STARS
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Lancaster University

ANAEROBIC DIGESTATE FRACTION AND NUTRIENT STOICHIOMETRY SIGNIFICANTLY INFLUENCE THE CARBON AND NITROGEN CYCLES IN GRASSLAND SOILS

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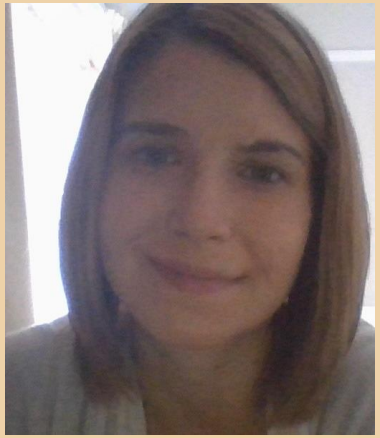

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WHAT IS DIGESTATE?

Feedstock: Agricultural/food wastes, manure etc. can be reused to produce biogas and digestate

Anaerobic digester: Fermentation of the feedstock and production of biogas (heat and energy)

Digestate: Residue of the anaerobic digestion which is considered an organic material

It can be separated into

Liquid fraction:

- NH_4^+, K^+, Na^+ and Cl^-
- High infiltration

Solid fraction:

- P, Ca^{2+} and Mg^{2+}
- Increase humic substances in soil
- High water holding capacity
- Reduces soil erosion and improves soil structure

Land application: Instead of inorganic fertilizers, digestate can be used in agriculture

Applying digestate to agricultural soils may influence the emission of greenhouse gases (e.g. CO_2, N_2O and CH_4)

HYPOTHESES 1ST INCUBATION

Digestate

Available C compounds + Recalcitrant C compounds (e.g. whole digestate, C:N = 4)

High nutrient soil

- ↑ CO_2-C
- ↑ N_2O-N
- ↑ CH_4-C

Low nutrient soil

- ↑ CO_2-C
- ↑ N_2O-N
- ↑ CH_4-C (lasted longer)

Only available C compounds (e.g. liquid digestate, C:N = 2)

High nutrient soil

- ↑ CO_2-C (but lower than whole)
- ↑ N_2O-N (but lower than whole)
- ↑ CH_4-C (higher than whole)

Low nutrient soil

- ↑ CO_2-C (higher than whole)
- ↑ N_2O (but lower than whole)
- ↑ CH_4-C (higher than whole and lasted longer)

Recalcitrant C compounds (e.g. solid digestate, C:N = 15)

High nutrient soil

- Slightly ↑ CO_2-C (but lower than other treatments)
- Slightly ↑ N_2O-N
- ↑ CH_4-C (lasted longer)

Low nutrient soil

- Slightly ↑ CO_2-C (lower than other treatments but lasts longer)
- ↑ N_2O-N (higher than other treatments)
- ↑ Slightly CH_4-C (but lower than other treatents and lasted longer)

HYPOTHESES 2ND INCUBATION

Digestate

Available C compounds + Recalcitrant C compounds (e.g. whole digestate, C:N = 4)

High nutrient soil

- ↑ CO_2-C
- ↑ N_2O-N
- ↑ CH_4-C

Low nutrient soil

- ↑ CO_2-C
- ↑ N_2O-N
- ↑ CH_4-C (lasted longer)

Only available C compounds (e.g. liquid digestate, C:N = 2)

High nutrient soil

- ↑ CO_2-C (higher than whole)
- ↑ N_2O-N (but higher than whole)
- ↑ CH_4-C (lower than whole)

Low nutrient soil

- ↑ CO_2-C (higher than whole but quickly decreases)
- ↑ N_2O (but higher than whole)
- ↑ CH_4-C (higher than whole and lasted longer)

Recalcitrant C compounds (e.g. solid digestate, C:N = 15)

