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How much fertilizer N can we save through cover crop cultivation?

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Background & Objectives

- Growing cover crops (CC) prior to sugar beet (SB) is well adapted.
- However, it is not yet clear . . .

  (i) . . . how much N from CC biomass differing in amount and composition can be accounted for the N supply of SB and winter wheat (WW) as 1st and 2nd succeeding crop, and

  (ii) . . . how much N_2O is released during the growing seasons of the CC, and subsequent sb and ww.
- For clarification, triennial field trials were performed (CC-SB-WW).

This study focuses on the effect of cover crops on the N supply of subsequent non-fertilized sugar beet

Field experiments, Measurements, Calculations

- Field trials were conducted at Ihinger Hof (South Germany) and Göttingen (Central Germany) on loessial soil in 18/19 and 19/20
- 4 CC species (oil radish, saia oat, spring vetch, winter rye) were grown in autumn/winter and compared with bare fallow
- CC biomass was measured in autumn and soil N_{min}–samples (0-90 cm) were taken in monthly intervals
- Following SB was sampled (i) in summer (July/August) and (ii) autumn (September/October), and N content was determined
- The CC N effect on SB (non–fertilized) was calculated for distinct periods as: N uptake SB (CC) - N uptake SB (fallow), in kg N ha^{-1}

Results & Discussion

N effect

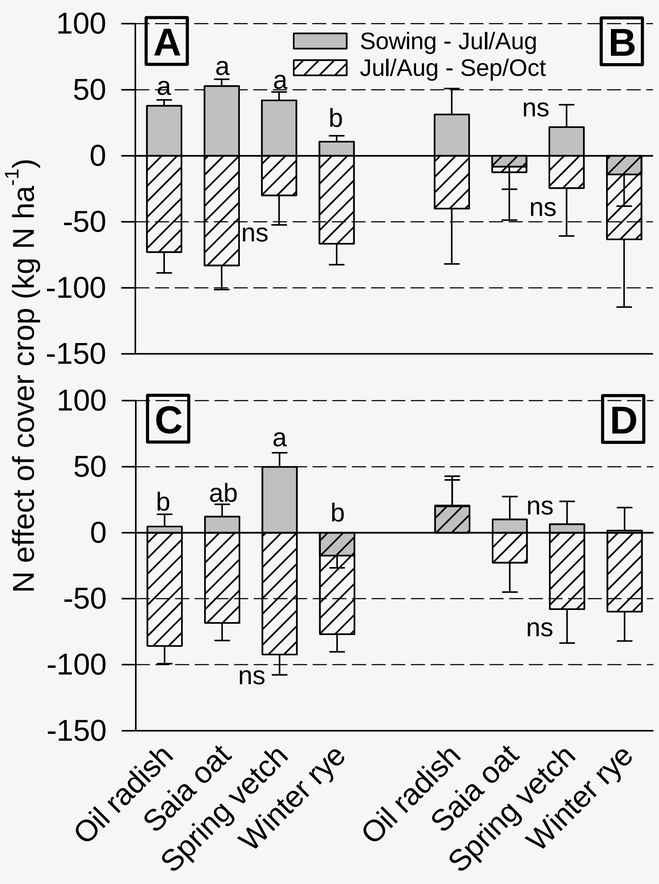

Figure 1:
Cover crop N effect to non–fertilized sugar beet in two periods of the season at Ihinger Hof 18/19 (A) and 19/20 (B), and Göttingen 18/19 (C) and 19/20 (D).

- **CC biomass C and N content** varied among site/year combinations and species from 365-1658 kg C ha^{-1} and 41-172 kg N ha^{-1} (not shown).
- **N_{min} in March** was lowest after rye and radish, and highest after bare fallow in all trials, while after vetch and oat N_{min} was either intermediate or as a high as after fallow (not shown).
- Across all CC, the **N effect** on non-fertilized SB compared to fallow was **positive from Mar-Jul/Aug**, but substantially **negative from Jul/Aug-Sep/Oct** (Fig. 1).
- In the **first period**, the **N effect** was consistently **lowest after rye** and higher after the other CC, with variable effects of the different CC species in individual trials (Fig. 1).
- In the **second period**, the **N effect was negative** compared to fallow, indicating N immobilization caused by CC biomass, without clear differences among species (Fig. 1).

