Aula 6 - Impacto das mudanças climáticas nos principais processos fisiológicos – Parte 2

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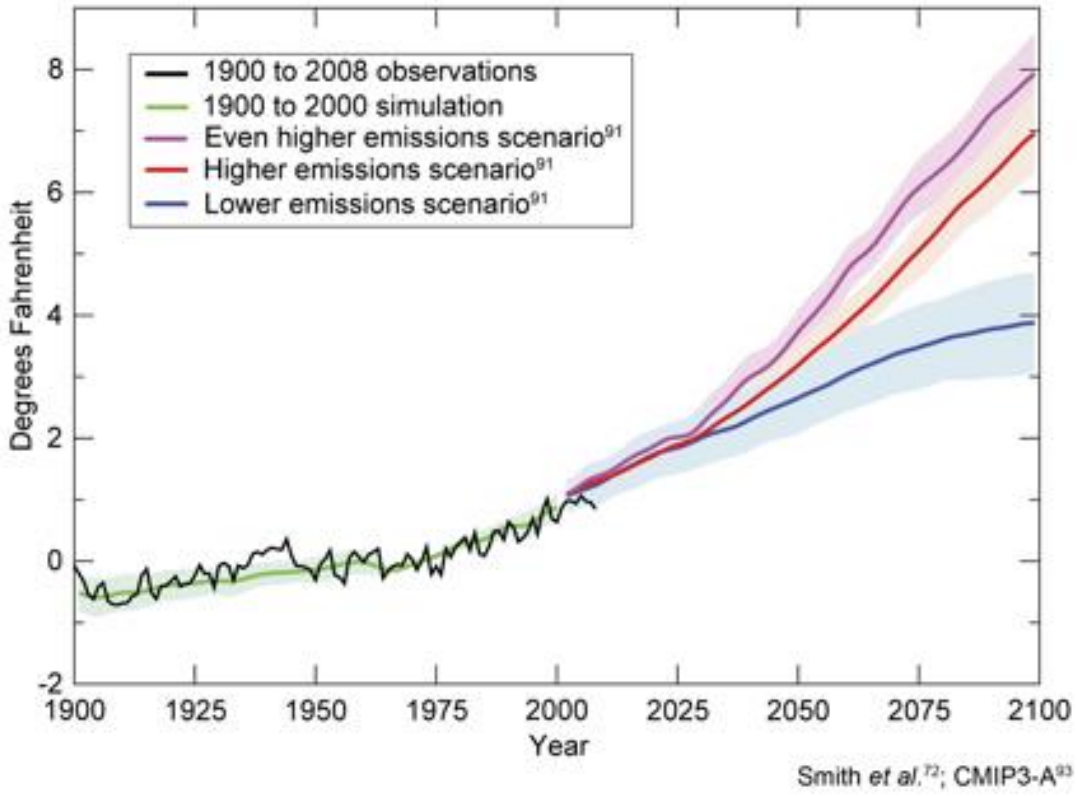
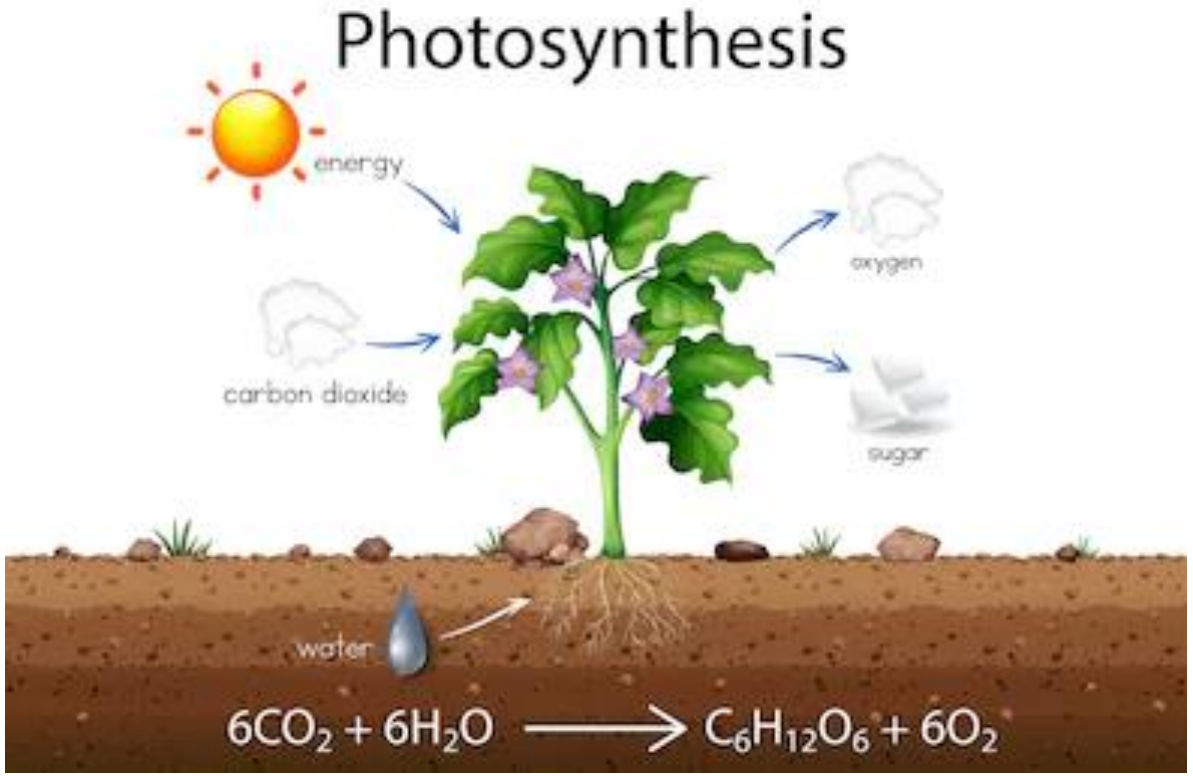
LEB0410 - Mudanças Climáticas e Agricultura

Tendências futuras de CO2

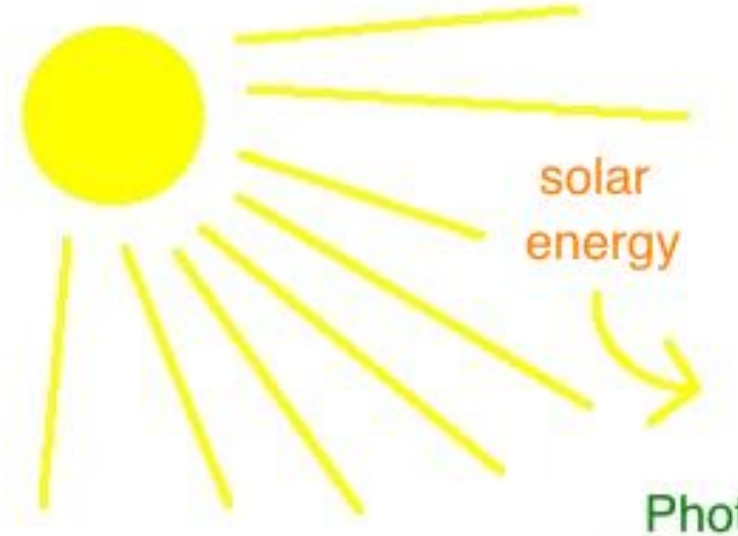


Observed and projected changes in the global average temperature under three IPCC no-policy emissions scenarios. The shaded areas show the likely ranges while the lines show the central projections from a set of climate models. A wider range of model types shows outcomes from 2 to 11.5ºF.[68] Changes are relative to the 1960-1979 average.