High nutrient soil

Low nutrient soil

Same as previous incubation

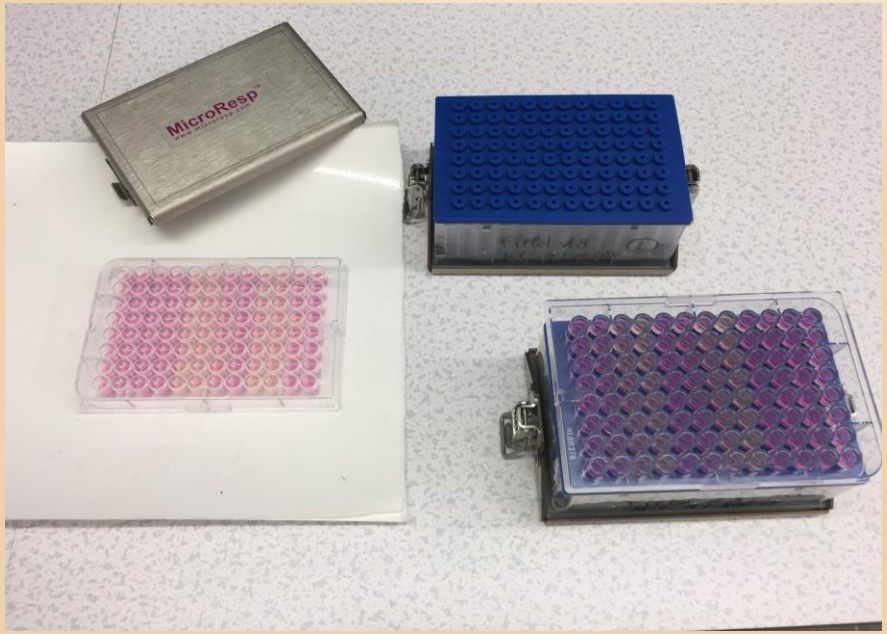
MATERIALS AND METHODS

- *Two incubations: 7* days each (carried out in two consecutively weeks)

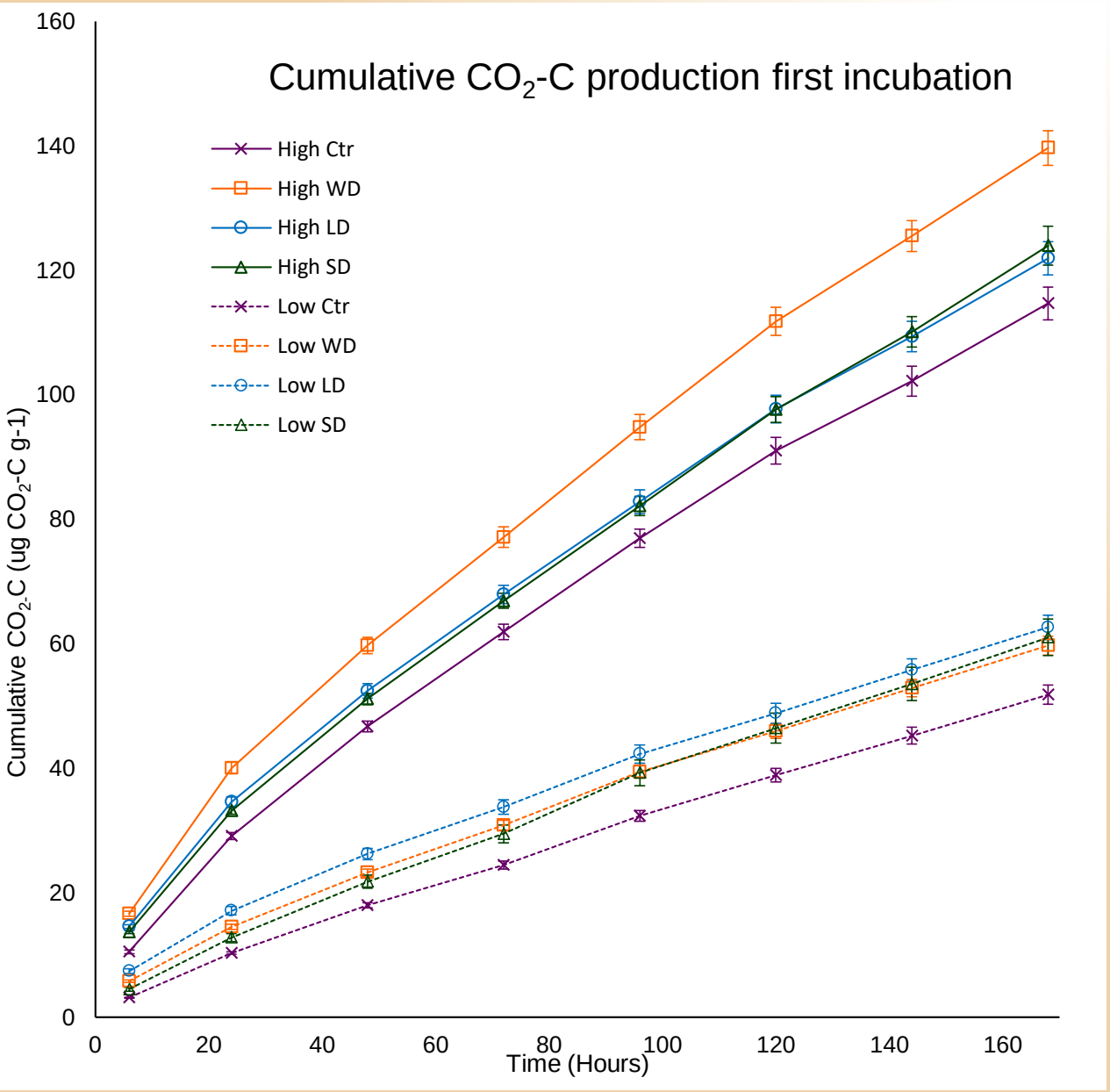
Applyed with N at fixed rate (C variable)

