NO_3^- UPTAKE AND C EXUDATION – DO PLANT ROOTS STIMULATE OR INHIBIT DENITRIFICATION?

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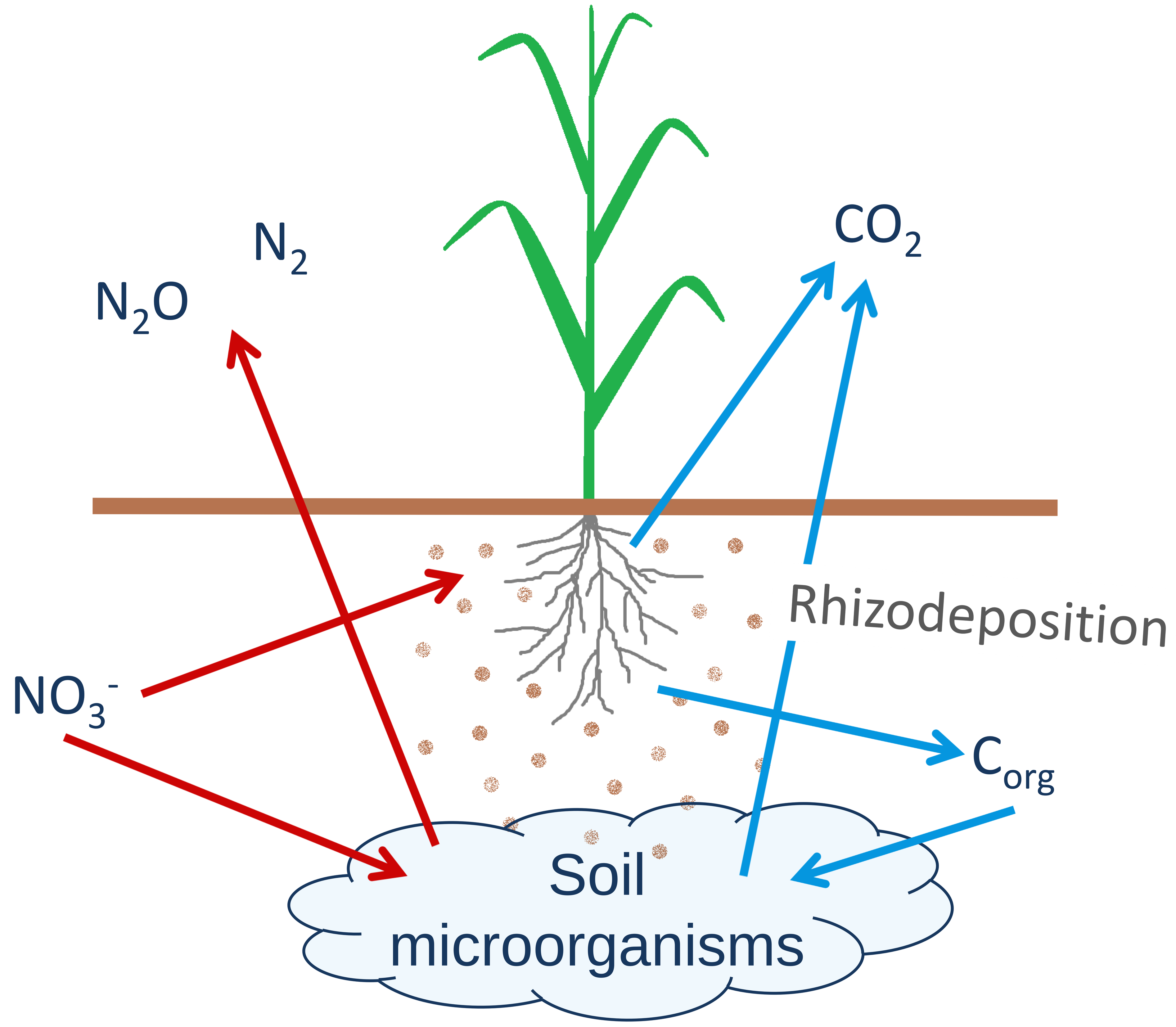

