



Instituto de Botânica

Secretaria do Meio Ambiente

Instituto de Botânica

Núcleo de Pesquisa em Fisiologia e Bioquímica

Effects of high atmospheric CO₂ concentration in Open Top Chambers (OTC) and Free Air CO₂ Enrichment (FACE) systems on photosynthesis and natural resistance mechanisms of coffee plants to coffee rust

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Workshop on Impacts of Global Climate Change
on Agriculture and Livestock
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**Support
12/08875-3**



EQUIPE



PROJETO CLIMAPEST

EXPERIMENTO “FACE”
 (“FREE-AIR CARBON DIOXIDE ENRICHMENT”)

Impactos do aumento da concentração de CO₂ atmosférico
sobre problemas fitossanitários



Ministério da
Agricultura, Pecuária
e Abastecimento



Embrapa – Instituto de Botânica
FACE

Perspectives:



- First Experiment with Coffee x High CO₂ – OTC and FACE;
- 2 Coffee cultivars: Catuaí (susceptible) and Obatã (resistant) x 2 [CO₂] x **infected e non-infected** (*H. vastatrix*);
- Seasonal changes (Summer- rainfall period **and** winter – dry period);

Aims

Assess changes in photosynthesis and responses of resistance mechanisms of two coffee cultivars growing under enriched-CO₂ atmospheres in OTC and FACE systems, exposed to the causal agent of coffee rust (*Hemileia vastatrix*).

Main Goal: Elevated atmospheric CO₂ concentrations induce Resistance to coffee leaf rust?

C and N
metabolism

Photosynthesis

TSS

(Dubois, 1956)

RS

(Somogyi-Nelson, 1946)

Starch

(Amaral *et al.*, 2007)

Mono-
Oligosaccharides

HPLC/PAD

(Carvalho *et al.*, 1997)

Isotopic
Discrimination of
Carbon

C/N Ratio

Metabolic Profile

GC/MS

(Roessner *et al.* 2001
modificado)

Induced Resistance Markers



Peroxidase
Activity

(Urbanek *et al.*, 1991)

Chitinases

(Wirth & Wolf, 1990)

Phenol content

(Swain & Hillis, 1959)

Lignin

(Stadnik & Buchenauer,
2000)

OTC Experiment (mai-jul 2012)

101 dias



Coffea arabica cv. Catuai IAC 144 e Obatã IAC 1669-20 seedlings



Poted Plants with 6/7 pairs of leaves



Grown in OTCs
*380 ppm CO₂
*760 ppm CO₂

SAMPLING: 0h, 24h, 48h, 96h, 7d, 14d e 28 days after inoculation

Plants Inoculated with *H. vastatrix* After 16 days under OTC conditions



A x PAR curves (IRGA Li-Cor 6400 XT)