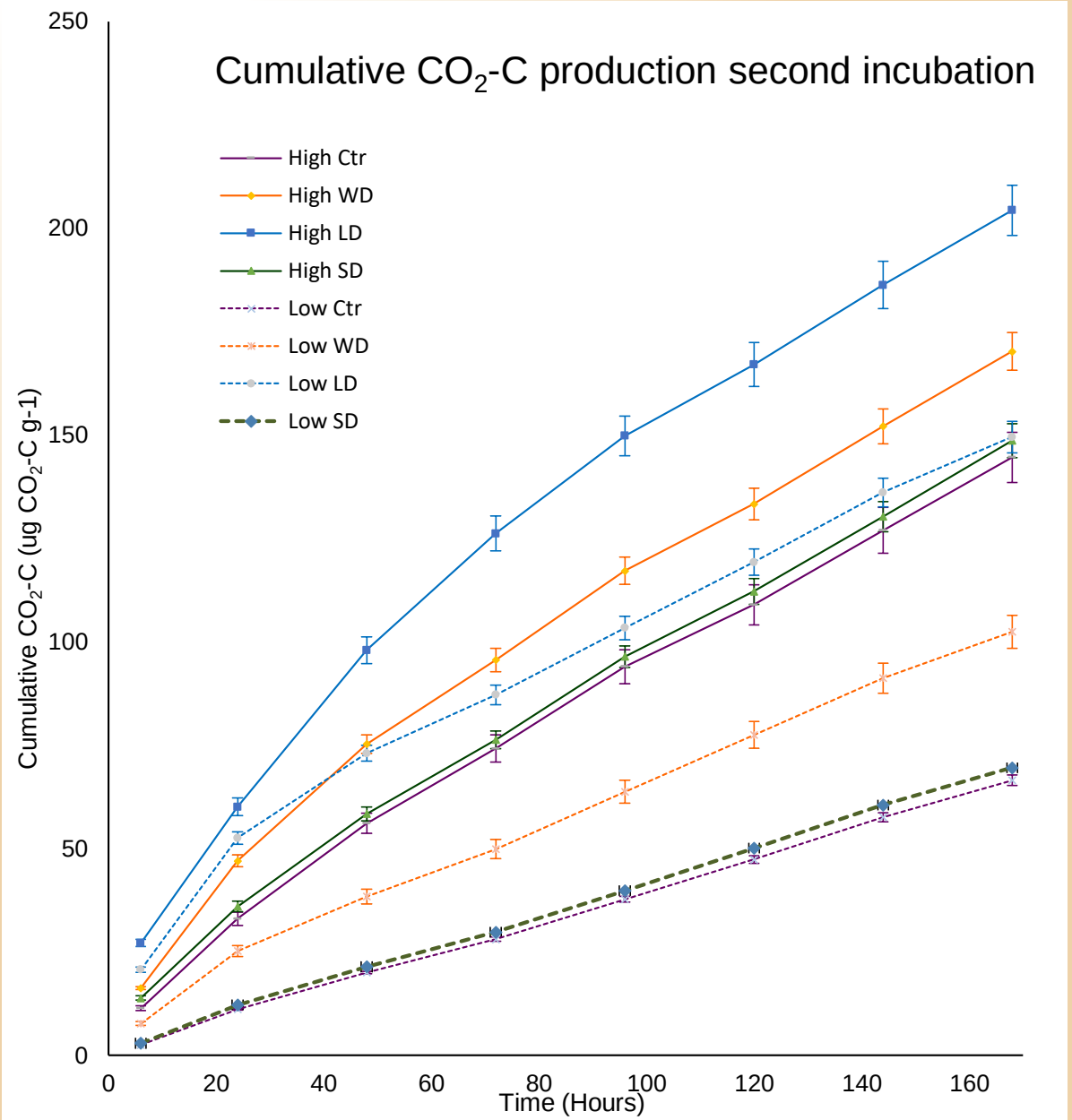
Applyed with C at fixed rate (N variable)

