Effects of Fertilizer Addition on Microbial Respiration and Uptake of Carbon Monoxide in a Cerrado Soil

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Região do Cerrado

Área Total :
204.000.000 ha


O Cerrado Brasileiro
The Cerrado is a Region of Rapid Land Conversion

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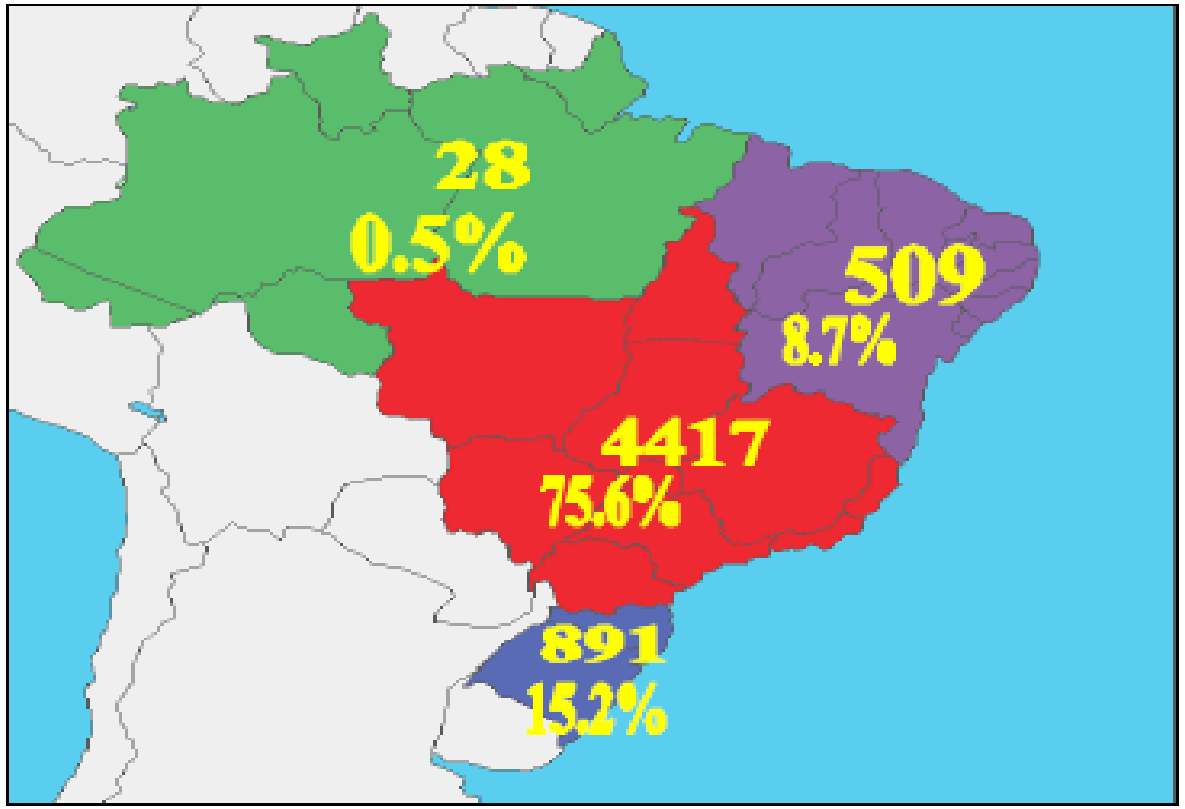
1999

NPK Consumption by Region
('000 MT nutrient)



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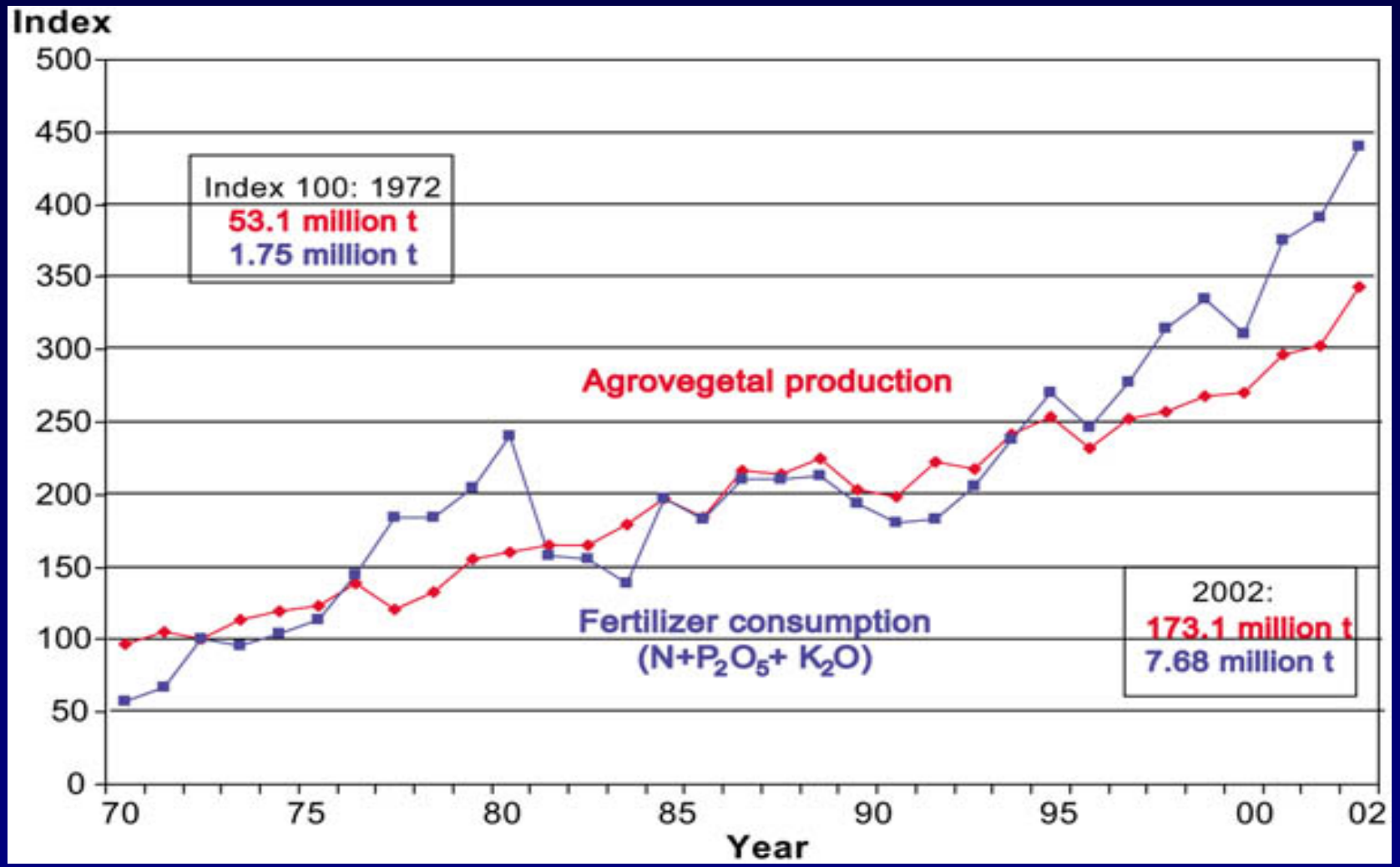
Fertilizer Use and Crop Production in Brazil