BACKGROUND

- Denitrification in soils depends on availability of NO_3^- and C_{org}
- Plant N uptake controls N availability in soil
- Rhizodeposition increases C availability in rhizosphere

HYPOTHESES

(1) Plant N uptake governs NO_3^- availability for denitrification leading to increased N_2O and N_2 emissions, when plant N uptake is low due to smaller root system or root senescence

(2) Denitrification is stimulated by higher C_{org} availability from root exudation or decaying roots increasing total gaseous N emissions and decreasing their $N_2O/(N_2O+N_2)$ ratios

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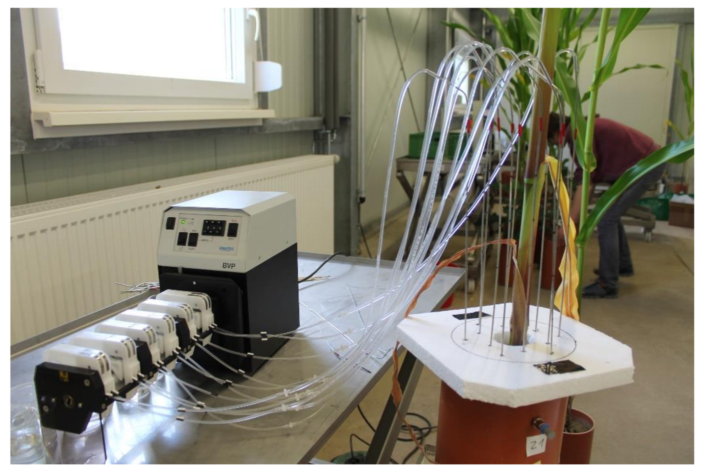
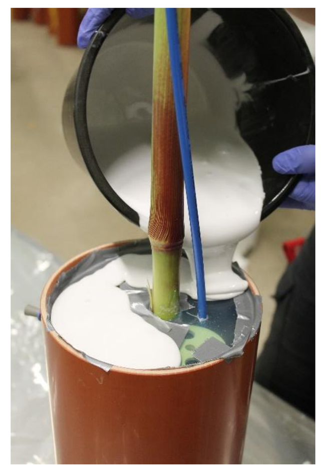

MATERIAL & METHODS

- Growth chamber experiment
- Maize (Zea mays L., 3 N levels S/M/L)
- Cup plant (Silphium perfoliatum L., N level M)
- 16 h day 25°C, 8 h night 18°C, 70% WFPS
- $^{15}NO_3^-$ labeling to estimate N_2O and N_2 emissions (injection of 0.1 g N kg^{-1} $Ca(^{15}NO_3)_2$, 60 at%, all pots)
- $^{13}CO_2$ pulse labeling to link denitrification with available C in the rhizosphere (5 g $NaCO_3$, 99 at%, all pots)
- CO_2 trapped in NaOH over periods of 12 h each
- Headspace sampling for N_2O and N_2 analysis every 12 h