O processo fotossintético



O processo fotossintético

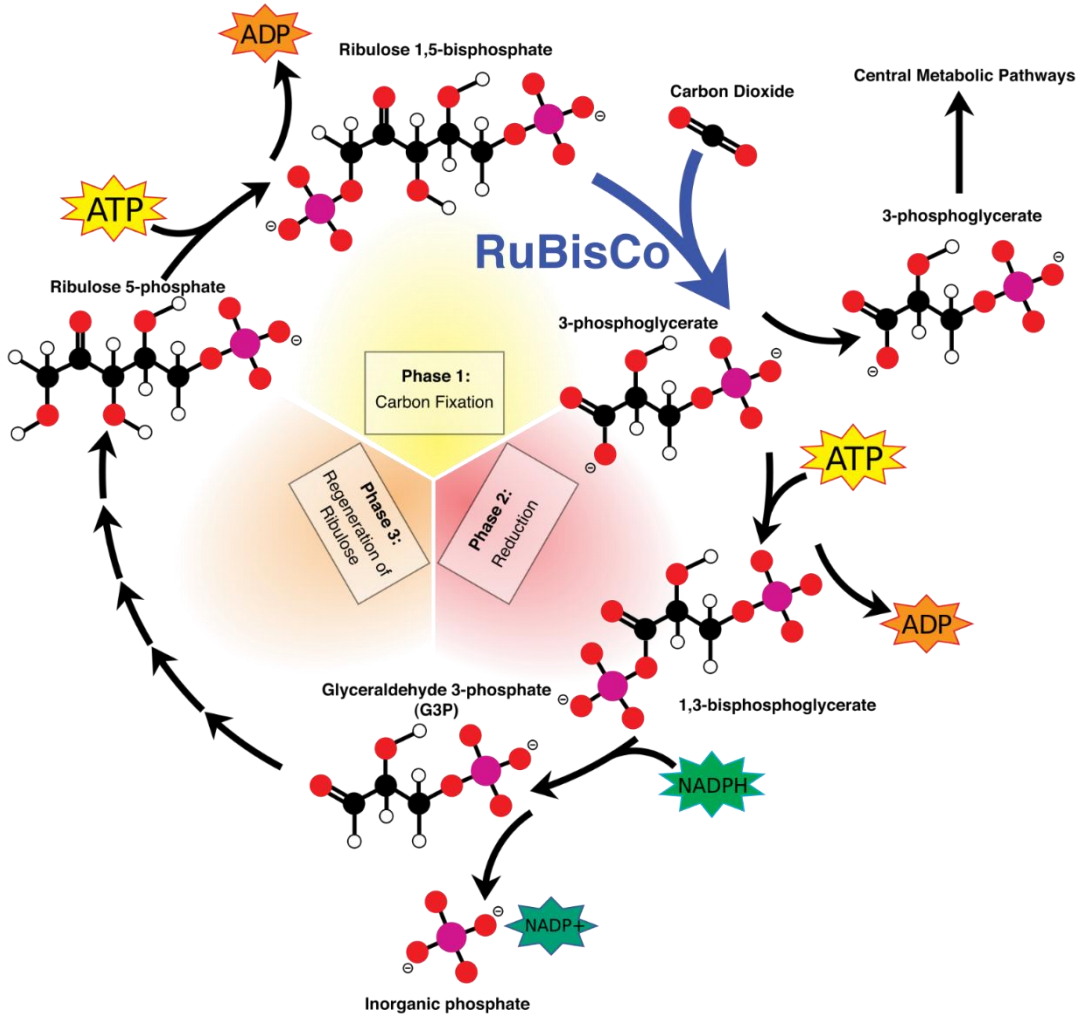


$$6CO_2 + 6H_2O \xrightarrow{\text{Photosynthesis}} C_6H_{12}O_6 + 6O_2$$

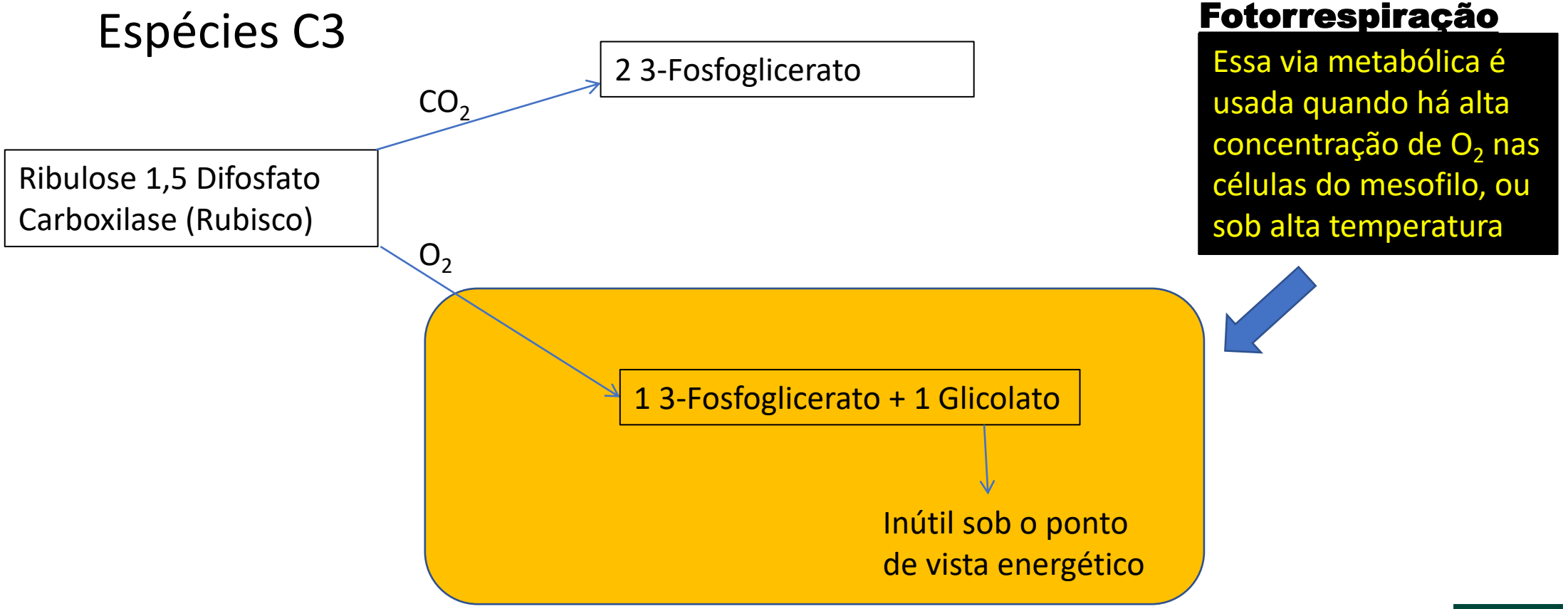
carbon dioxide | water | glucose | oxygen