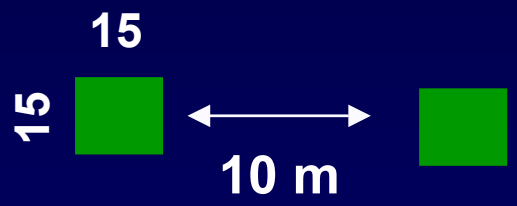
A.S. Lopes, FAO Corporate Document, 2002

Objective

- To determine the effect of fertilizer treatments on the microbial decomposition rates of soil organic matter (SOM) pools and consumption of carbon monoxide (CO) in soil samples from native Cerrado areas.

LBA Study Sites

Fertilization Experiment - Cerrado Stricto sensu

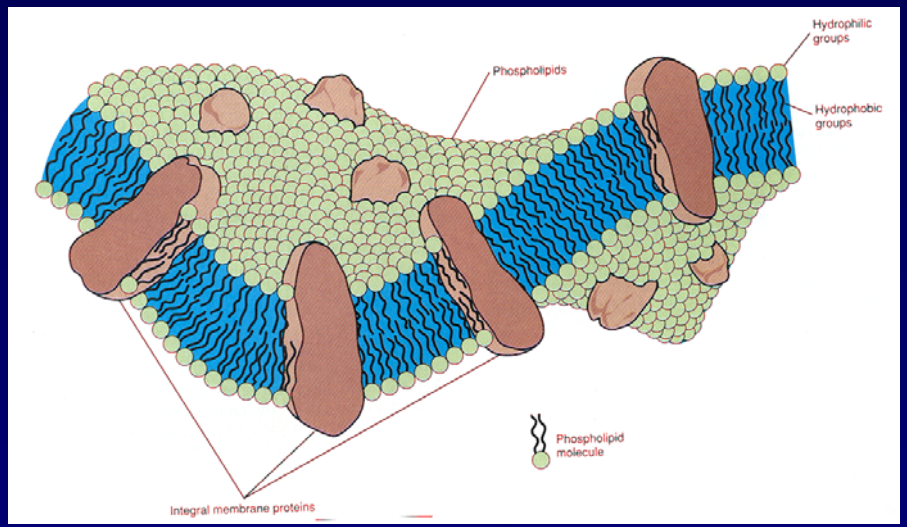


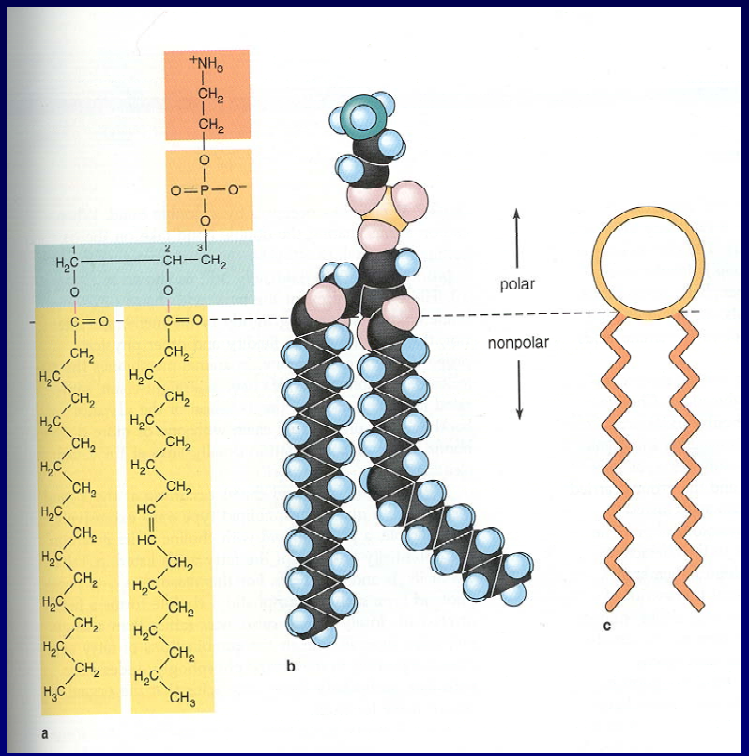
C	Ca	N	Ca	P
P	C	N+P	N	N+P
Ca	P	N	C	Ca
C	N+P	N	P	N+P

Fertilizers Applied (granulate form):

N: 100 kg N/ha (ammonium sulfate)
P: 100Kg P/ha (Super phosphate simple)
N + P: 100 Kg/Ha (each)
Ca: 4000 kg/ha (lime + calcium phosphate)
C: control

