Interaction of decreased crop growth and retarded mineralization of ^{15}N ^{13}C labelled green manure under decreased precipitation patterns

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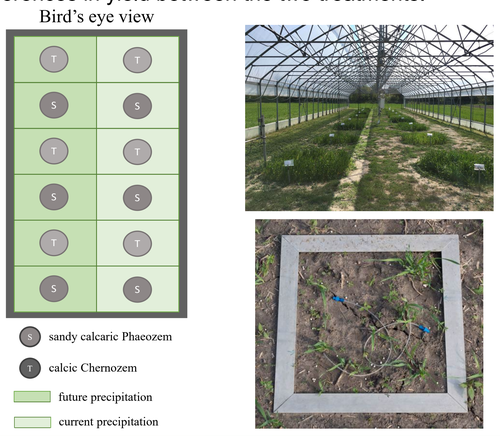
Introduction

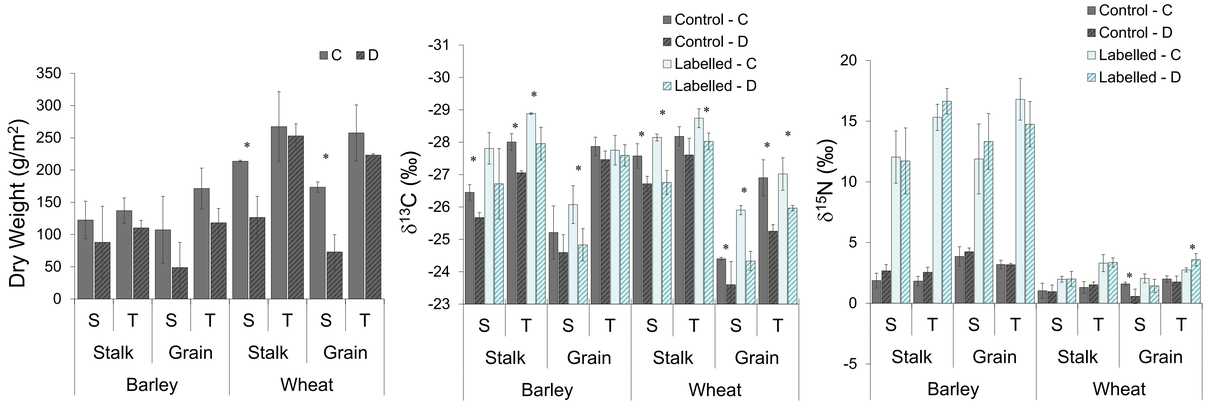
Climate change will alter precipitation patterns in the future, consequently altering soil moisture - an important parameter for plant production, organic matter mineralisation and nutrient release. We investigated the effect of future rainfall patterns affecting the mineralisation process of isotopically labelled green manure amendments in model agroecosystems with regard to **C** and **N cycling**, by using different agricultural soils and simulating future/drier precipitation patterns of the agricultural intensive Marchfeld region in Austria.