- Treatments: whole digestate (WD), solid digestate (SD), liquid digestate (LD) and control (Ctr)
- Soils: High and low nutrient
- *Analyses over time: CO_2 (MicroResp^{TM}), CH_4 & N_2O released (incubation with GC jars), soil C, N fractions, soil microbial community*



PRELIMINARY RESULTS





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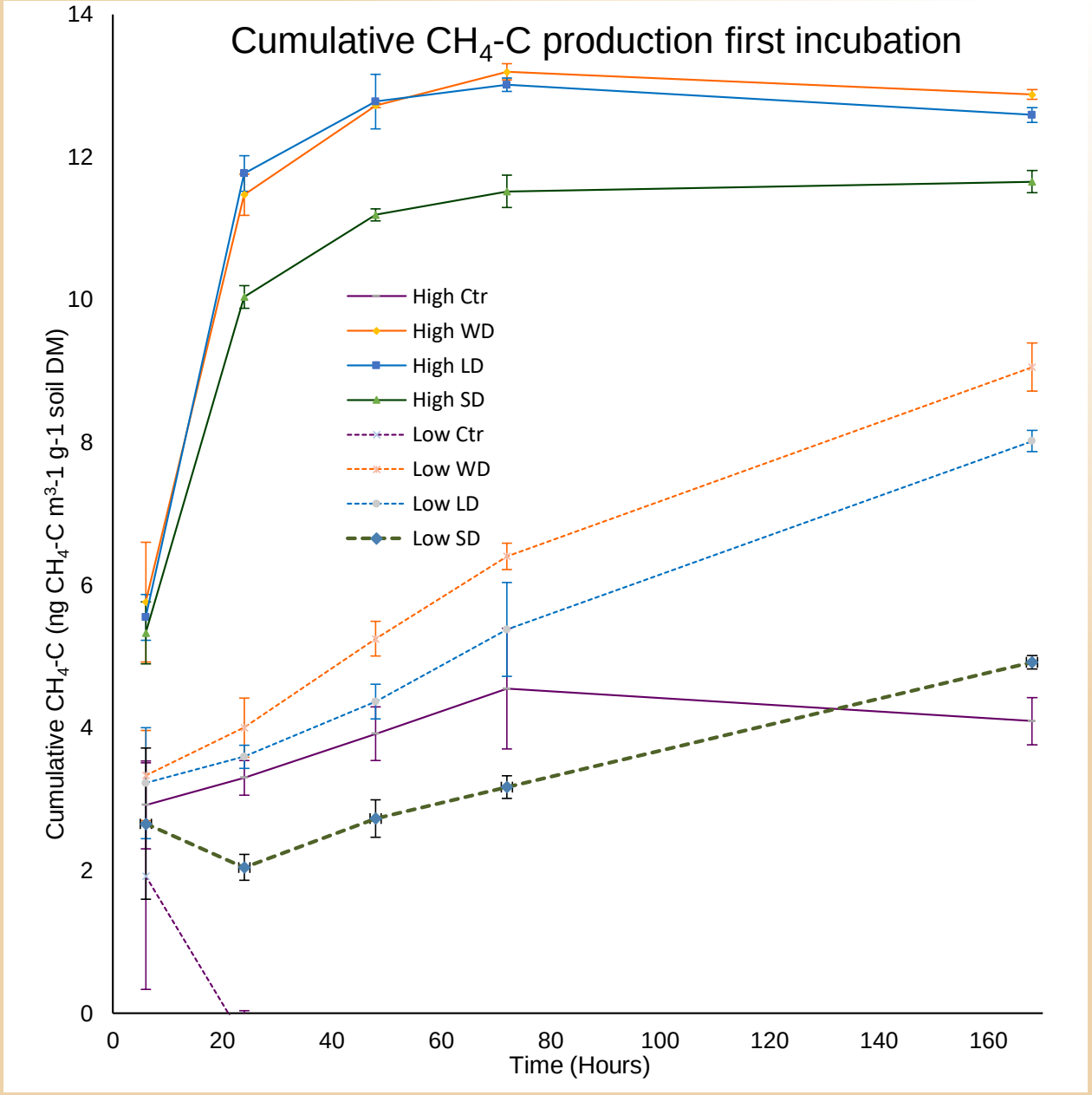