Phospholipid Fatty Acid (PLFA) Analysis



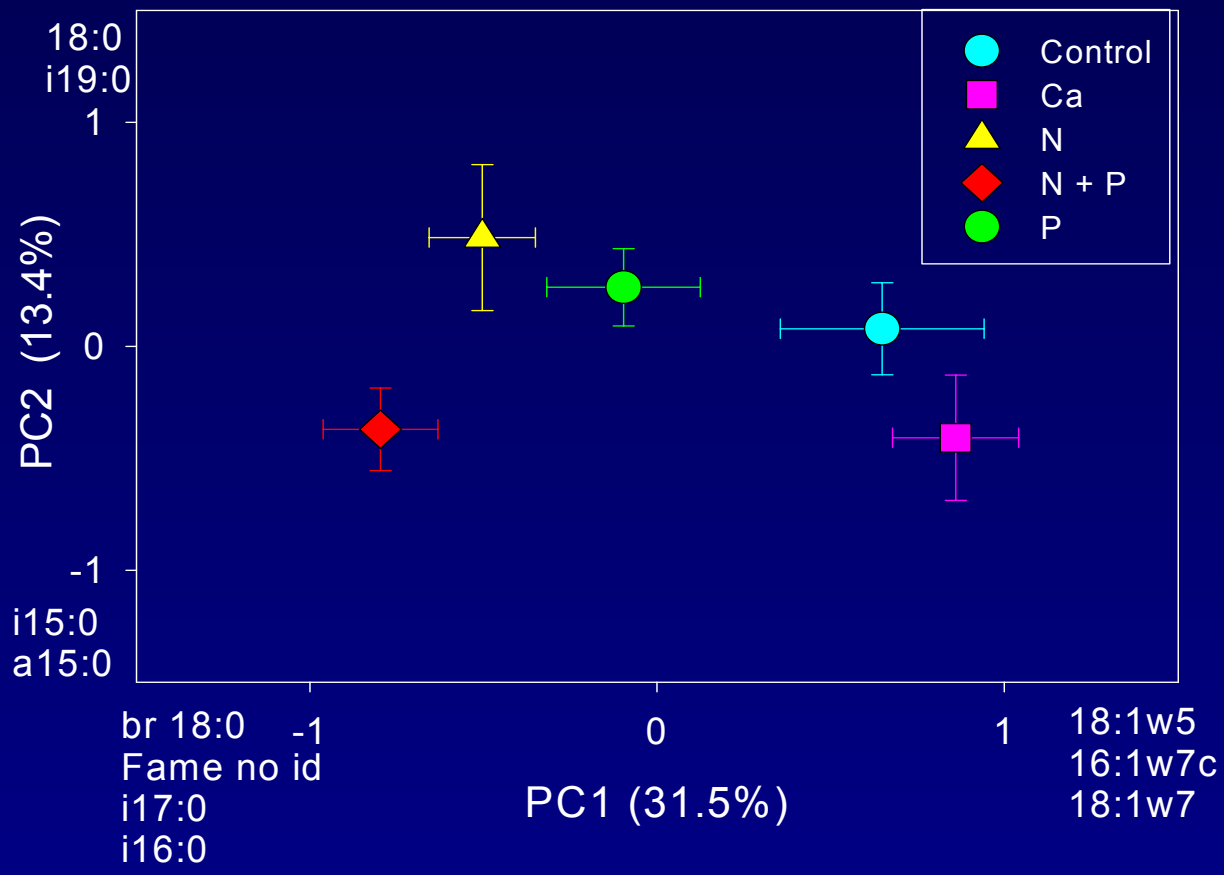


Nomenclature: i.e.,

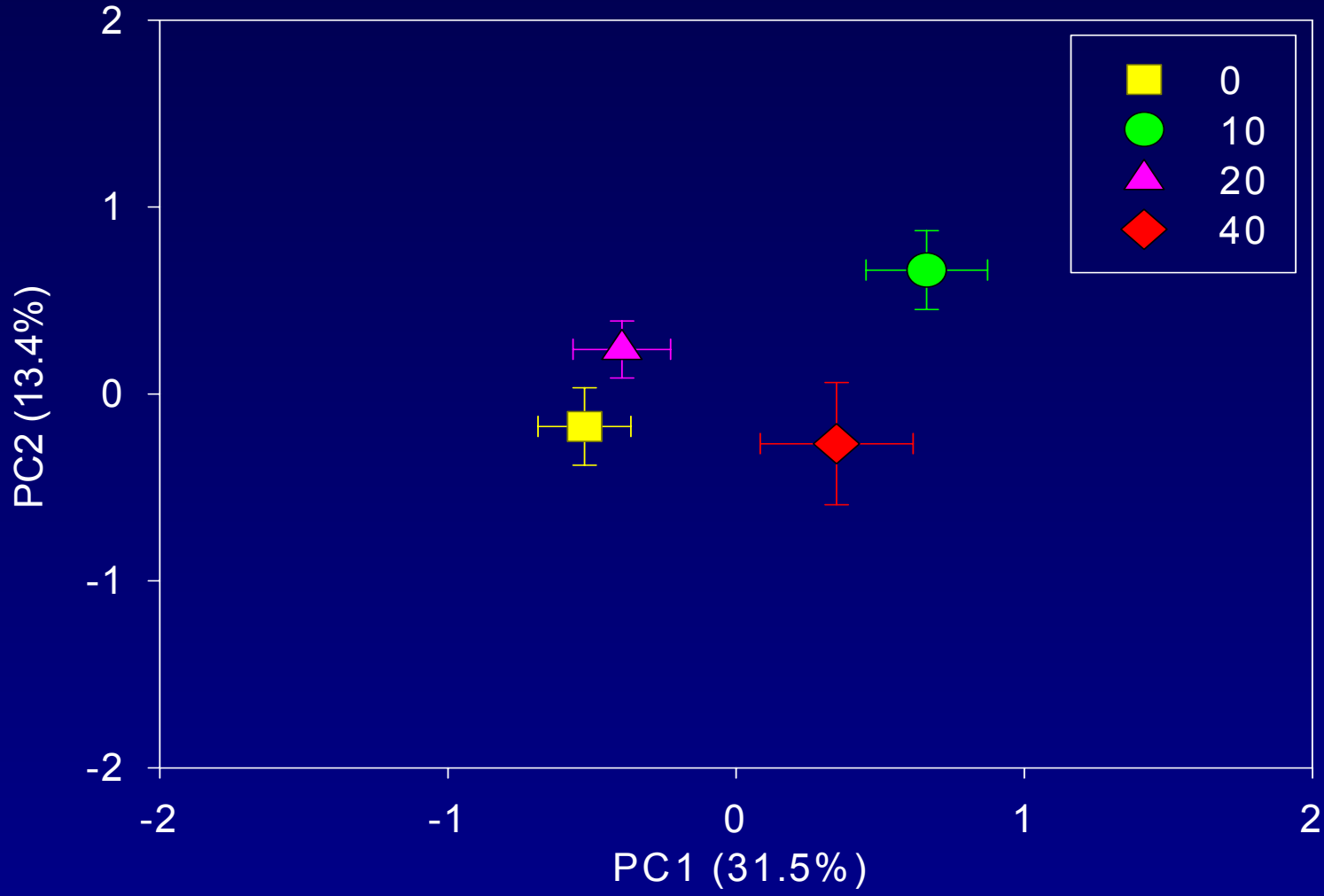
#C : #B w #

17:1w8

Effect of Different Fertilization Treatments on the Microbial Community Structure in Cerrado Soils