Estequiometria	264g	108g	180g	192g

O processo fotossintético

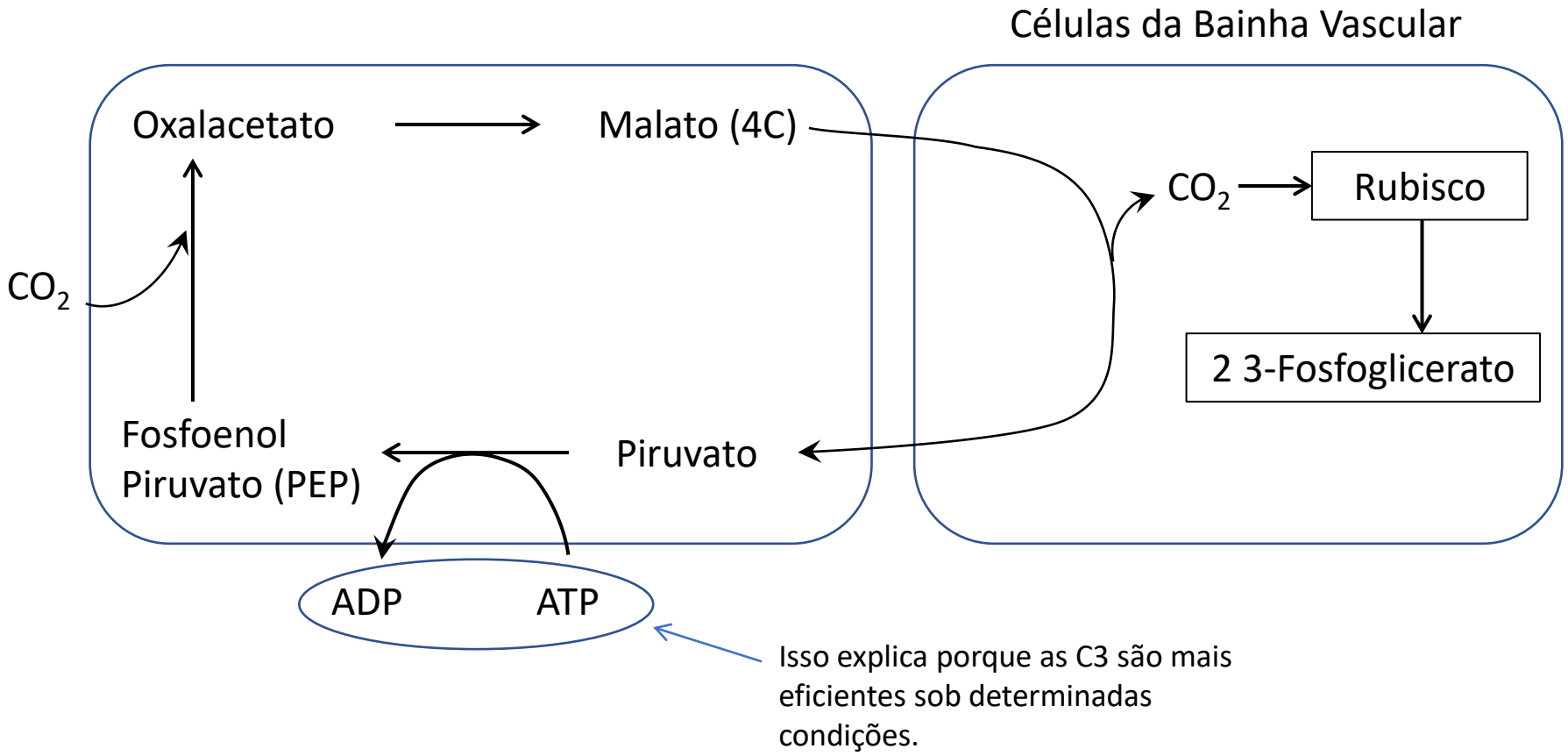


O conceito de Fotorrespiração



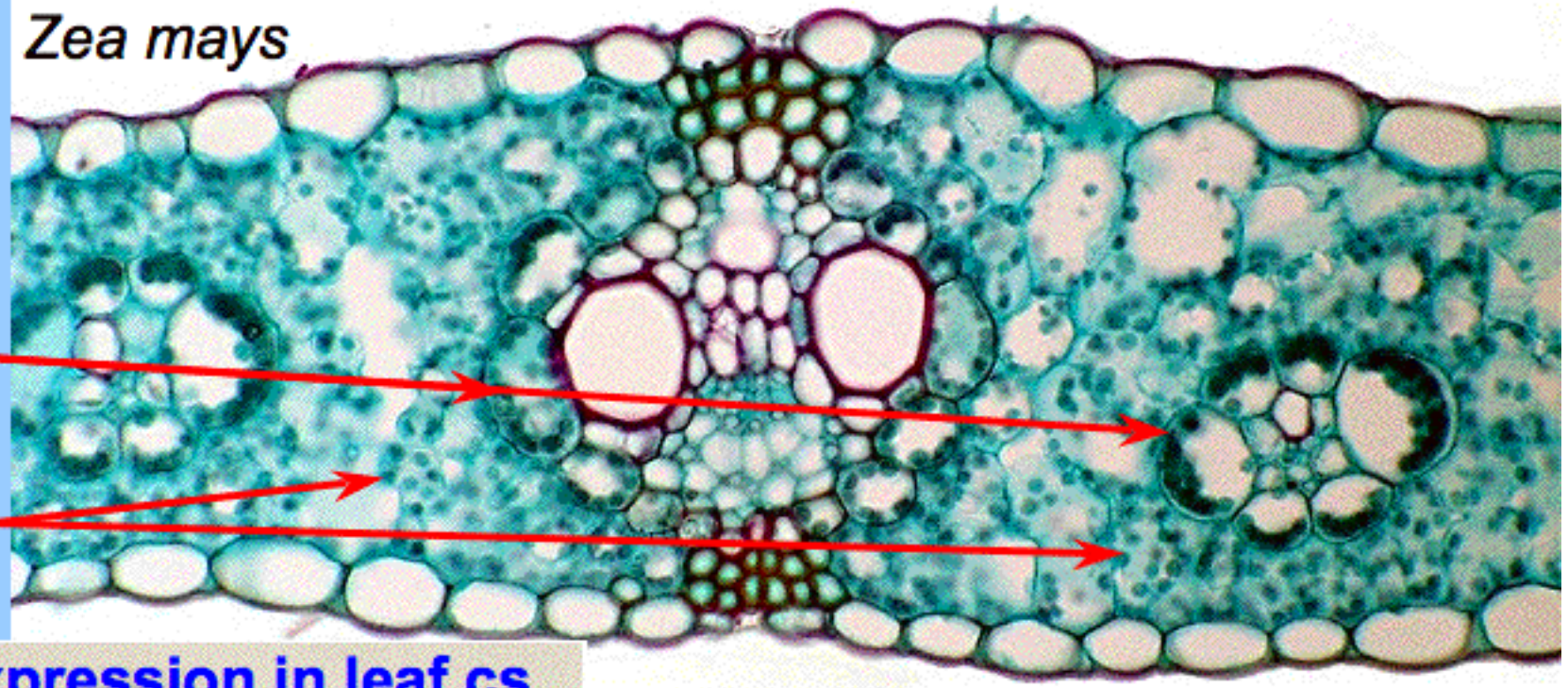
Mudança no Clima e a Produção Agrícola
Ciclo C4

Espécies C4



C_4 Leaves

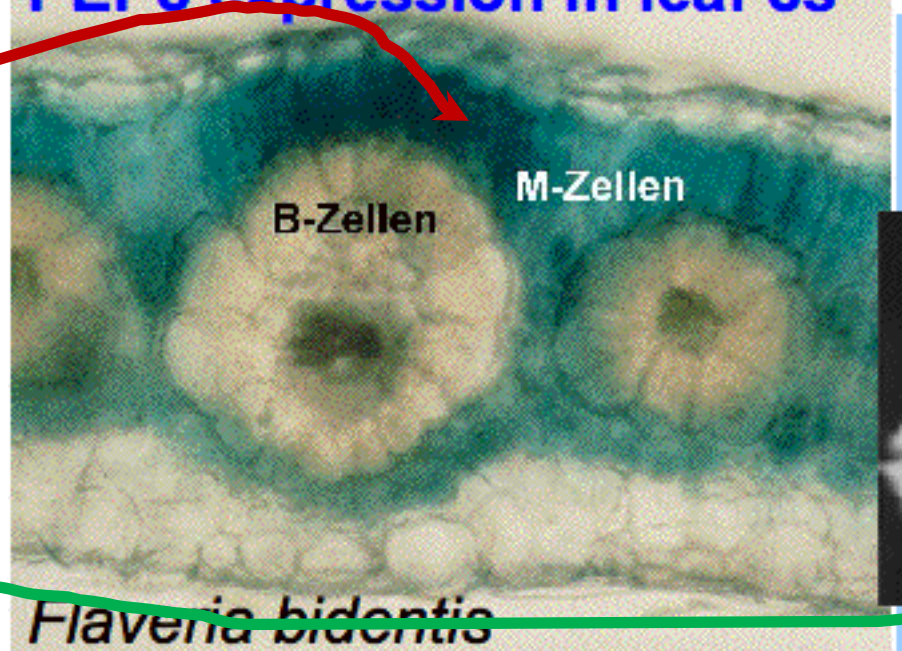
Zea mays



http://botit.botany.wisc.edu/images/130/Leaf/Zea_leaf_cross_section/Major_vein_MC.jpg

http://www.conabio.gob.mx/malezasdemexico/asteraceae/flaveria-trinervia/imagenes/rama.jpg