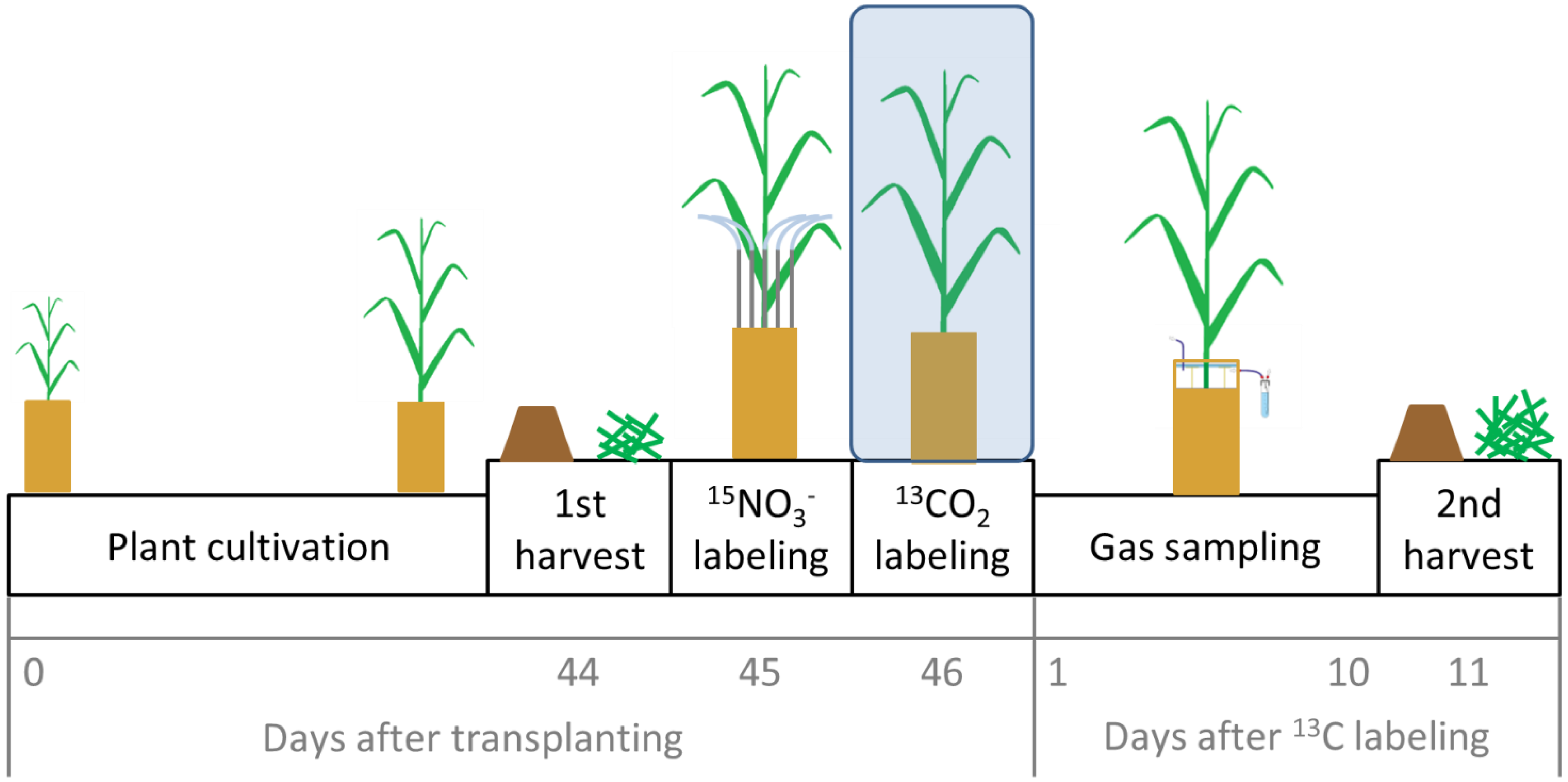

Fig. 1: Timeline of the experiment

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RESULTS

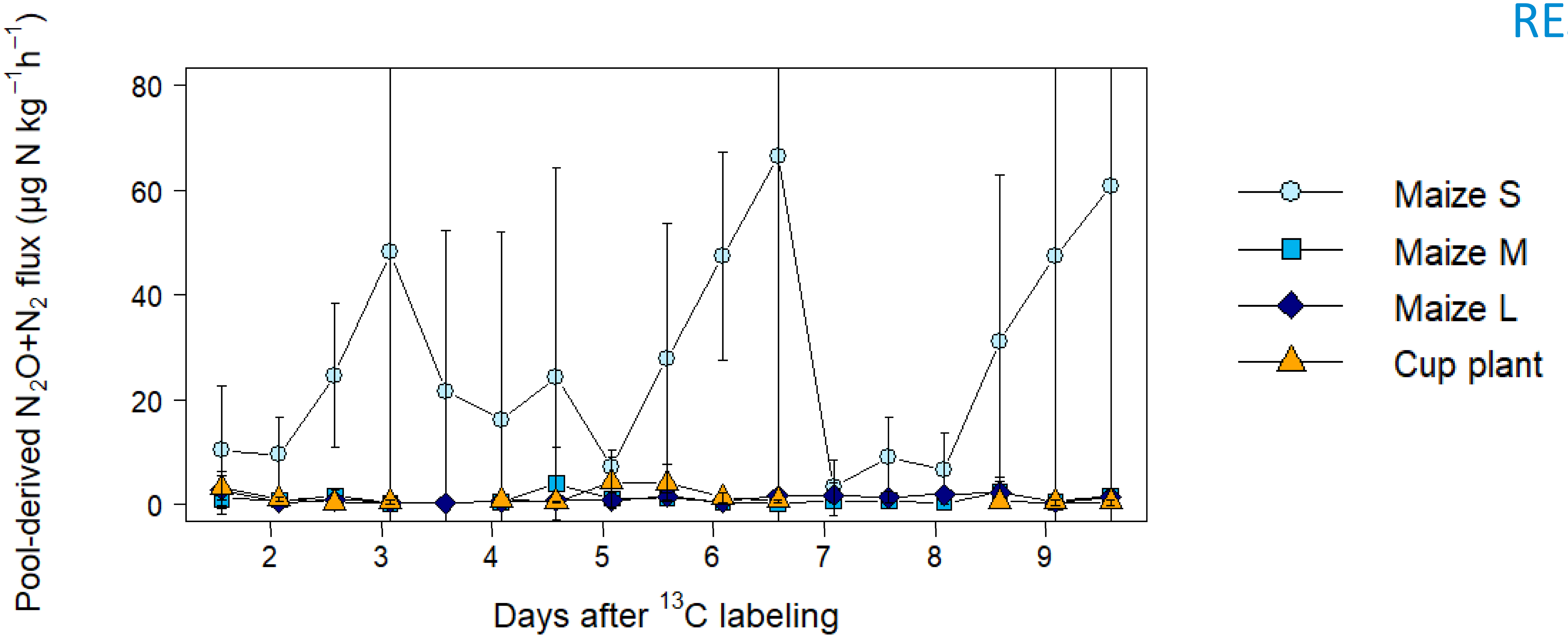

Fig. 2: N_2O+N_2 fluxes derived from the labeled NO_3^- pool. Means and standard deviation for n=1-6

- Highest N_2O+N_2 emissions in Maize S with smallest root system
- Lowest N uptake and highest soil NO_3^- (at the end) in Maize S
- Higher soil moisture enhanced conditions for denitrification

→ Plant growth was an important regulator of water and N uptake and thus controlled denitrification-derived N_2O+N_2 emissions