Microbial Community Structure in Fertilized Cerrado Soils as a Function of Time (Days after Fertilization)



Long-term Incubation Experiment

Collect Soil samples
0-10 cm
10-20 cm

↓

Sieving

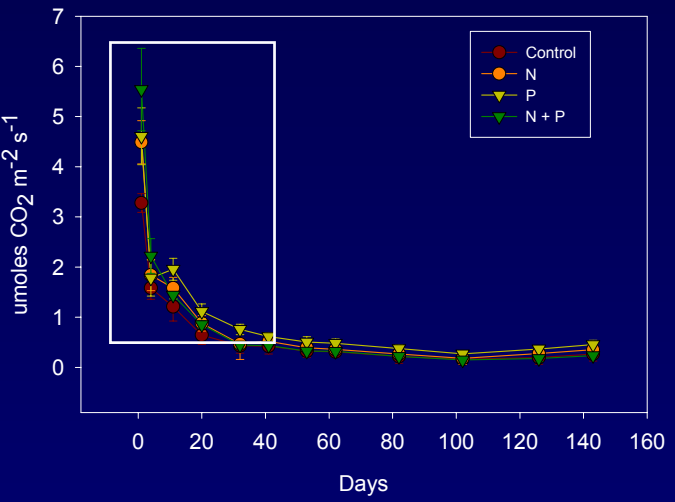
↓

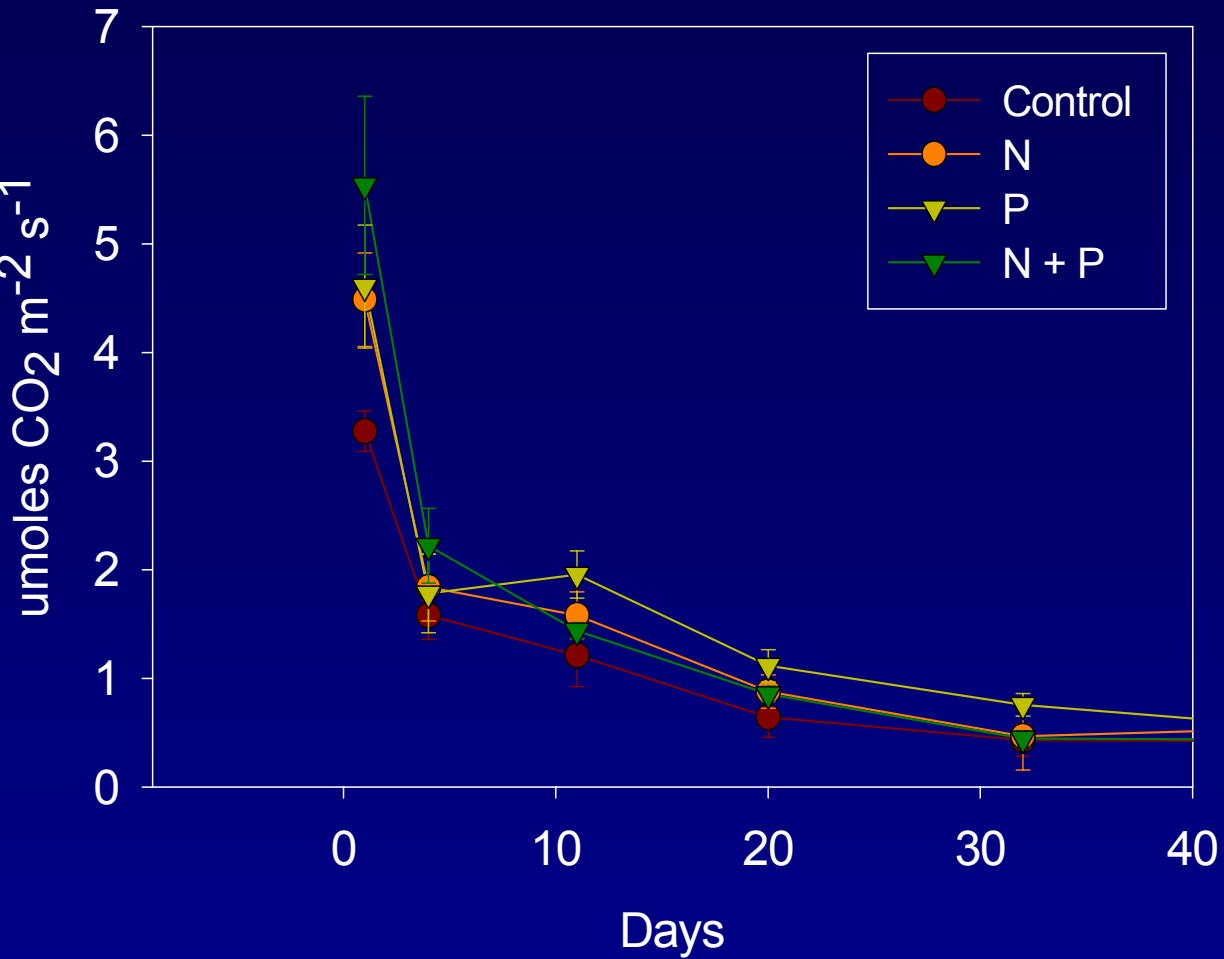
Addition of Soil and Nutrients to Jars

CO_2 (Licor) CO (Trace A)