PEPc expression in leaf cs



Flaveria bidentis

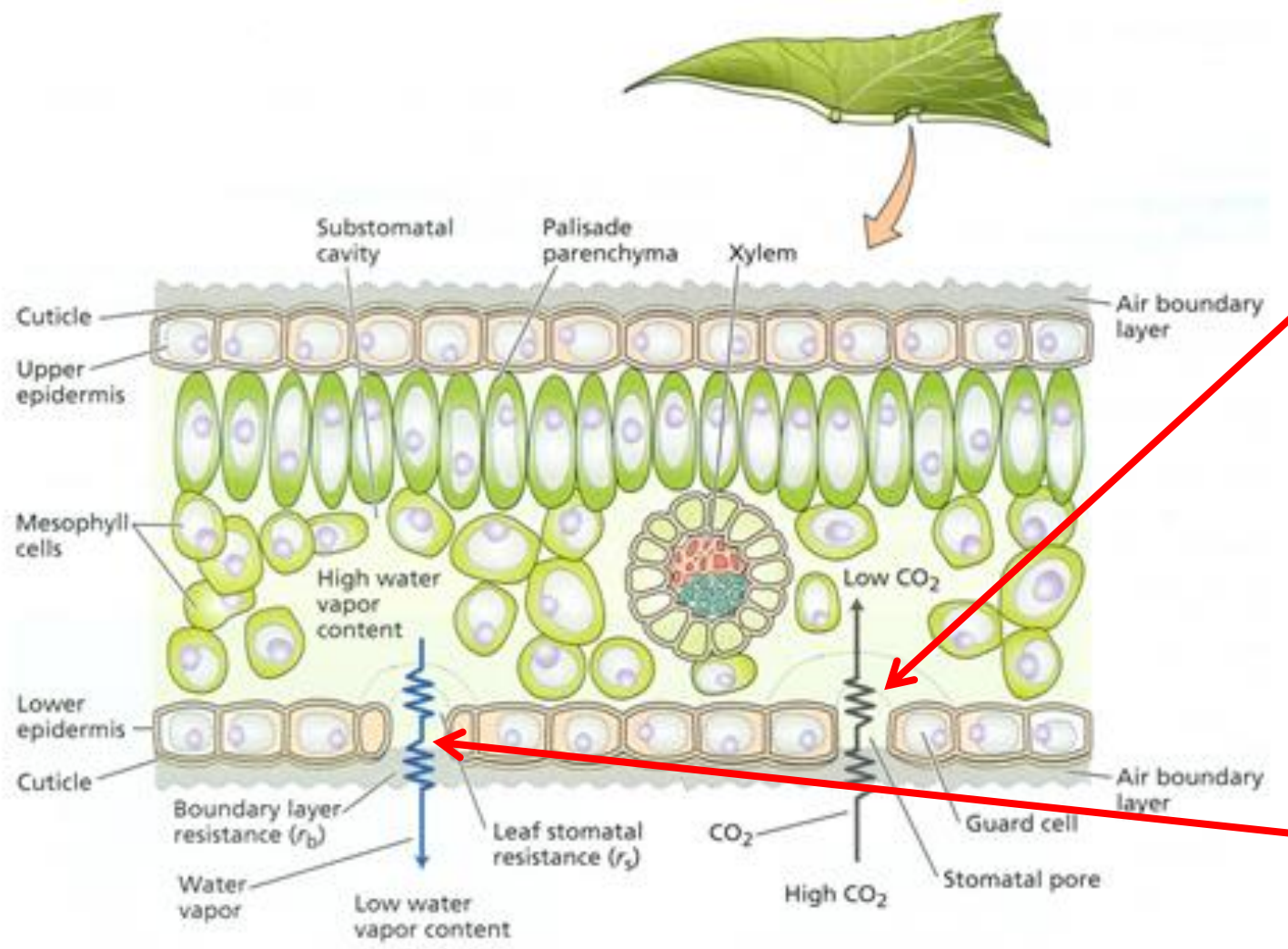
http://www.uni-duesseldorf.de/home/Jahrbuch/2002/Grieshaber/Grafik/Grieshaber05.gif

RubisCO expression in leaf cs

http://wings.buffalo.edu/academic/department/fnsm/bio-sci/facultyart.GIFS/Berryart.gif

Observe que a **PEP** fica no mesófilo, enquanto a **RUBISCO** fica apenas dentro das bainha vascular, protegida do contato com o O_2

Transpiração e Absorção de CO_2 e os estômatos



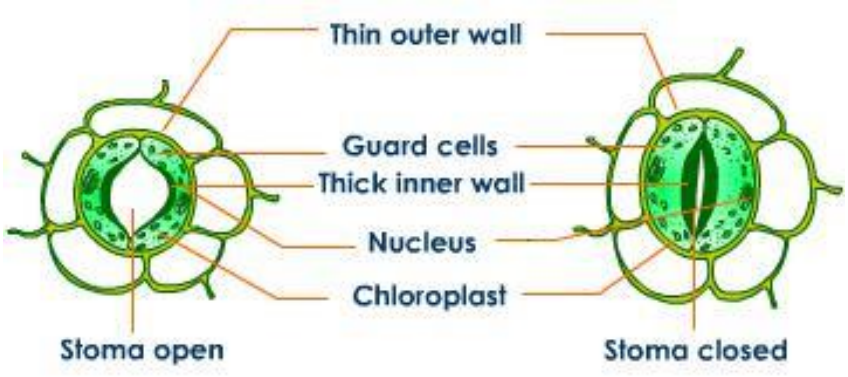
Note que este gradiente é o "motor" para o deslocamento do CO_2 para dentro o mesófilo. Se a diferença é grande, a célula pode fechar parcialmente os estômatos mantendo a mesma taxa de fluxo para dentro. Com isso, evita-se a perda de água.

Regulação Estomática

- Três fatores principais controlam a abertura estomática:

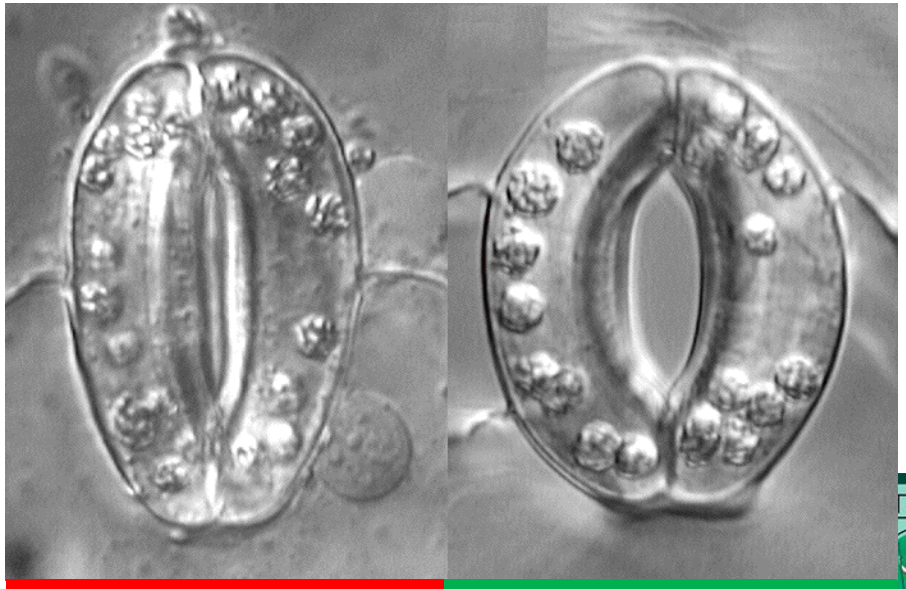
  1) Radiação solar – fechamento no escuro;

  2) Estado hídrico das folhas – células guarda túrgidas tornam-se ovaladas e se abrem, permitindo a saída de vapor d'água e a entrada de CO2;



Com maior turgor, as células-guarda se abrem e permitem a transpiração e entrada de CO2.