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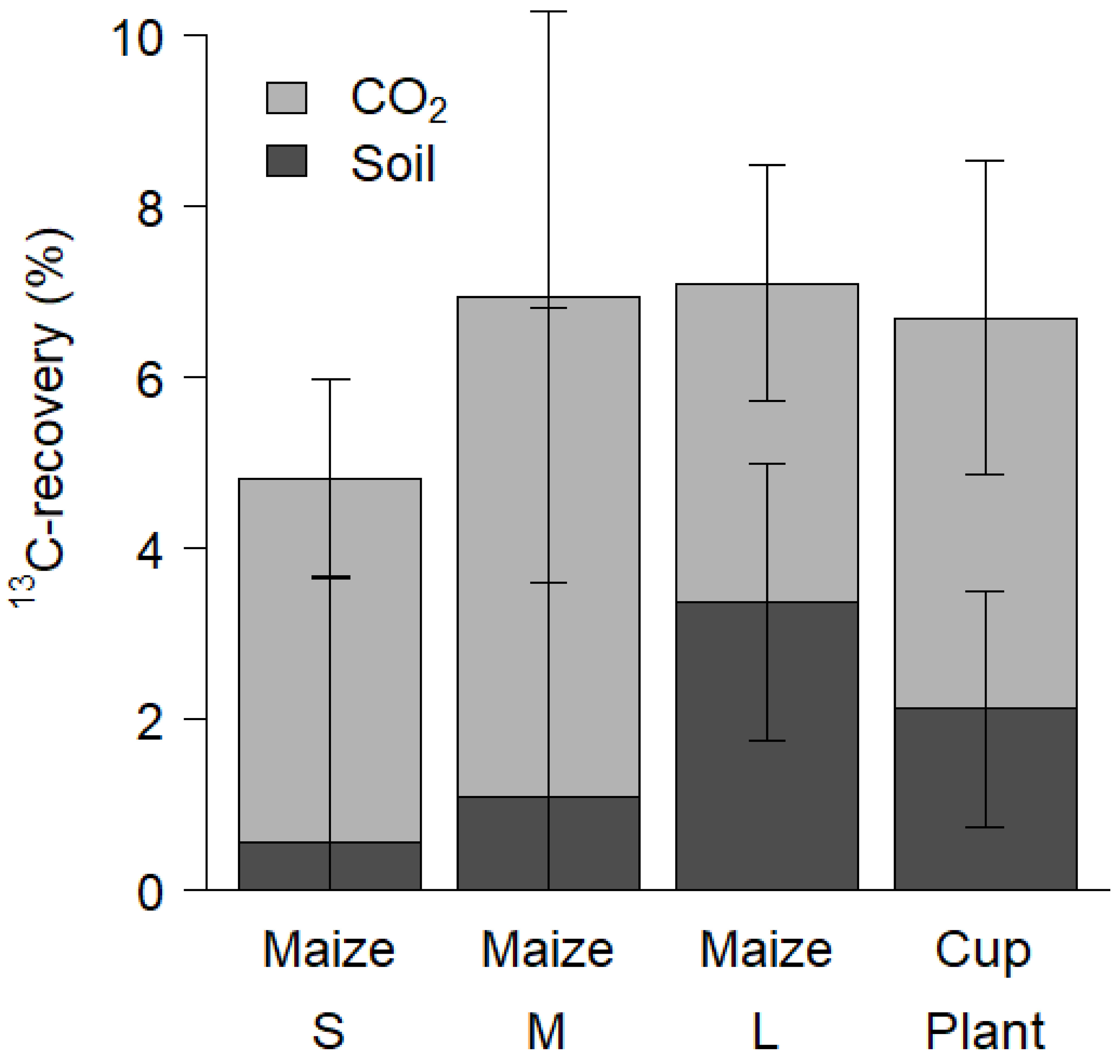

Fig. 3: ^{13}C recovery in cumulative CO_2 efflux from soil and in soil at the end of the incubation experiment. Means and standard deviation for n=6.

RESULTS

- Total CO_2 efflux increased with root dry matter (R^2=0.36, $p<0.01$)
- No statistically significant differences ($p<0.05$) in relative ^{13}C recovery in CO_2, soil, or soil+CO_2
- Relative ^{13}C recovery in soil increased with root dry matter