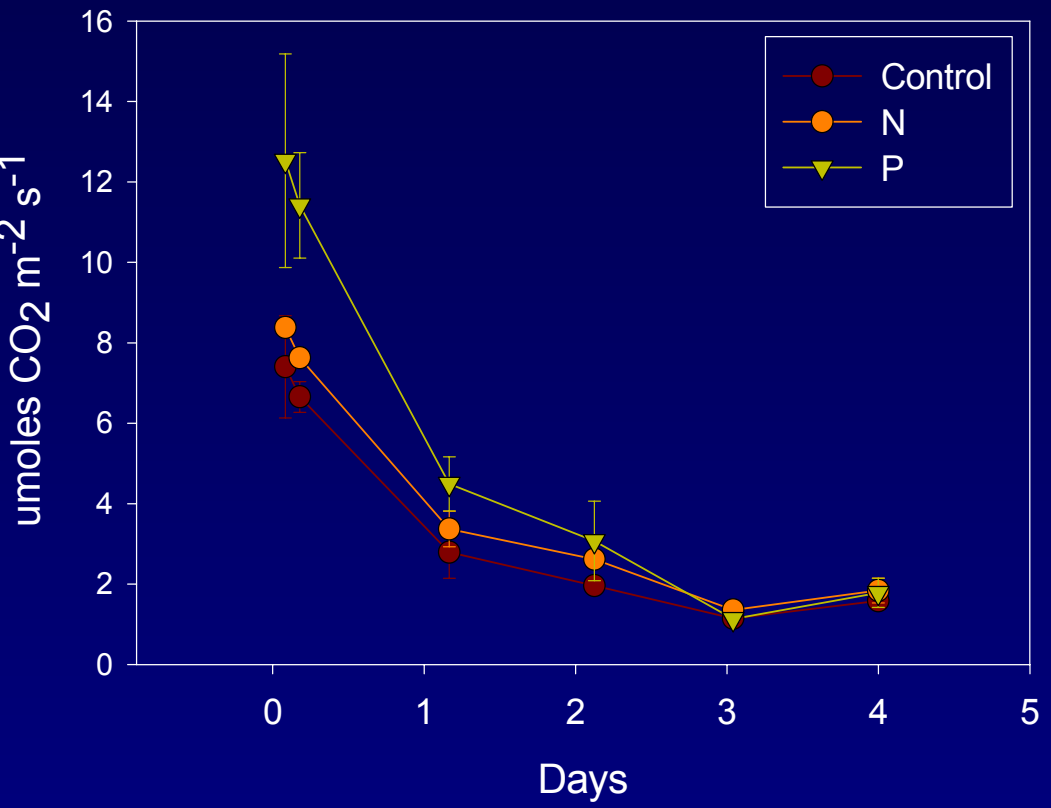
- Fertilizers added: N, P, N+P
- All fertilizers added in granular form
- Jars were incubated in the dark at room temperature, at 60% WHC for 143 days.

Average CO_2 flux from soils (0-10 cm depth) amended with N and P
(Long Term Incubation Experiment)

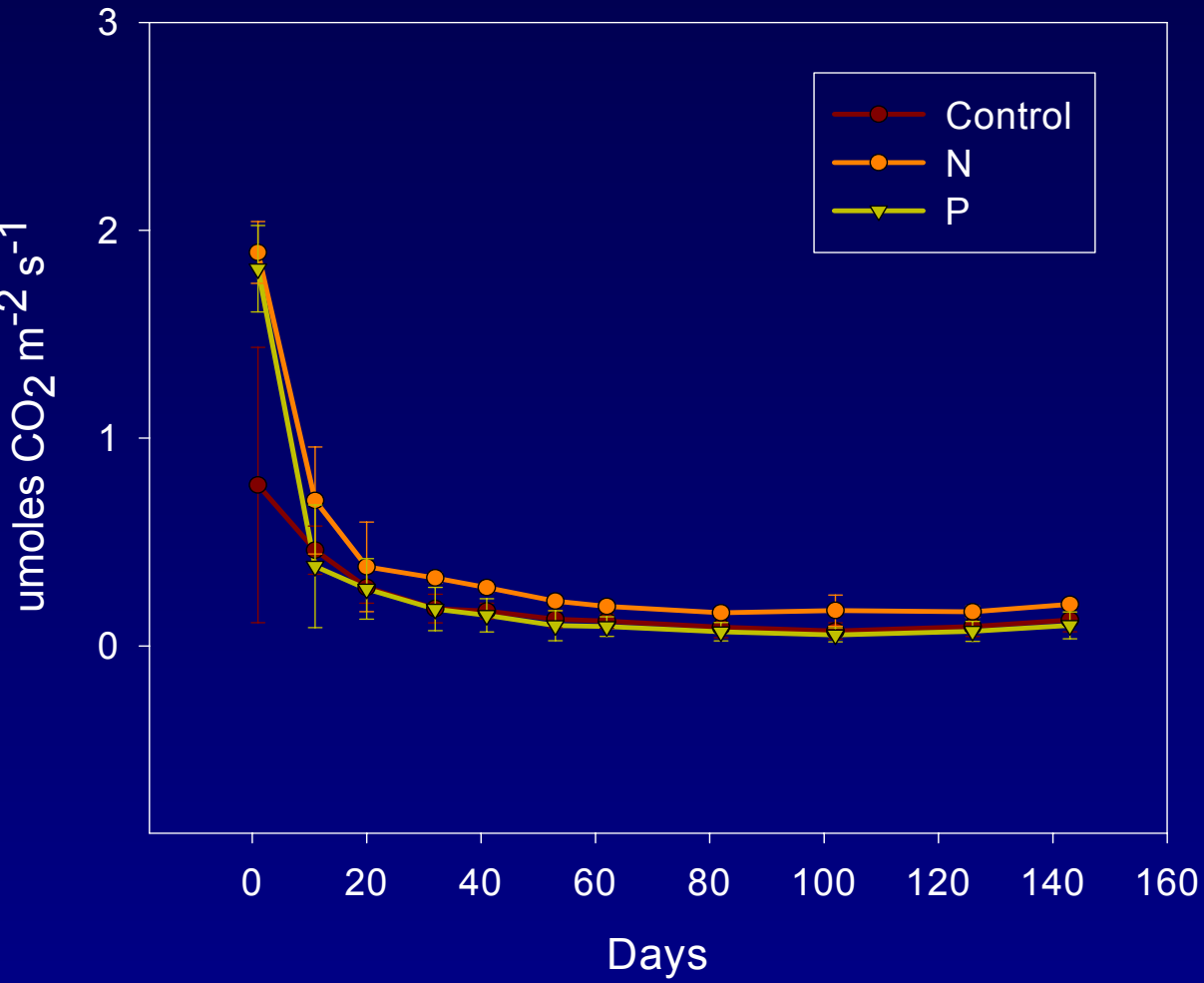




CO_2 flux in Soils (0-10 cm deep) Amended with Fertilizers (Long Term Incubation Experiment)