Estômato fechado por causa do baixo turgor das células-guarda

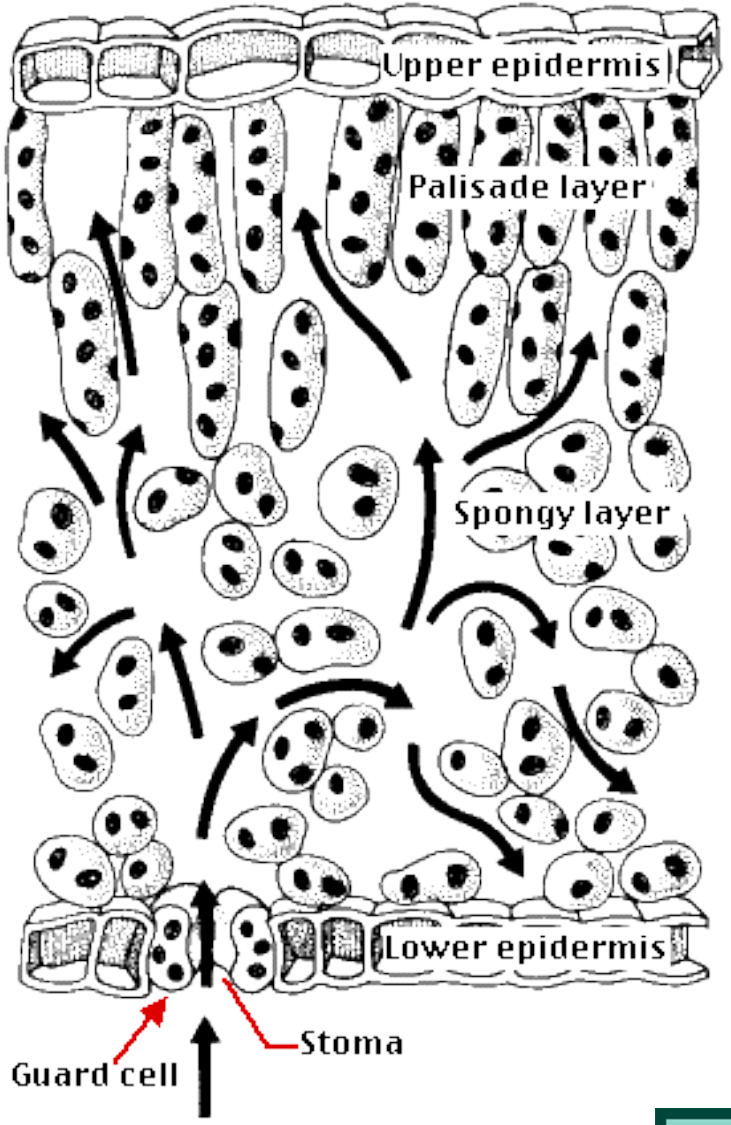


Estômato fechado por causa do baixo turgor das células-guarda

Com maior turgor, as células-guarda se abrem e permitem a transpiração e entrada de CO2.

Regulação Estomática

- **3) Concentração de CO_2 no ambiente**
  - A queda na concentração de CO_2 interna desencadeia um caminho bioquímico que faz com que as células-guarda tornem-se túrgidas e reabram.
  - O fluxo de CO_2 é controlado pelo gradiente entre a atmosfera e o interior dos estômatos;
  - Pela teoria fluxo-gradiente, com o aumento na concentração externa, o gradiente é mantido mesmo com o estômato relativamente fechado, permitindo a redução da perda de água sem redução na taxa fotossintética.



Fotossíntese e CO_2

Figure 4.1 Typical photosynthesis response of plants to CO_2. Net photosynthesis of wheat is about 70 mg of CO_2 $dm^{-2}h^{-1}$ compared with maize (about 55 mg of CO_2 $dm^{-2}h^{-1}$) for equivalent light intensity (0.4 cal cm^{-2} min^{-1}). Maize is saturated at a lower CO_2 concentration (c.450 ppmv) than wheat (c.850 ppmv). (Adapted from Akita and Moss, 1973).[4]

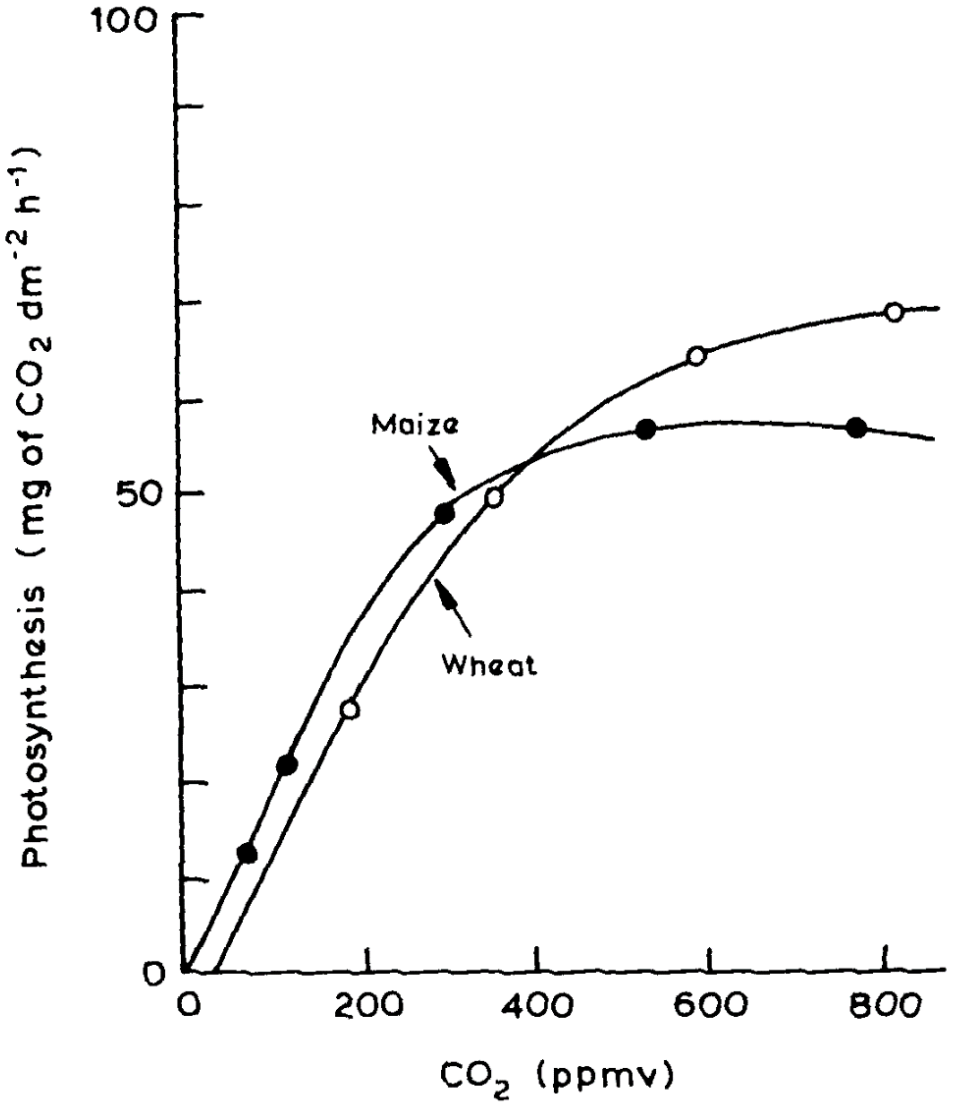
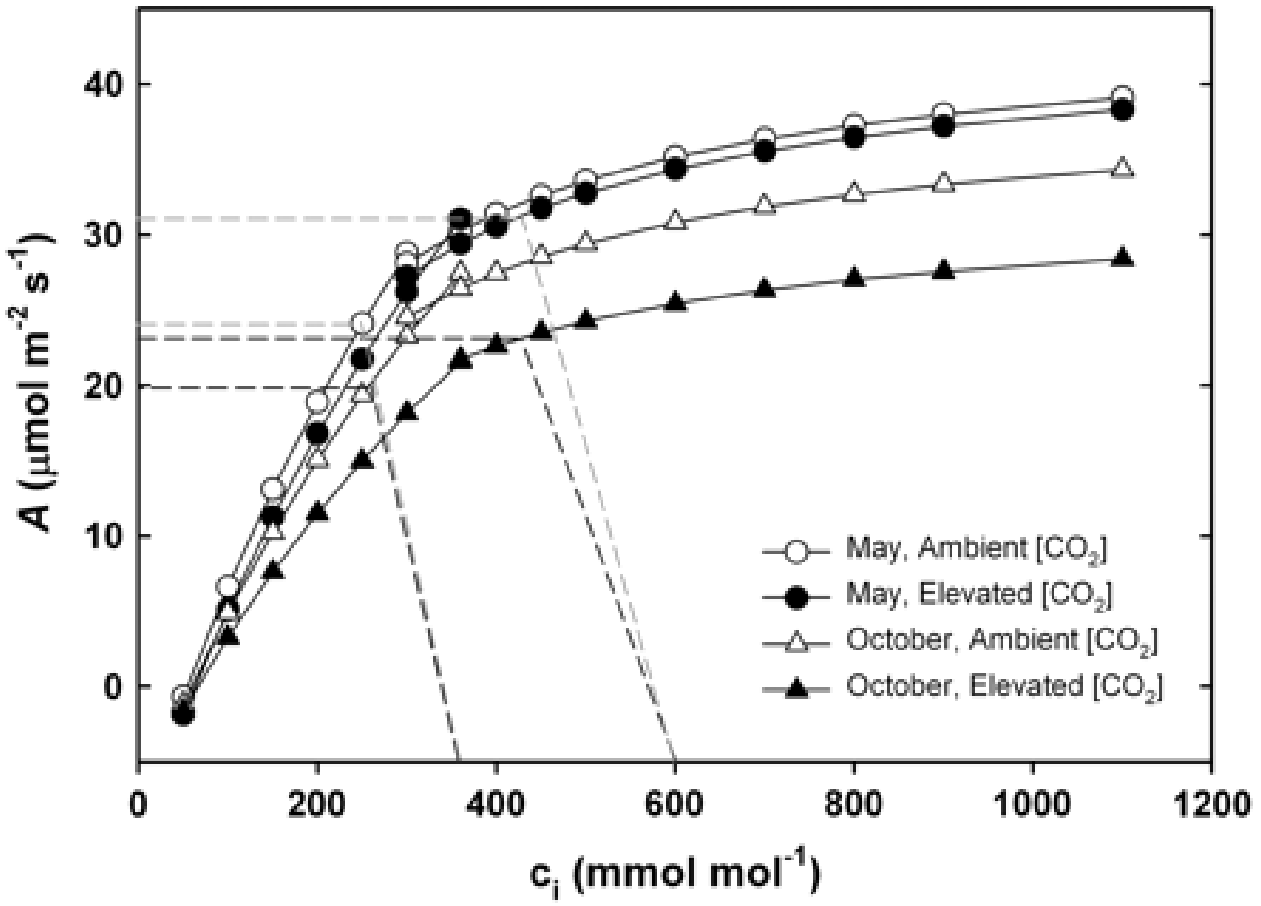