→ Belowground C deposition increased with root dry matter

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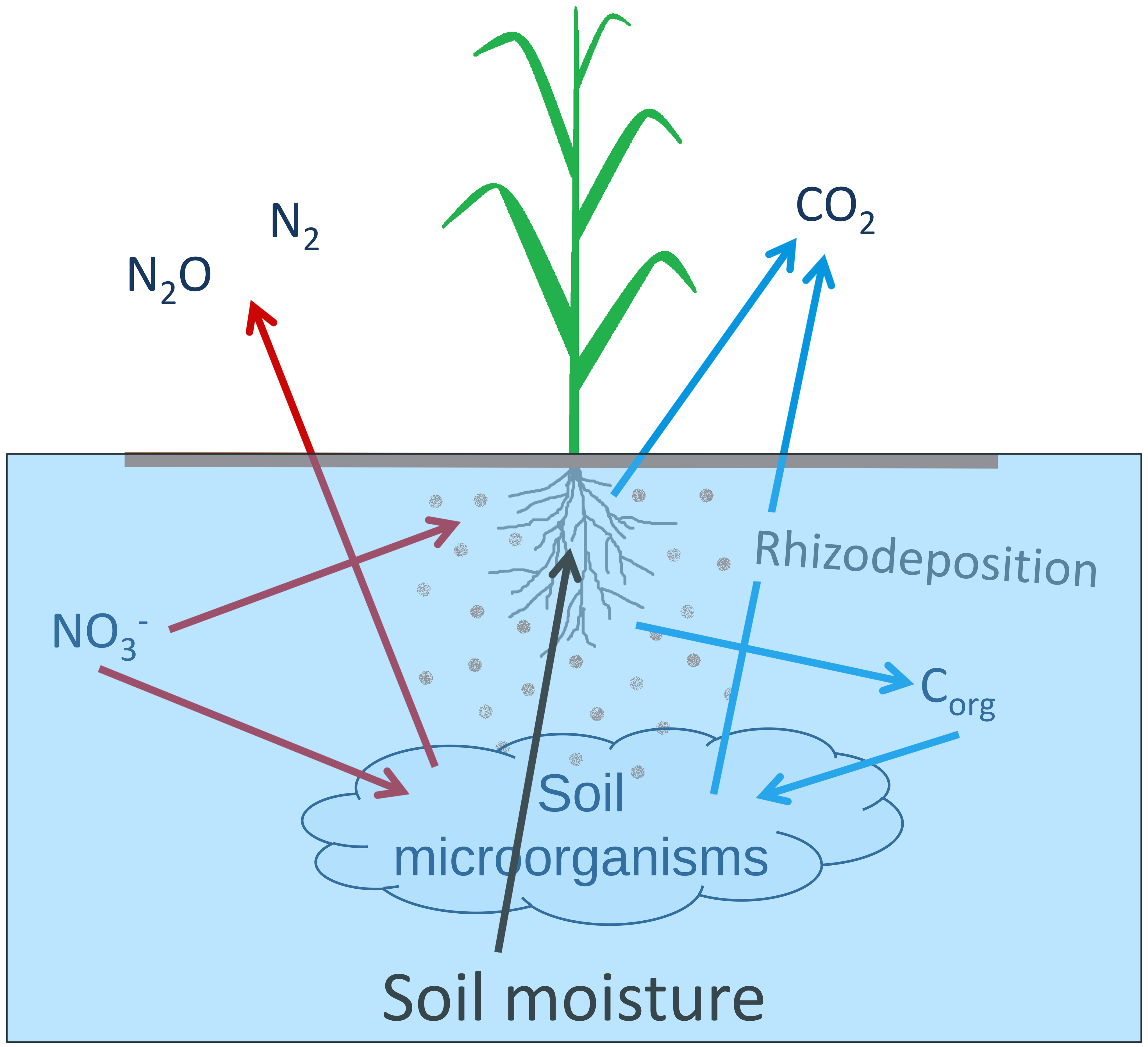
SUMMARY

- Plant water uptake was a main factor controlling N_2O+N_2 emissions
- Plant growth controlled N uptake and thus NO_3^- availability for denitrification
- Root size affected C availability from root exudation,

  but there was no indication of any relationship with N_2O+N_2 emissions
- We anticipate that higher C_{org} availability did not increase

  denitrification rates as NO_3^- was limited due to plant uptake



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