Average CO_2 Flux in Soils (10-20 cm depth) Amended with N and P in a Long Term Incubation Experiment

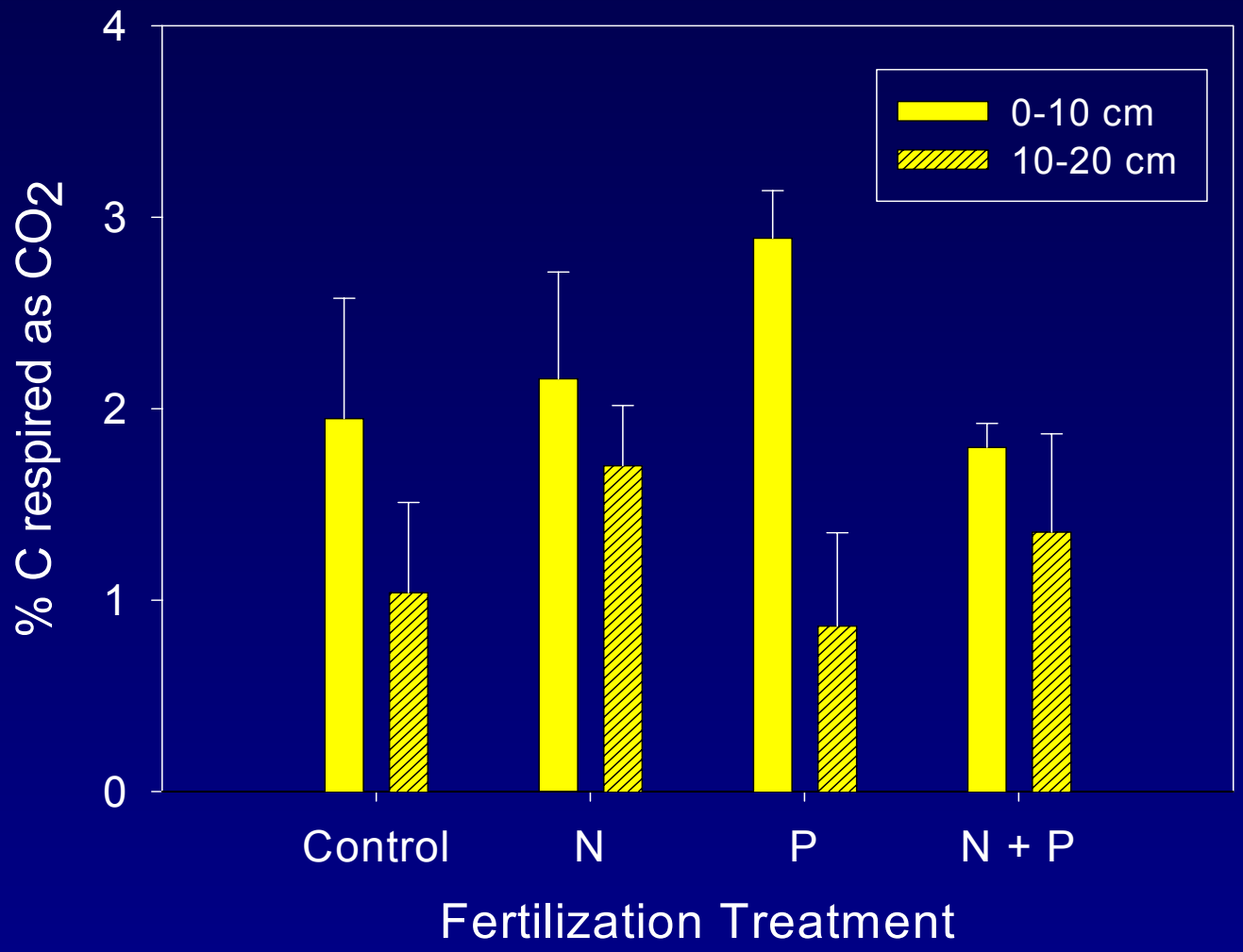


Exponential Decay Constants for the Active and Slow C Pools in Cerrado Soils Amended with Fertilizers