Fig. 1. Average plots of A/C_i response curves for Trifolium repens grown at ambient [CO_2] (~365 ...

Trevo



J Exp Bot, Volume 60, Issue 10, July 2009, Pages 2859–2876, https://doi.org/10.1093/jxb/erp096

Fig. 2. A summary of results from FACE experiments of change in evapotranspiration as a result of growth in elevated ...

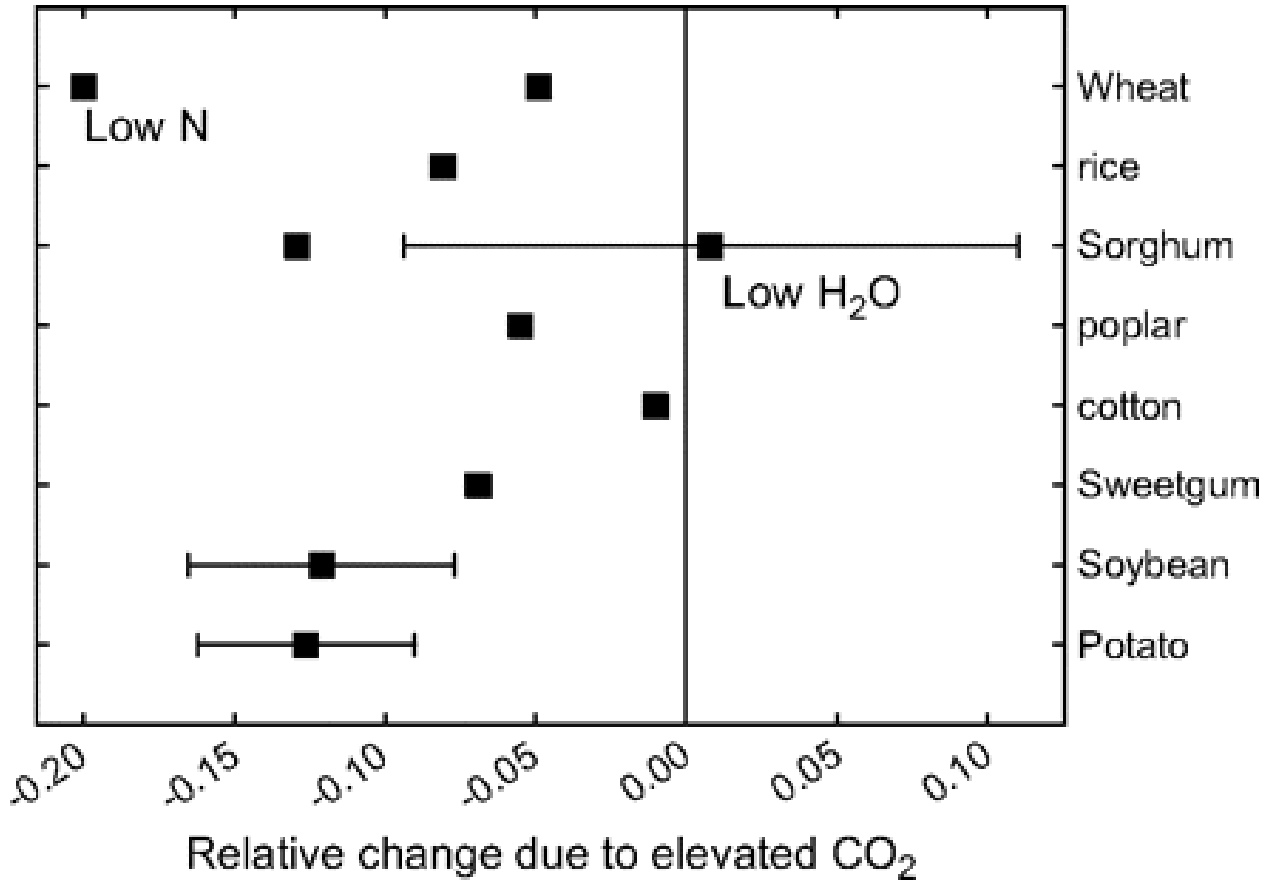