Methods

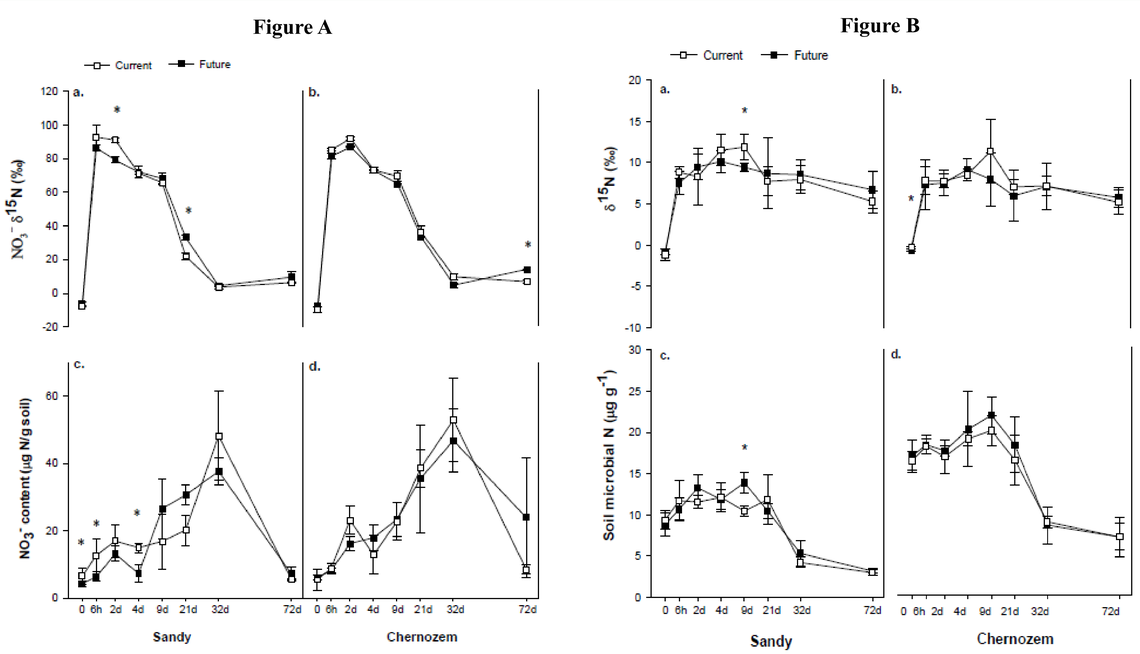
The fate of SOM under **different precipitation conditions** was assessed by applying green manure (*Sinapis alba*) labelled with the stable isotopes **^{13}C** and **^{15}N** to 2 different soils - **sandy calcaric Phaeozem** and a **calcic Chernozem.** The labelled manure was then traced throughout the growing season of 2018 and 2019 in plants, bulk soil, soil MOs, inorganic and organic N, as well as in N_2O gas emissions. Crop biomass was assessed for differences in yield between the two treatments.



Results

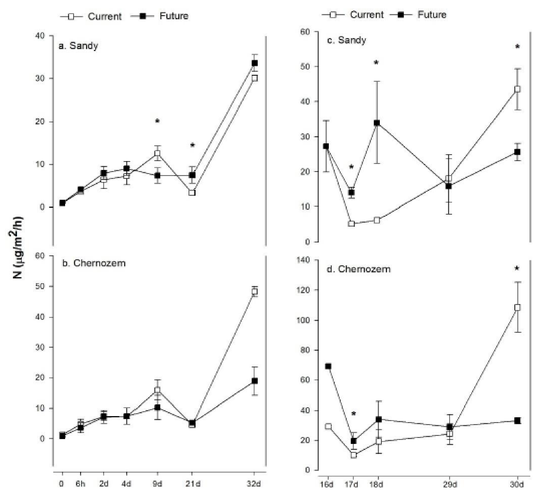


Crop yield results and isotopic signatures for different plant compartments and soil types (S - sandy Phaeozem and T - Chernozem), under current (C) and future (D) precipitation regimes, inside and outside the labelled plot. The asterisks above bar series represent statistically significant differences between the two treatments. Values are means ± SD, n=3.



^{15}N kinetics in soil extractable nitrogen (**figure A**) and extractable soil microbial biomass N (**figure B**) for both soil types at different sampling timepoints after the application of green manure (sampling point 0). The asterisks above bar series represent statistically significant differences between the two treatments. Values are means ± SD, n=3.

Results



N_2O emissions for individual sampling times (a & b) and repeated individual lysimeter measurements after heavy rainfall simulation and after fertilisation events (b & c). Values are means ± SD, n=3.

Discussion & Conclusion

Results showed a **decrease in plant biomass** for the future scenario due to drought stress (increased leaf δ13C for the future compared to current). Mineralisation of green manure and label uptake into soil microorganisms was shown to start within hours of application. However, isotope results showed that **mineralisation of green manure** is **initially slower under the future scenario** (soil NO_3^-, N_2O emissions) and that it changes during summertime, emphasizing the **importance of plant biomass production for nutrient uptake in agricultural systems**. Overall, this study shows that agricultural soils respond differently to changes in precipitations, and it highlights the importance of a better understanding of interaction processes between soils and plants.

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