Sugar yield

- **Sugar yield** was very high after vetch at all site/year combi–nations and lowest after rye in 3 out of 4 trials (Fig. 2).
- **Correlation analysis** revealed a clearly **negative relationship between CC biomass and N_{min} in March** (not shown).
- **Increasing CC biomass decreased the N effect** (significant at Göttingen 18/19 only) and **sugar yield** (at Ihinger Hof 19/20 and Göttingen 18/19; not shown).
- Consequently, whole season **N effect and sugar yield** were **correlated positively** (significant at Göttingen only, not shown).

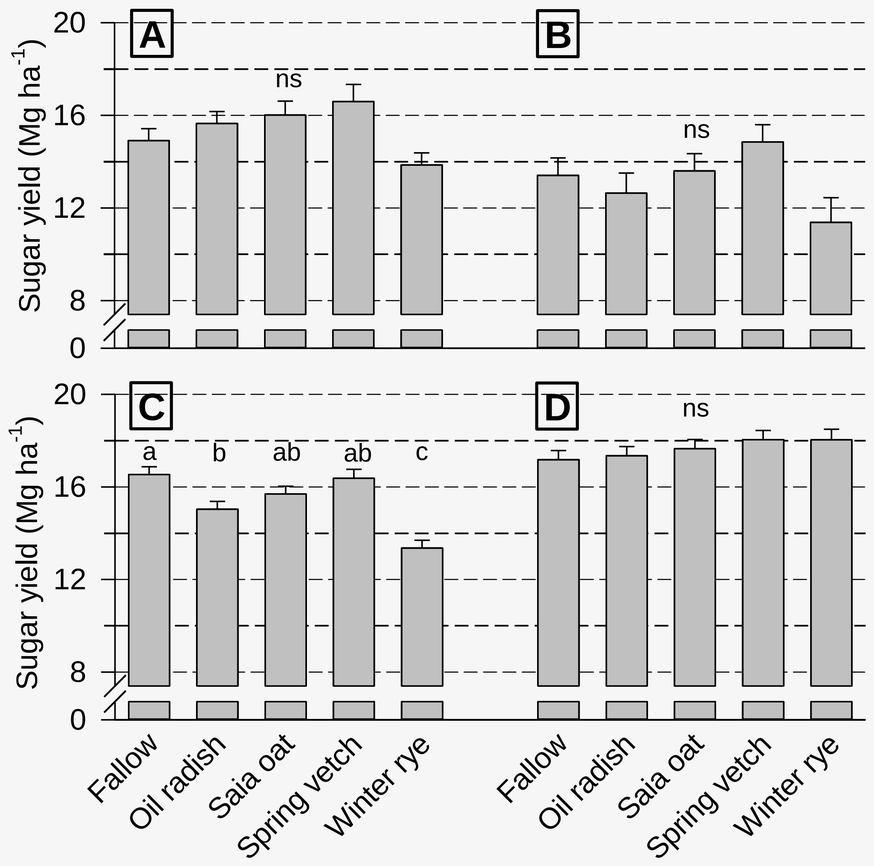

Figure 2:
Cover crop effect on **sugar yield** of non–fertilized sugar beet at Ihinger Hof 18/19 (A) and 19/20 (B), and Göttingen 18/19 (C) and 19/20 (D).

Conclusions and Outlook

- **Cover crops caused additional N mineralization in spring to midsummer, but substantial N immobilization in summer to autumn.**
- **Cover crop species effects on N release were inconsistent: only spring vetch, producing low biomass, increased sugar yield.**
- **Further data evaluation will reveal, which cover crop types allow to reduce the N fertilizer dose for high yielding beet crops.**

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