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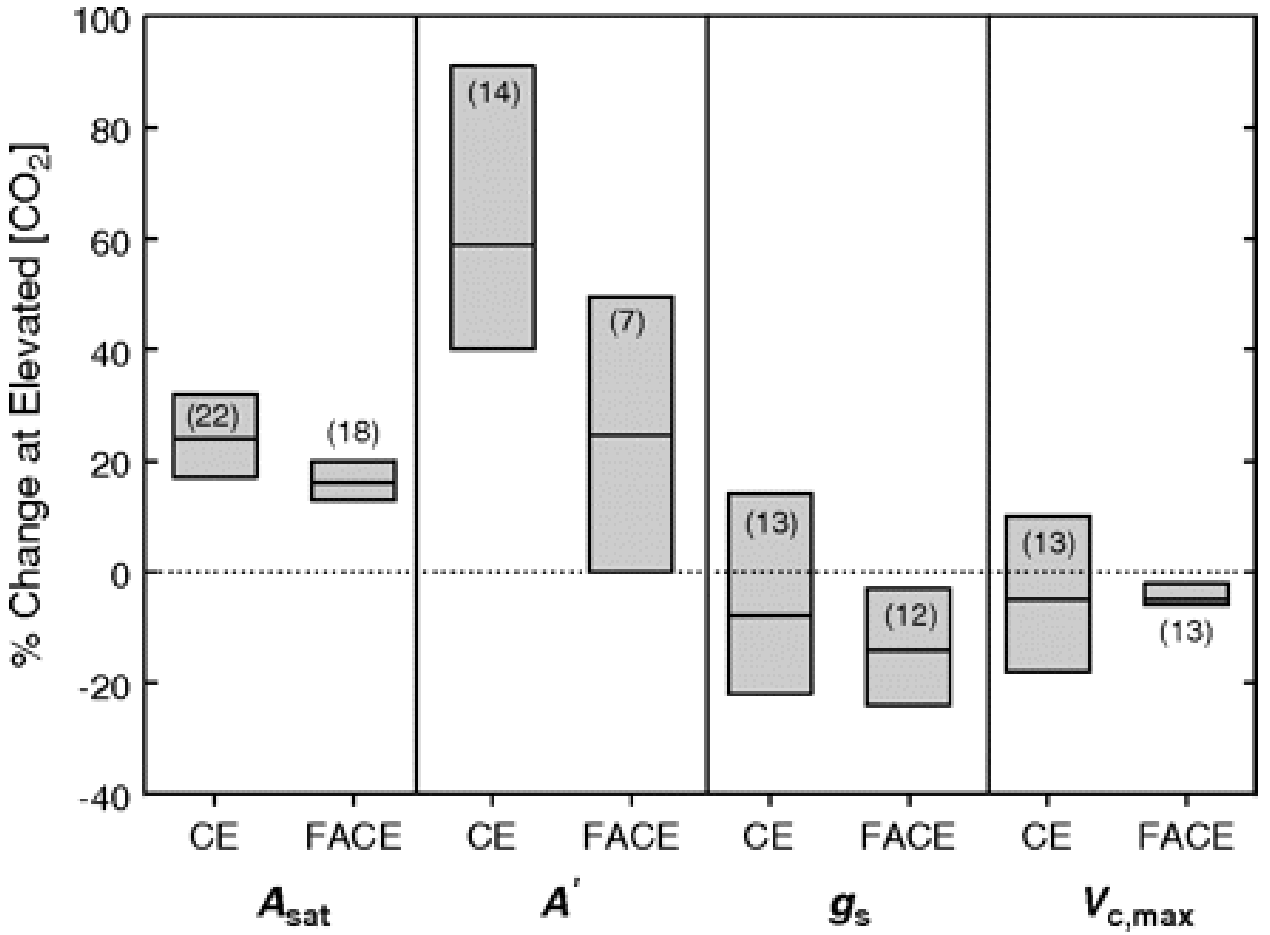
Fig. 5. A comparison of light-saturated photosynthesis (A_{sat}), daily carbon uptake (A′), stomatal conductance



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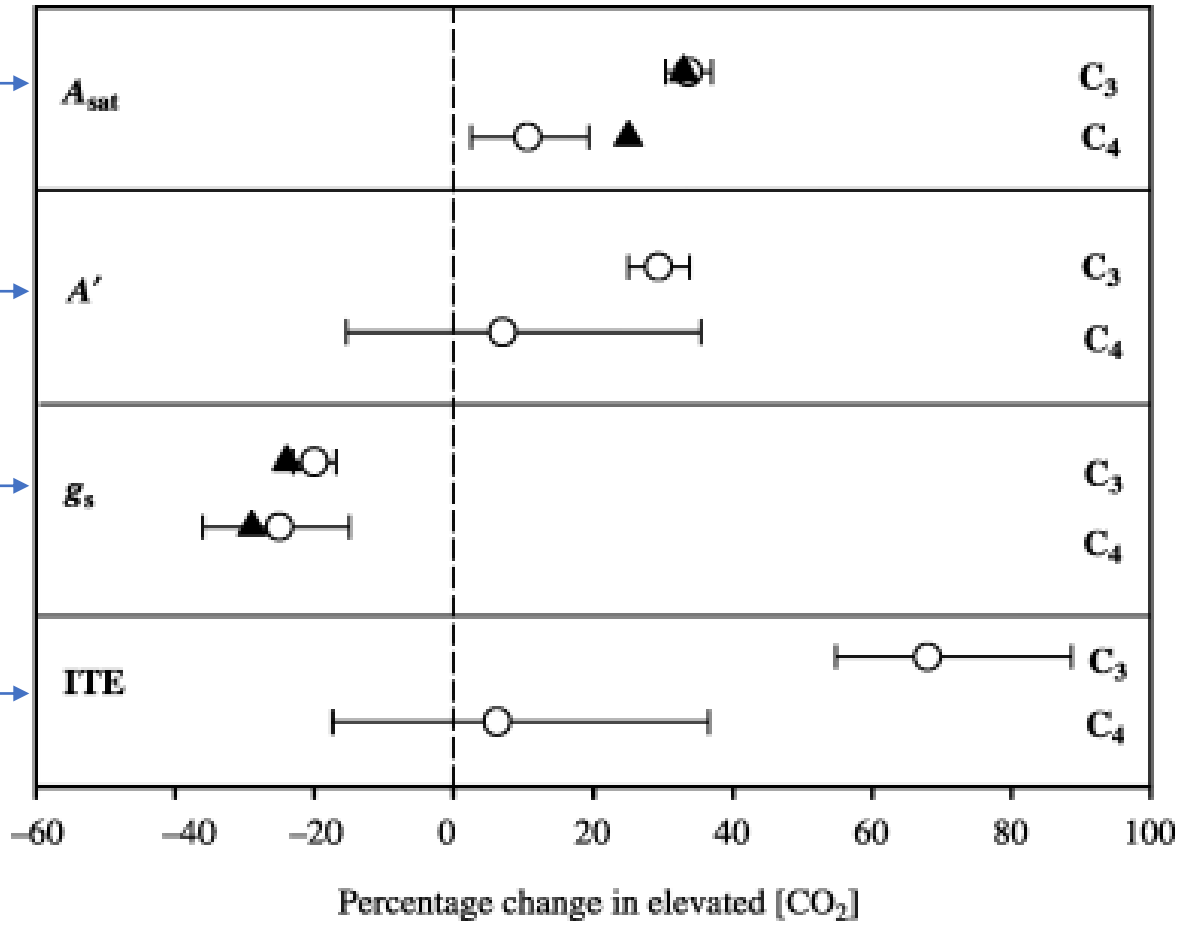
What have we learned from 15 years of free-air CO2 enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO2

