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– Perspectives and Challenges –
A Tribute to Lorenz Hiltner

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DIRECT AND INDIRECT EFFECTS OF ELEVATED CO_2 ON LOLIUM PERENNE ROOT EXUDATION: CONSEQUENCES ON SOIL ORGANIC MATTER DECOMPOSITION

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It is still unclear whether elevated CO_2 increases plant root exudation and affects soil microbial biomass by furnishing greater quantity of easily decomposable carbon (C). The effects of elevated CO_2 on the C and nitrogen (N) contained in old soil organic matter (SOM) pools is also controversial.
In this study we compared the short-term and long-term effects of elevated CO_2 on C and N pool and fluxes by growing ryegrass (*Lolium perenne*) plants on soil monoliths originating from the New Zealand FACE site (ambient and enriched soil) and under low and elevated concentration of atmospheric CO_2. Using CO_2 pulse labelling, we studied the effects of elevated CO_2 on C allocation within the plant soil system of plants.
Under elevated CO_2 more root derived C was found in the soil and in the microbial biomass (Table 1). The increased availability of substrate enhanced soil microbial growth (Figure 1) and acted as "priming effect" enhancing native SOM decomposition regardless of the mineral N supply. Despite indications of faster N cycling in soil under elevated CO_2, N availability for the growing plants stayed unchanged. Soil from elevated CO_2 rings exhibited higher N cycling rates but again it did not affect plant N uptake. With respect to the difficulties of extrapolating glasshouse experiment results to the field, we concluded that elevated CO_2 stimulates microbial biomass through increased root exudation. This phenomenon is not likely to lead, at least by itself, to SOM accumulation under elevated CO_2 since a "priming effect" leading to enhanced SOM decomposition occurred.

Table 1. ^{14}C-assimilate partitioning (in % of the total radioactivity recovered in the plant-soil-micro-organisms system) in the plant, the rhizosphere respiration, the soil and the microbial biomass (MBM). Significant main effects are given at p<0.1 (+), <0.05 (*),<0.01 (**), <0.001 (***)

Treatment			% of total radioactivity recovered			
N	Atm	Soil	Plant	Rhiz. respiration	Soil	MBM
N-	A-	S-	85	11	4	0.4
		S+	83	12	5	0.6
	A+	S-	84	11	5	0.7
		S+	80	14	6	0.8
N+	A-	S-	85	12	3	0.3
		S+	85	11	3	0.3
	A+	S-	87	10	3	0.5
		S+	84	11	5	0.6
Effects of the treatments		N	+	n.s.	**	*
		A	n.s.	n.s.	+	***
		S	n.s.	n.s.	n.s.	+

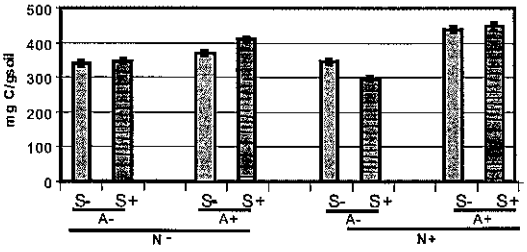

Figure 1. Microbial biomass (mg C per g soil) in the under ambient (A-) and elevated (A+) atmospheric CO_2 concentration, on soil originating from ambient (S-) and elevated (S+) FACE rings and under low (N-) or high (N+) nitrogen fertilisation. Values are mean of six replicates ± s.d.