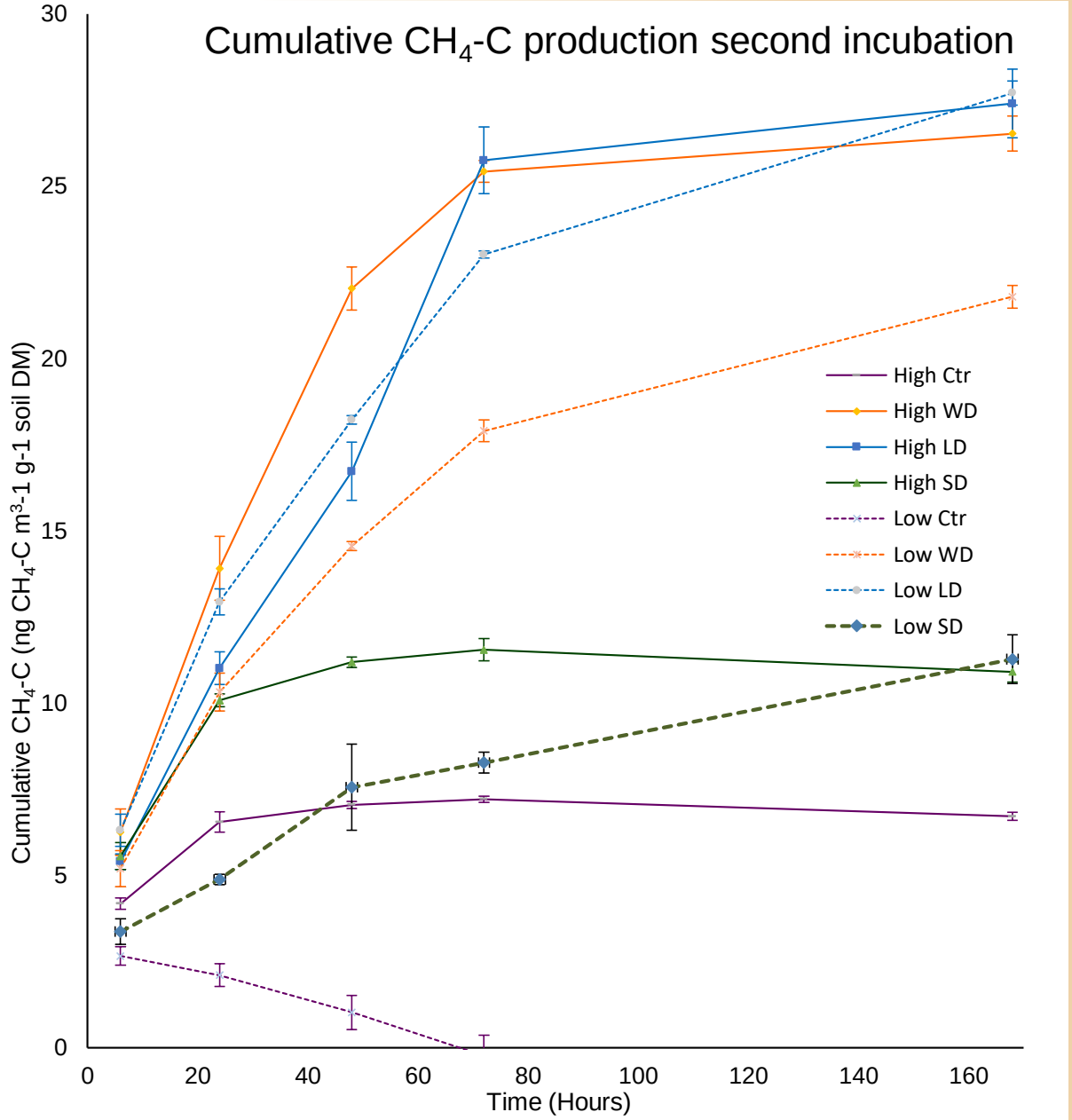

