SEA2LAND

Producing advanced bio-based fertilizers from fisheries wastes

Benefits of bio-based fertilisers (BBFs) despite yield penalties under future climate scenario

LIÈGE université Gembloux Agro-Bio Tech

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Introduction

Four BBFs produced from fishery waste and originating from the main European aquatic regions were tested under two contrasted climates at mesocosm scale

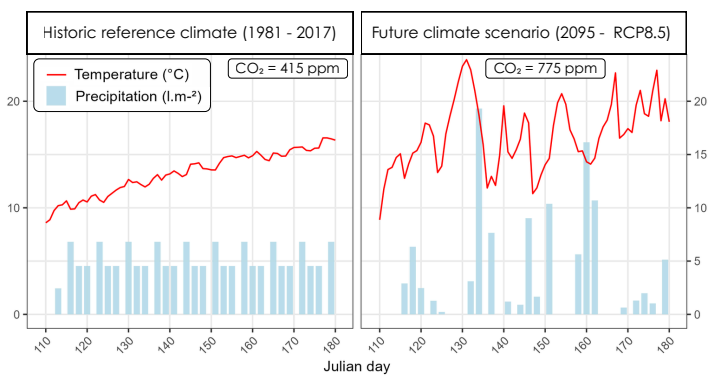
BBF1 - Adriatic Sea
Amino acids and peptides

BBF2 - Atlantic Sea
Protein fraction

BBF3 - Cantabrian Sea
NPK solution with amino acids

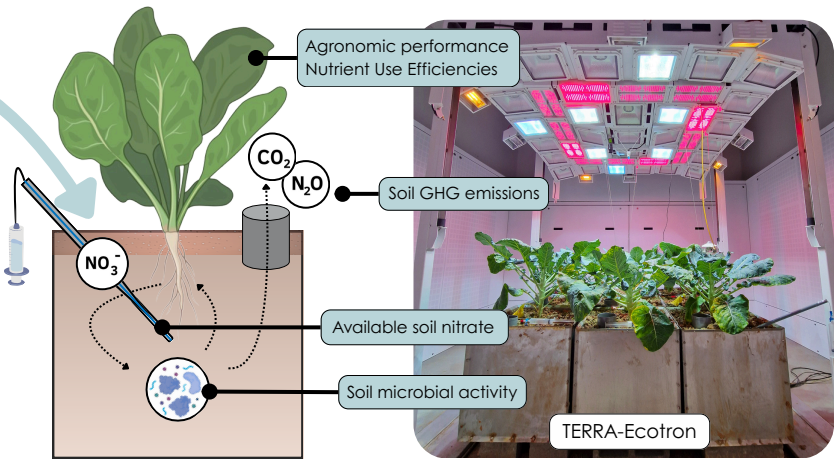
BBF4 - North Sea
Fish sludge pellet

- **Bio-based fertilisers** (BBFs) are part of the **circular economy** model for Europe to achieve **climate neutrality** by 2050
- In this study, an **Ecotron experiment** evaluated the **agronomic and environmental performance** of four BBFs and a synthetic control fertiliser (SYN) under a reference and future climate scenario



Materials and methods

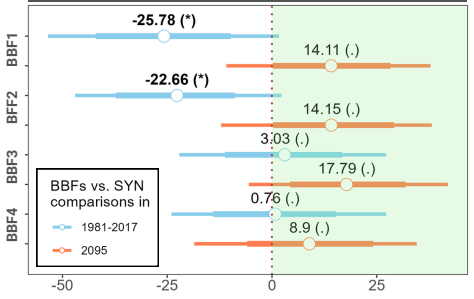
Pair-wise comparisons of plant-soil data under two climates and five treatments using Bayesian linear mixed models



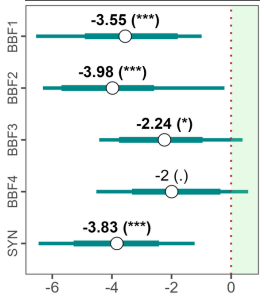
- Broccoli plants grown in intact soil monoliths from suitable agricultural field
- BBFs or SYN fertilisers applied to target 120 kg N ha^{-1} for all treatments
- Head diameter and fresh weight, total biomass and N/PUE measured
- Soil N_2O & CO_2 fluxes recorded using a respiration chamber (LI-COR)
- Soil available nitrate (NO_3^-) measured from pore water samples (Rhizons)
- Soil microbial activity assessed using fluorescein diacetate (FDA) hydrolysis

