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Carbon partitioning into *Lolium perenne* plant-soil-microorganisms system after 9 years of Free-Air CO₂ Enrichment (Swiss FACE)

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CONTEXT

The Swiss FACE system is the oldest available in the world running with a temperate grassland ecosystem. Very few devices are available for long term studies of the consequences of elevated CO₂ on C allocation in the continuum atmosphere-plant-soil-microorganisms.

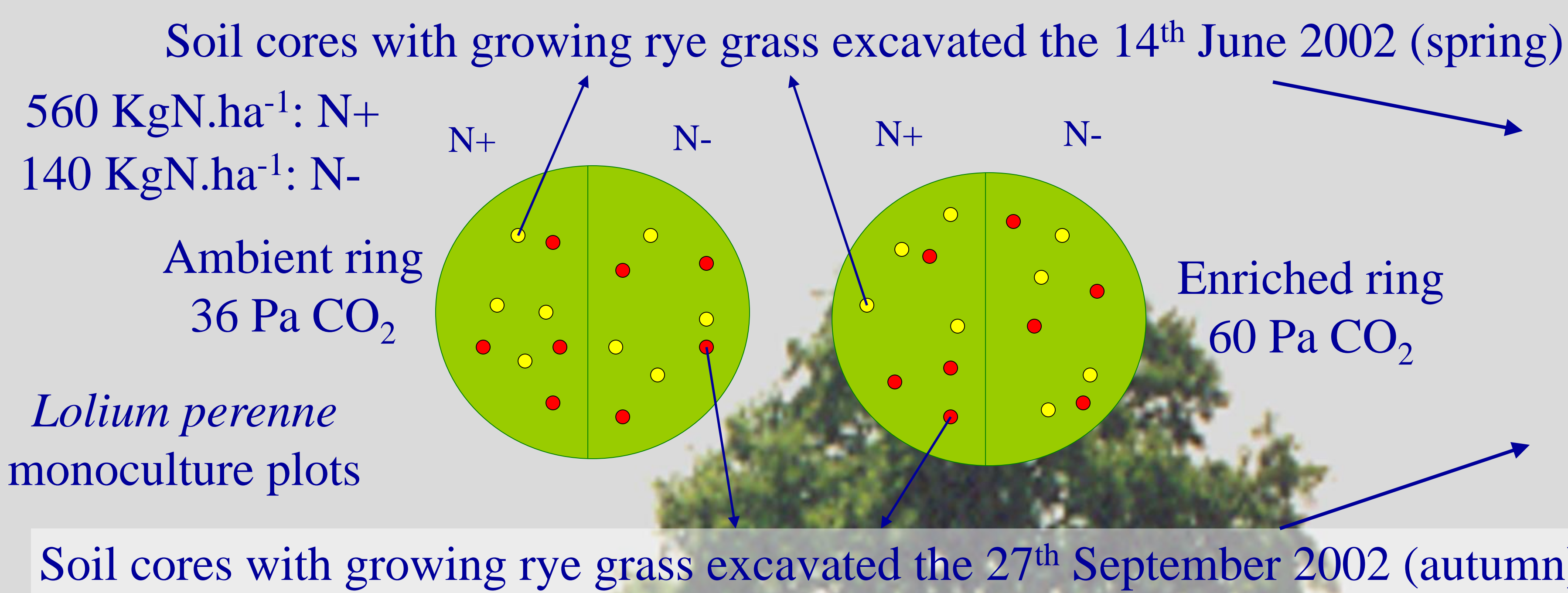
HYPOTHESES

Long term soil CO₂ enrichment affect plant C partitioning and belowground C allocation. Climatic conditions, variations in the resource availability aboveground (defoliation rhythm) and belowground (mineral nutrient availability) influence the plant-soil-microorganisms responses to increased CO₂.

OBJECTIVES

Dry matter production, C partitioning in rhizosphere compartments, microbial biomass growth and activity and soil C content were investigated at two distinct dates during growing season

METHODS



¹⁴C labeling procedure



Harvest

RESULTS

1. Dry matter production (DM)

Elevated CO₂ enhanced DM only at the autumn sampling (Table 1).

2. C allocation in the belowground compartments

Recent C allocated to rhizosphere (AS) decreased in enriched rings at the autumn sampling.

Microbial C decreased at both date of sampling.

Total soil C content was unaffected by elevated CO₂ (Table 1).

3. Mineralisation (autumn sampling)

The amount of ¹⁴C mineralised was higher under elevated than ambient CO₂ (Figure 1).