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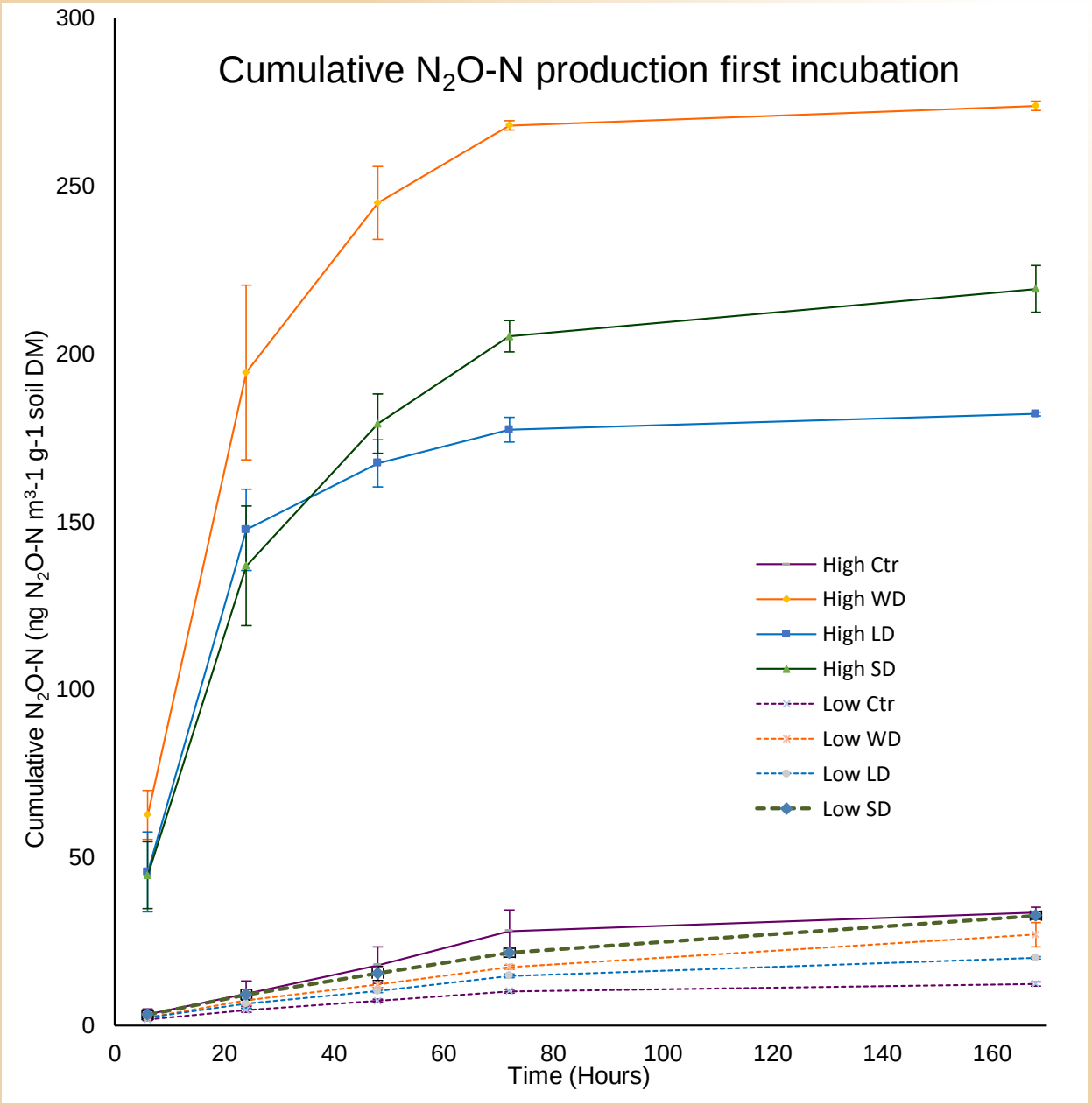