16days

22days

32days

68days

82days

96days

Carbohydrates

*Total Soluble Sugars

*Reducing Sugars

*Starch

16days

22days

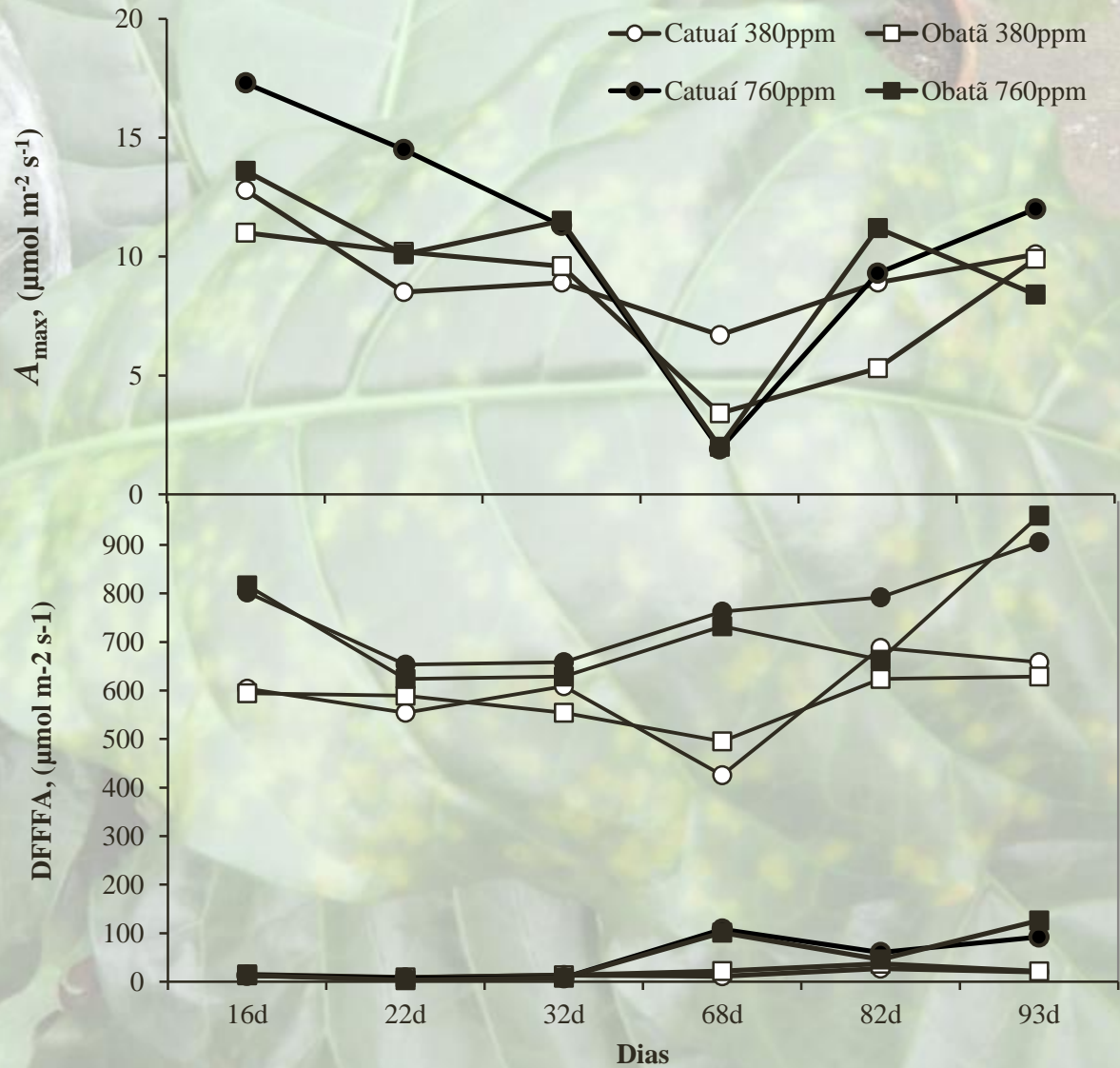
32days

82days

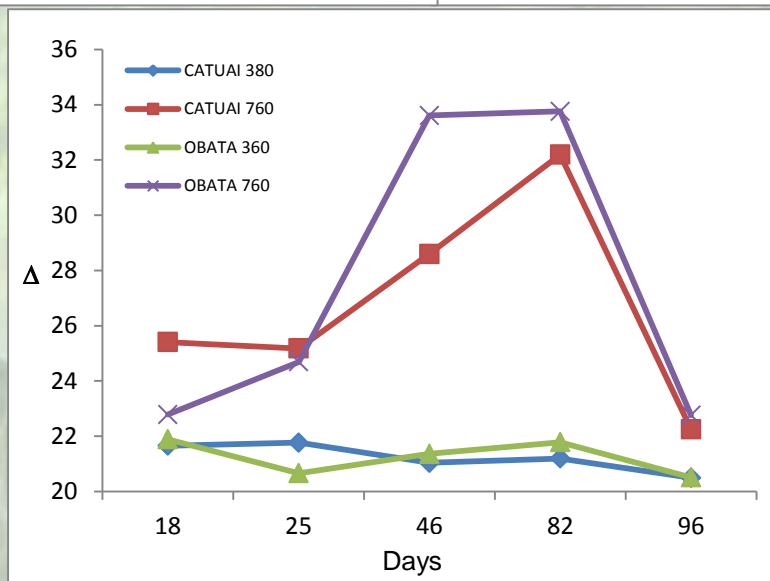
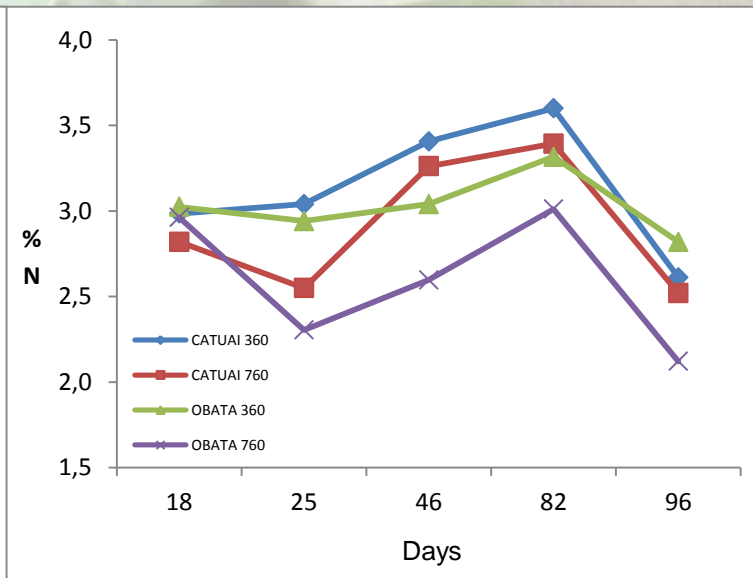
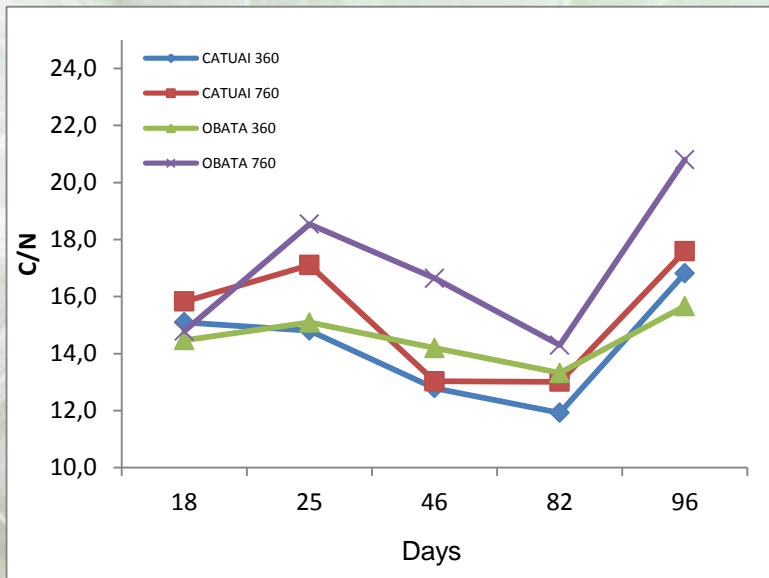
96days

Monosaccharides
Oligosaccharides
(HPAEC/PAD)

Changes in Maximum Net Assimilation rates and in Light Compensation and Saturation points of Coffee Plants under OTC's (mai/jul 2012)

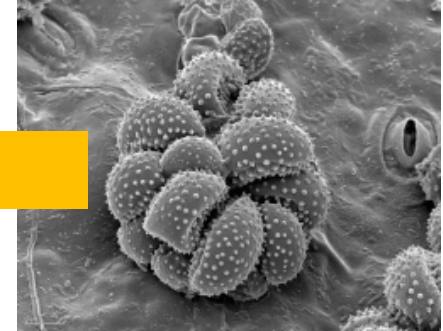


C/N Ratio, %N e Isotopic Discrimination of Carbon(Δ) - OTCs





Leaf Rust ?!



Catuaí 380ppm

Nº Leaves	Leaves with lesions	nº of sporulated lesions per/leaf
94 ± 29	24 ± 14	24,7 ± 17,7