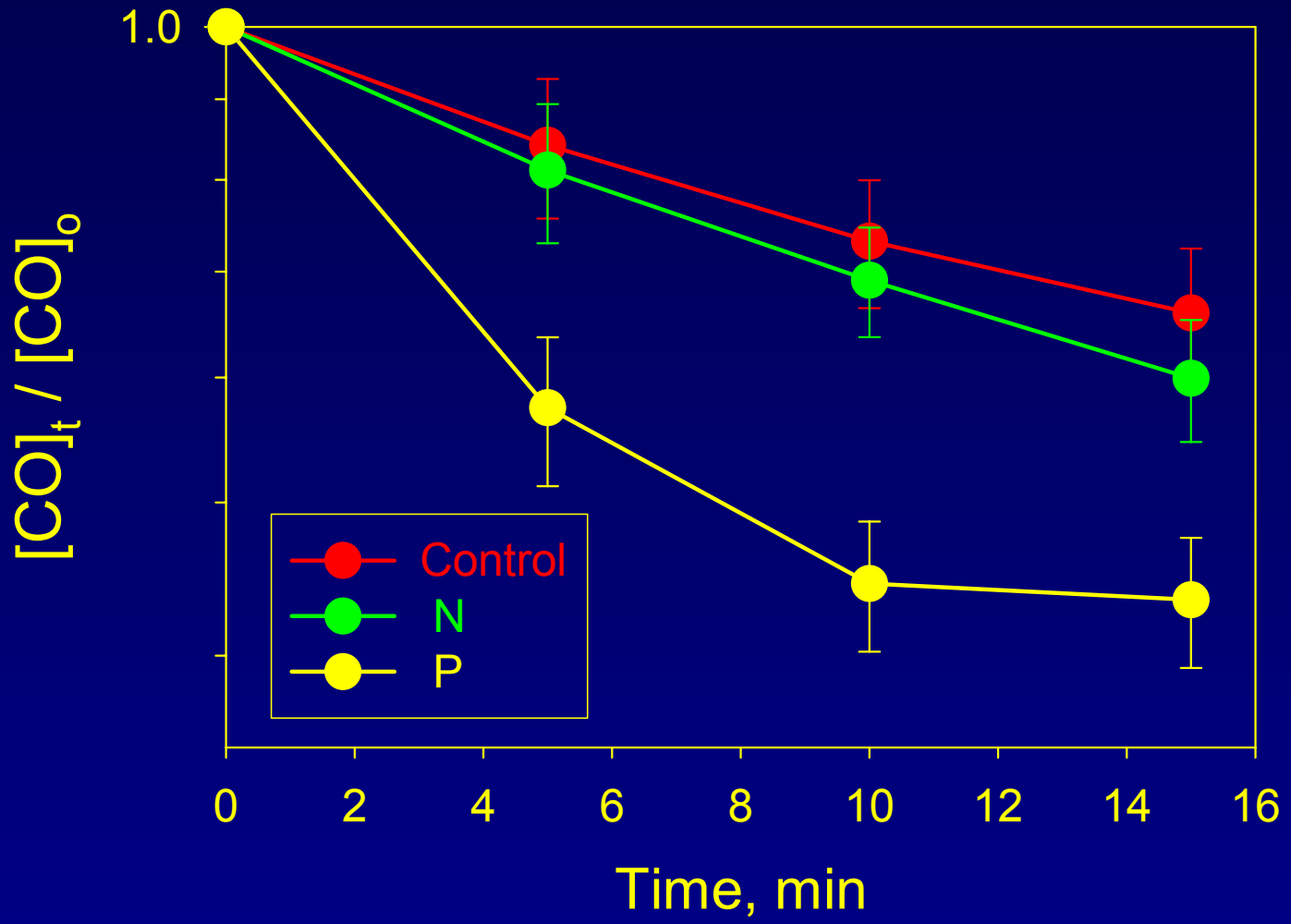
Treatments	Original Soil Depth (cm)	Active C ka	T_{99} (days)	Slow C ks	T_{99} (days)
Control	0-10	1.22	3.77	0.024	188.52
N		1.17	3.93	0.026	175.25
P		1.19	3.87	0.018	258.43
N+P		0.62	7.41	0.034	133.72
Control	10-20	0.06	70.88	9.9×10^{-12}	4.6×10^{11}
N		0.13	34.56	4.5 x 10-3	1022.2
P		0.23	19.90	1.5×10^{-2}	314.42
N+P		0.13	36.31	1.2×10^{-2}	369.77

$$CO_2 \text{ flux} = C_a e^{-kat} + C_s e^{-kst}$$

% Organic Carbon respired as CO_2 in Soils Amended with Fertilizers



Laboratory Studies of CO Uptake By Cerrado *strictu sensu* Soil Treated with Fertilizer