Results

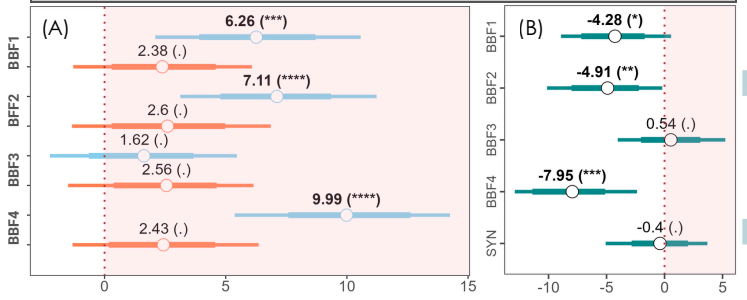
Nitrogen Use Efficiency



Head diameter (cm)



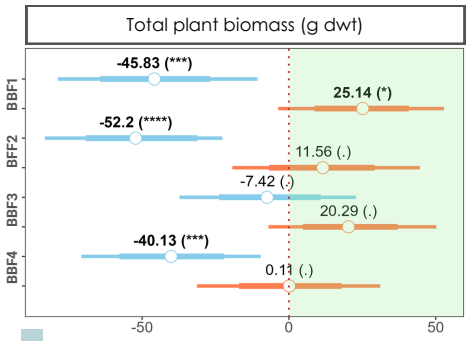
∑N_2O emissions (µmol m^{-2})



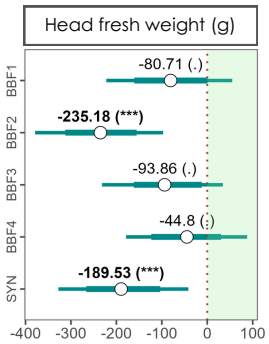
Systems under BBFs consistently emitted more GHGs than those under SYN, especially regarding N_2O (positive shifts, panel A)

Decreased N_2O fluxes observed for most BBFs under future climate (negative shifts, panel B)

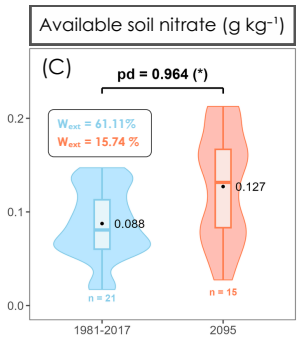
Total plant biomass (g dwt)



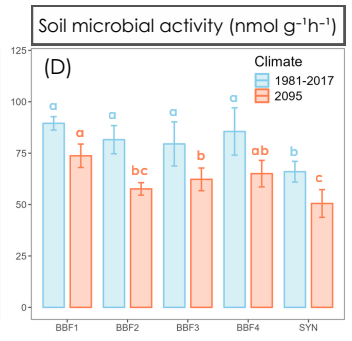
Head fresh weight (g)



Available soil nitrate (g kg^{-1})



Soil microbial activity (nmol g^{-1}h^{-1})



Plant available soil nitrate was on average increased in the future climate, despite a lower water extractability (W_{ext} , panel C)

Enhanced soil microbial activity was observed under soil fertilised with BBFs under both climates but decreased in the future scenario (panel D)

Reference climate (blue) : SYN generally outperform BBFs (mostly negative shifts)

Future climate (orange) : Most BBFs gain in performance compared to SYN (positive shifts)

Similar trends observed for PUE and head fresh weight, with head diameters being the least impacted

Future climate induced yield penalties regarding head quality (negative shifts observed on all treatments)

Conclusion

BBFs show promise as **sustainable alternatives** to SYN, especially under future climate

Yield penalties persist across all fertilisers; further research is needed to secure productivity

Climate x fertiliser **interactions are complex**, stressing the value of empirical data to anticipate the impact of climate change on agriculture

To improve their environmental footprint and efficiency, **BBFs must be evaluated in diverse contexts** to support scalable, region-specific solutions

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