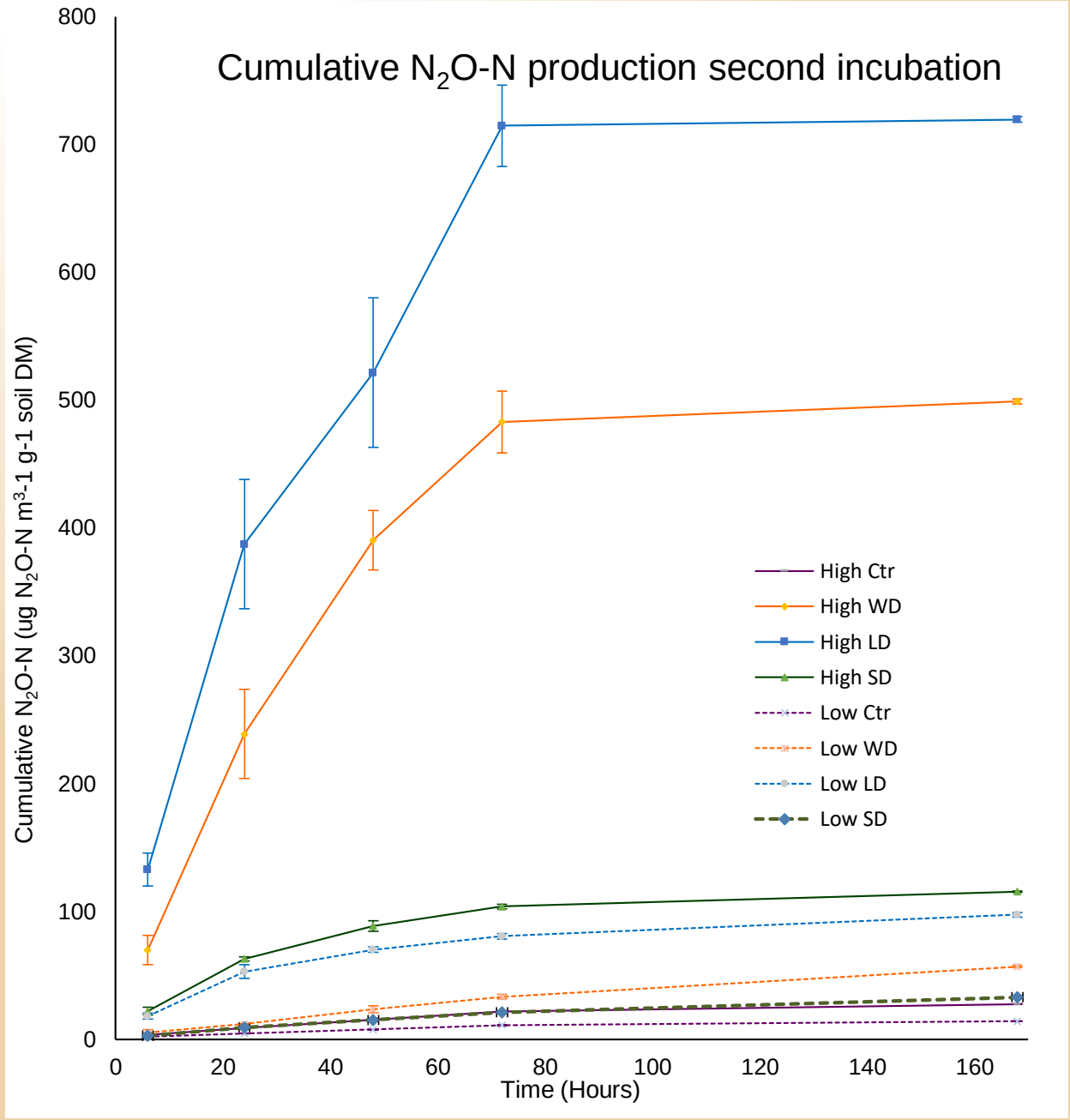

PRELIMINARY DISCUSSION AND CONCLUSION

- The quantity of GHGs emitted depend on the soil nutrient status, the fraction of digestate applied and the quantity applied

- Applications of the treatments at fixed C rates (N variable) can increase the cumulative GHGs emission by nearly double

↙ bacteria can shift their metabolic pathway

↓ based on the tot C and tot N applied with the treatments

↓ Quantity and quality of available C compounds addedd with the treatments, as well as NH_4^+

↘ gas already trapped inside the treatments

THANK YOU FOR YOUR ATTENTION!!!!