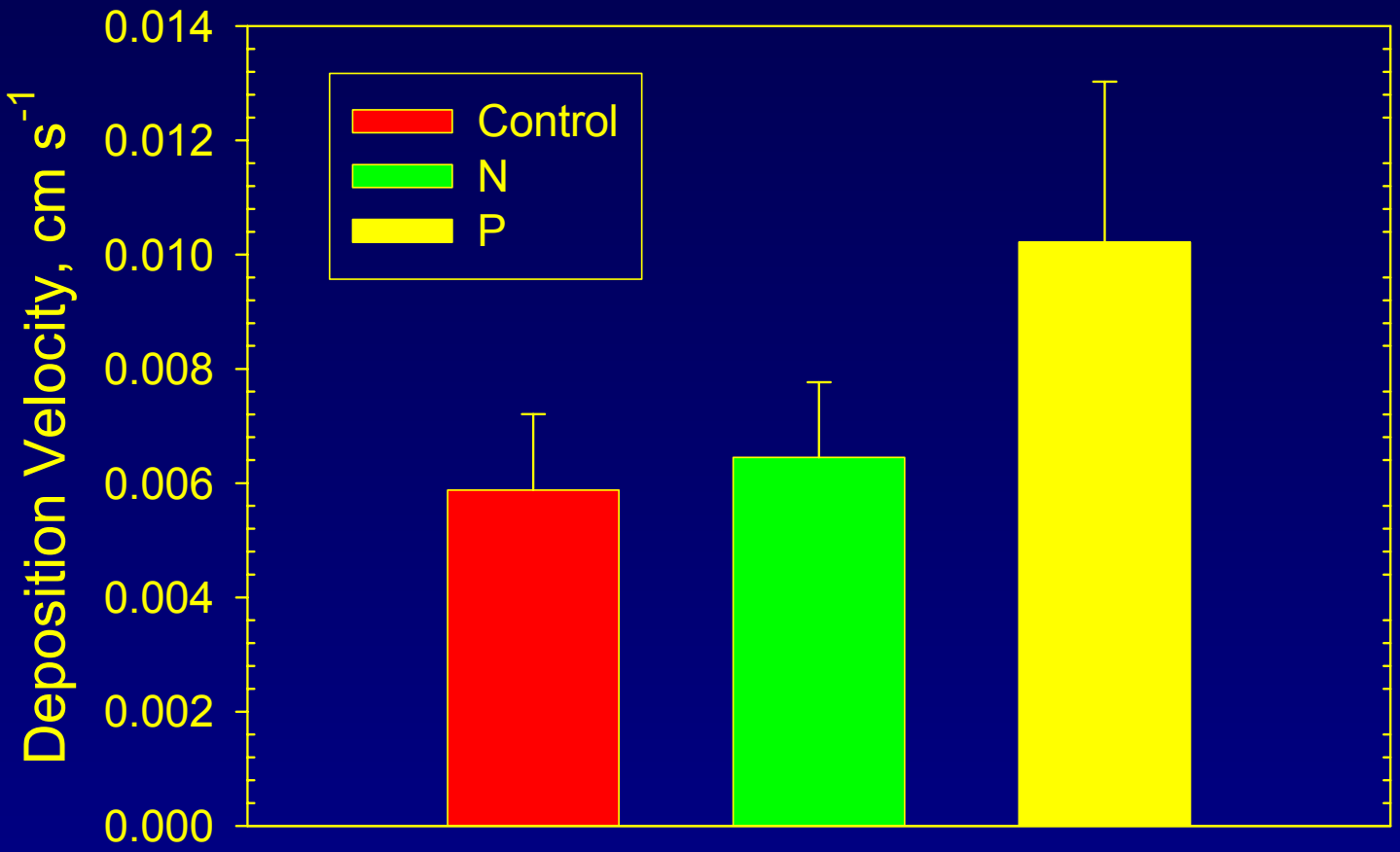


Definition of Deposition Velocity ($cm\ s^{-1}$)

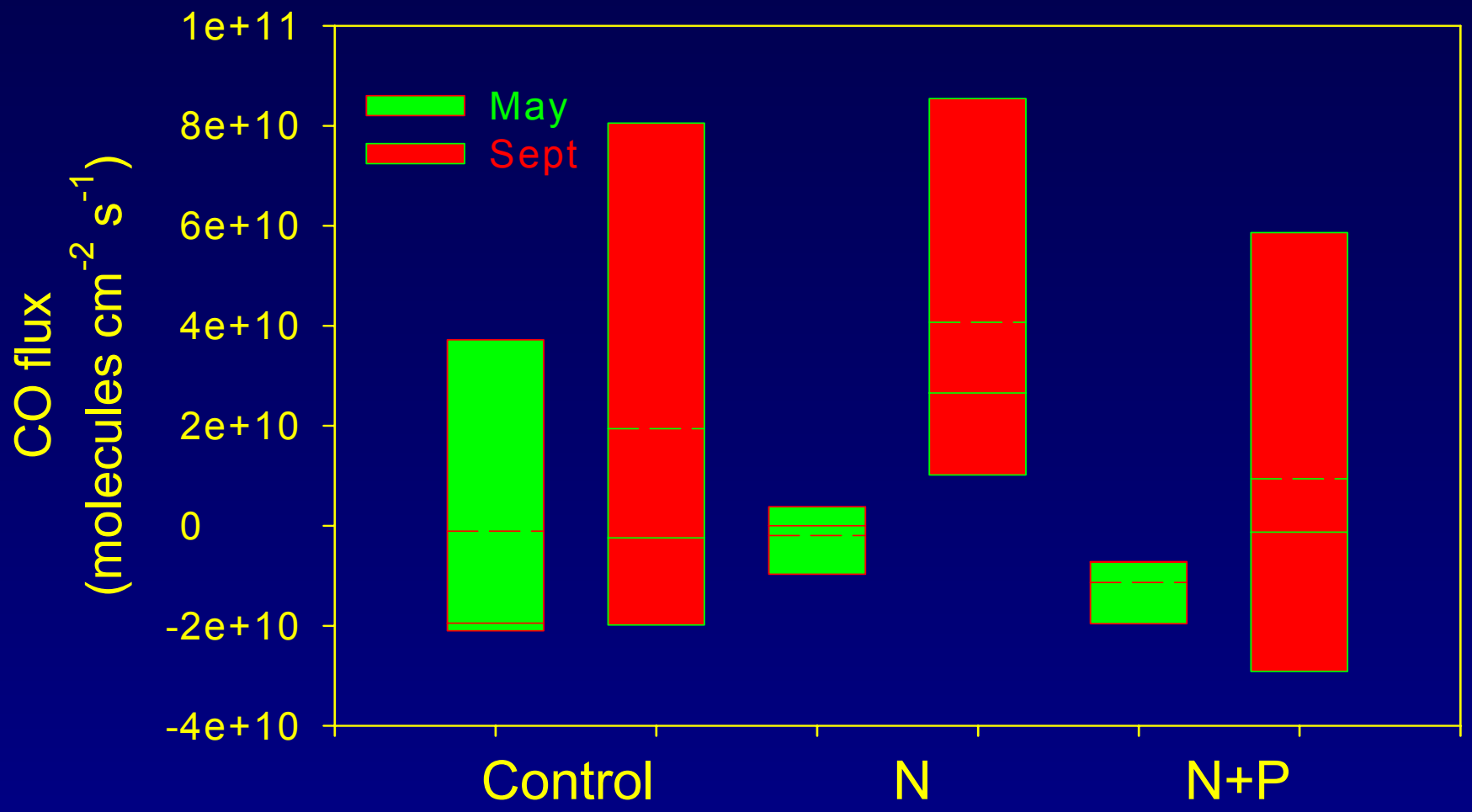
= Flux / [CO]

= First order k x vol/surface area

Deposition Velocities for CO Uptake By Soil Treated With Fertilizer



CO Fluxes For Field Studies in Fertilized Plots at Cerrado *strictu sensu* Sites in IBGE



Conclusions

- Addition of fertilizers increases the fraction of available organic carbon that is respired by the microbial community at both the 0-10 and 10-20 cm soil depths,

- The presence of fertilizers significantly changes the microbial community in the field and might offer an explanation for the difference observed with the CO_2 fluxes. Also the fast decrease in the respiration rate observed during the first days in the jars corresponds to the rapid change in microbial community observed within 10 days in the field.

- P has the strongest effect on the CO_2 fluxes at 0-10 cm, increasing by almost 1% the CO_2 respired from TOC, while N seems to increase the utilization at 10-20.

- Both CO uptake and deposition velocity of CO are enhanced in the presence of P.


Cerrado

PROCESSES DRIVING CO_2 and CO EXCHANGE IN AGROECOSYSTEMS