Obatã 380ppm

Nº Leaves	Leaves with lesions	nº of sporulated lesions per/leaf
82 ± 23	0	0

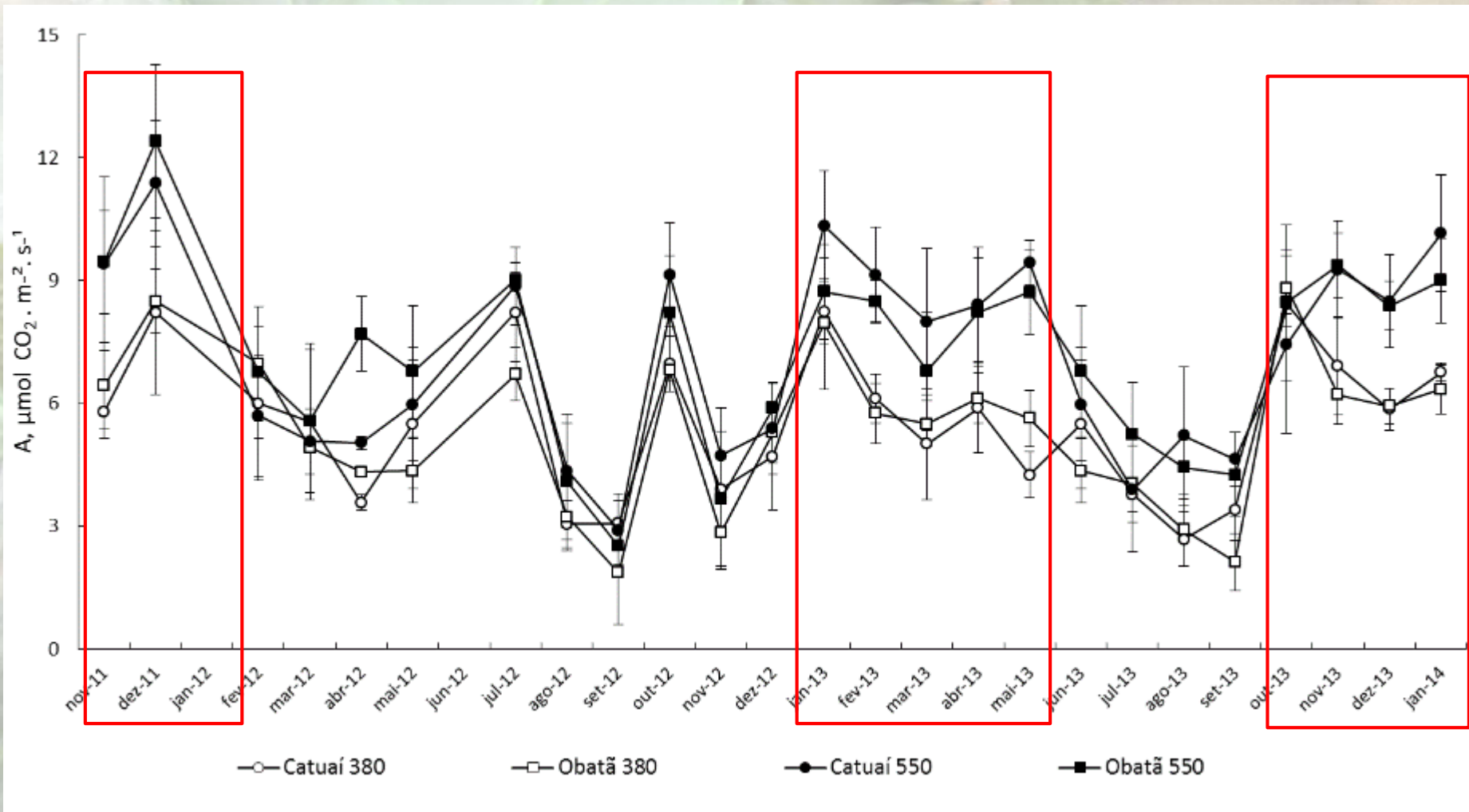
Catuaí 760ppm

Nº Leaves	Leaves with lesions	nº of sporulated lesions per/leaf
92±21	23±12	24,8±18,9

Obatã 760ppm

Nº Leaves	Leaves with lesions	nº of sporulated lesions per/leaf
83±14	0	0

Seasonal changes in photosynthesis of Coffee plants



Ongoing...

- ✓ Carbohydrates (HPAEC-PAD and GC-MS profile)
- ✓ Enzyme activity
- ✓ C/N ratio, %N, $\Delta^{13}\text{C}$ – FACE

Starting PhD Thesis – Rodrigo Fazani Sanches

Influence of High Atmospheric CO_2 Concentration ($\uparrow[\text{CO}_2\text{atm}]$) in the infection process and epidemiologic components of coffee rust and in the interaction $\uparrow[\text{CO}_2\text{atm}]$ x water availability in water relations and accumulation of carbohydrates in *Coffea arabica* L.

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