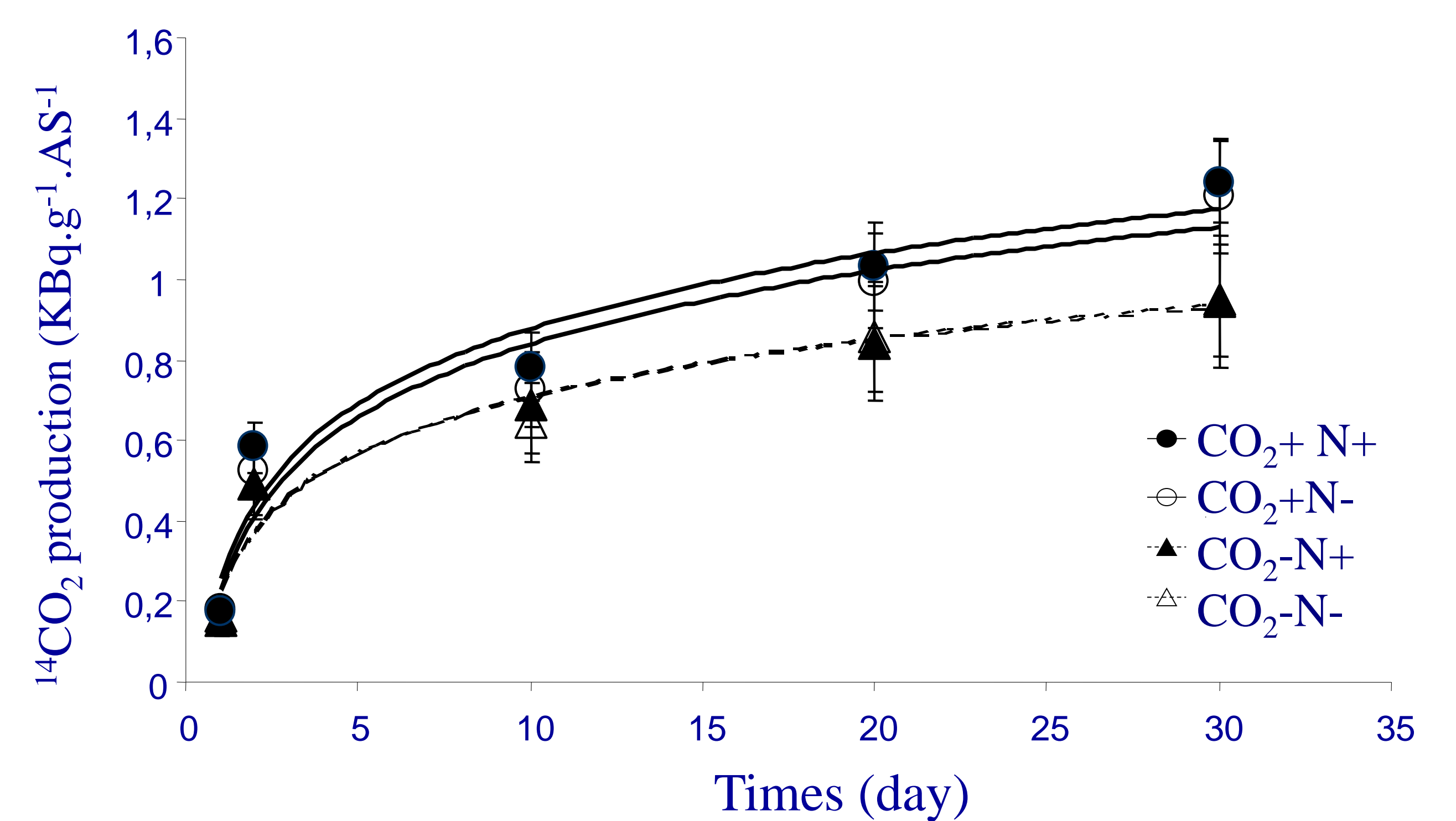


Figure 1 : Kinetic of mineralisation of ¹⁴C organic compounds in AS (Bq.g⁻¹ AS) measured for 30 days after harvest of AS.

| | | Biomass | | Microbial C | | %TRR Belowground | | Soil C content | |
|------------------------------|---------------------|-----------|-----------|-------------|-----------|------------------|----------|----------------|-------------|
| | | Spring | Autumn | Spring | Autumn | Spring | Autumn | Spring | Autumn |
| CO ₂ ⁺ | N+ | 4 (1.0) | 4.2 (0.8) | 355 (99) | 304 (81) | 38.3 (7) | 24.9 (5) | 7108 (772) | 6578 (839) |
| | N- | 2.9 (0.7) | 1.9 (0.4) | 400 (94) | 343 (72) | 53.5 (8) | 34.5 (6) | 6676 (824) | 6064 (728) |
| CO ₂ ⁻ | N+ | 3.7 (0.9) | 2.6 (1.0) | 528 (66) | 538 (121) | 41 (7) | 42.9 (8) | 6178 (817) | 5959 (1151) |
| | N- | 3.1 (0.8) | 1.3 (0.2) | 471 (109) | 646 (59) | 62.6 (8) | 43 (8) | 6713 (853) | 5718 (928) |
| Statistics | CO ₂ | ns | P=0,068 | ns | P=0,021 | ns | P=0,050 | ns | ns |
| | N | ns | P=0,004 | ns | ns | P=0,011 | ns | ns | ns |
| | N X CO ₂ | ns | ns | ns | ns | ns | ns | ns | ns |

Table 1: Plant dry matter production (grams.plant⁻¹), microbial C (mg C.Kg⁻¹) from adhering soil, ¹⁴C assimilate partitioning (percentage of total radioactivity recovered %TRR) in belowground and total soil C content (0-20cm depth in g.C.m⁻²)

CONCLUSIONS

It is likely that the lower amounts of rhizodeposited C allocated to the rhizosphere of enriched rings at the autumn sampling result from complex interactions between plant physiology, environment (CO₂, climate) and management of the plots (N, defoliation).

In spite of a decreased microbial C, mineralisation activity was higher under elevated than ambient CO₂ due to different microbial communities structure and / or composition of rhizodeposits.