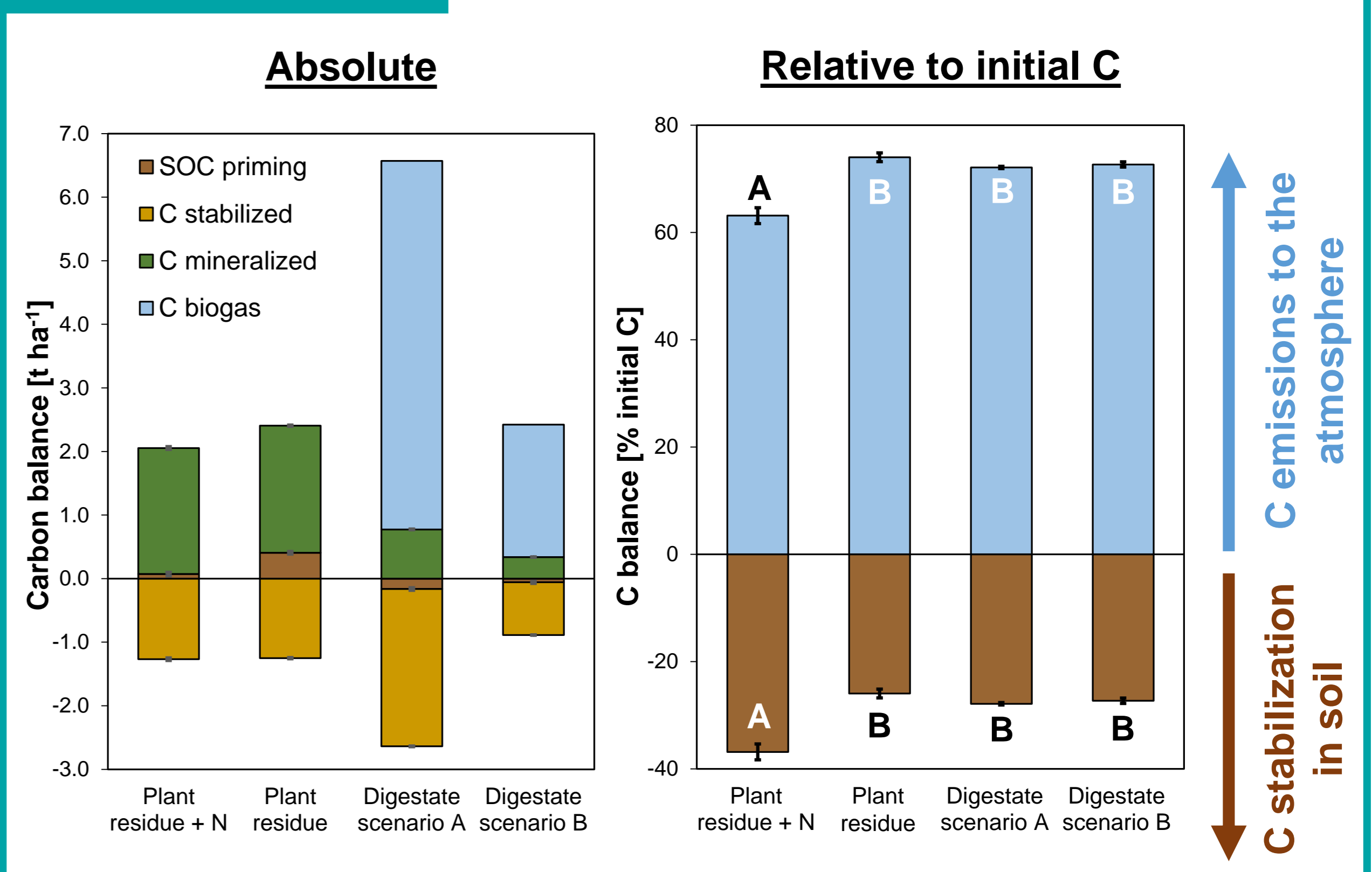
### SOC priming



### C stabilization in soil after 3 months



### Overall C balance



## Conclusions

### Scenario A

Initially, more plant material required for digestion.

→ Largest C stabilization with digestate.

→ Largest C emission with digestate.

But, similar C stabilization relative to the initially utilized plant C.

### Scenario B

Less C applied to soil for digestate, but...

→ ...similar C stabilization for plant residue and digestate,

→ Because relatively more digestate C is stabilized in soil than plant C.

Yet, similar C stabilization relative to the initially utilized plant C

**Overall: Largest C stabilization when plant residue is applied together with N to soils and no differences between other treatments/scenarios**