Assimilação de CO2 em saturação de luz

Assimilação de CO2 diurna

Condutância estomática

Eficiência de transpiração

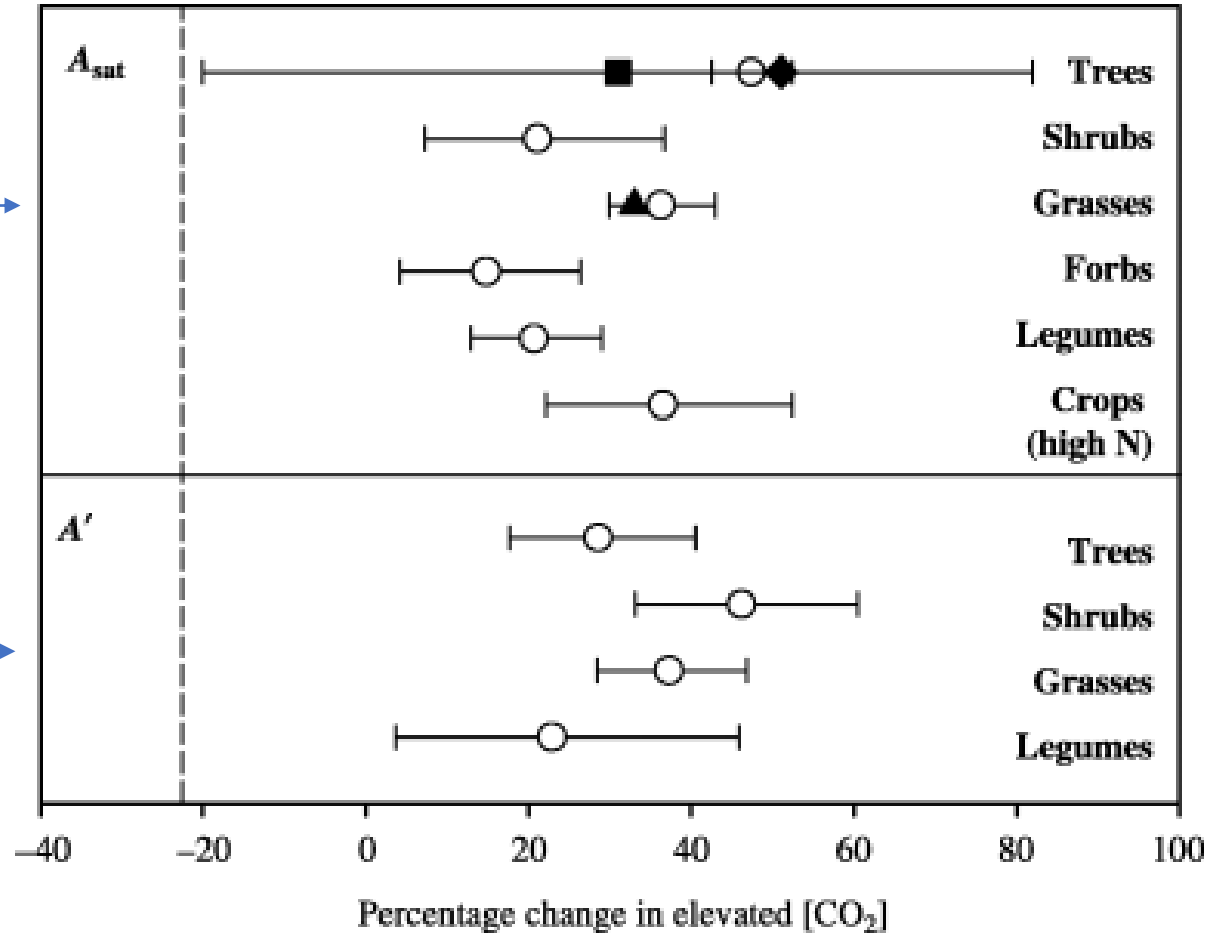


Comparative photosynthetic responses of C_3 and C_4 species to elevated [CO_2] enrichment. ○, Results from this meta-analysis; ▲, comparative results from a prior meta-analysis of C_3 and C_4 wild grass (Poaceae) species (**Wand *et al* ., 1999**).

New Phytologist, Volume: 165, Issue: 2, Pages: 351-372, First published: 18 November 2004, DOI: (10.1111/j.1469-8137.2004.01224.x)

Assimilação de CO2 em saturação de luz

Assimilação de CO2 diurna



Comparative photosynthetic responses of different C_3 functional groups to elevated [CO_2]. Results from: ○, this meta-analysis; ▪, a meta-analysis of tree species (Curtis & Wang, 1998); ◆, a meta-analysis of European tree species (Medlyn *et al* ., 2001); ▲, a meta-analysis of C_3 grasses (Wand *et al* ., 1999).

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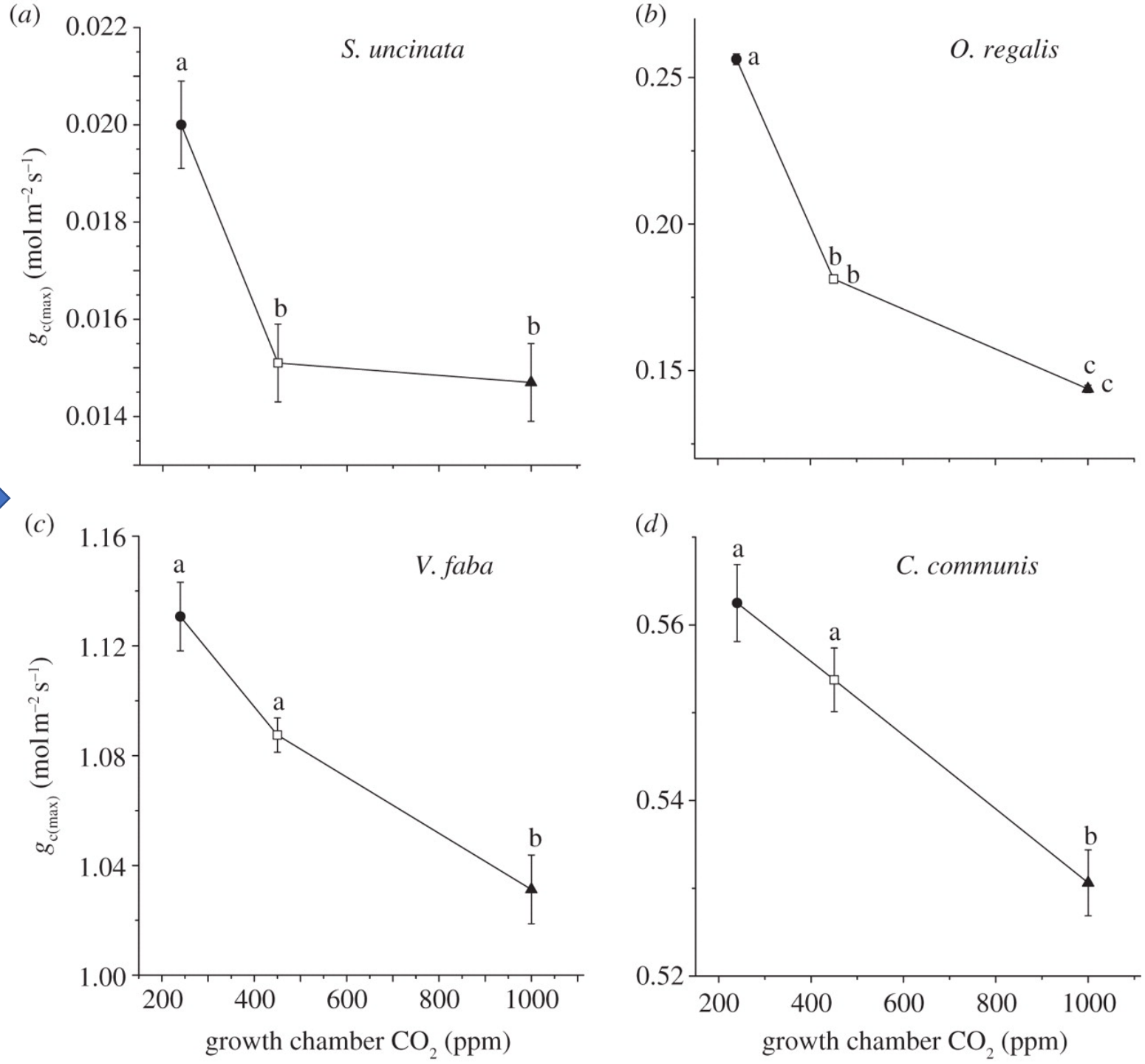
CO_2 e abertura estomática

Observe que os estômatos (representado por gs) tendem a fechar conforme aumenta a concentração de CO2 no ambiente



CO_2 e abertura estomática

Stomatal conductance (g_s) for the leaves of C_3 and C_4 plants grown and measured under a range of different CO_2 partial pressures, with an emphasis on experiments investigating the effects of CO_2below the current ambient level of approximately 40 Pa (data sources: [30,62–65]; electronic supplementary material). The data compilation is based on literature searches for studies reporting the leaf gas exchange of plants under sub-ambient CO_2. However, values for elevated CO_2 were included when they were reported as part of the same CO_2-gradient studies. The fitted curve for the C_3 species is $\ln(g_s) = 2.16 - 0.78 \ln(CO_2)$, and for the C_4 is $\ln(g_s) = 1.10 - 0.78 \ln(CO_2)$. Data and curves are shown on (*a*) log and (*b*) linear plots to illustrate relative and absolute sensitivity to CO_2, respectively. The fitted curves produce effect sizes for g_s at elevated CO_2 in C_3 and C_4 grasses that fall within confidence intervals of previous meta-analyses [66,67]. Filled circles, C_3; open circles, C_4.

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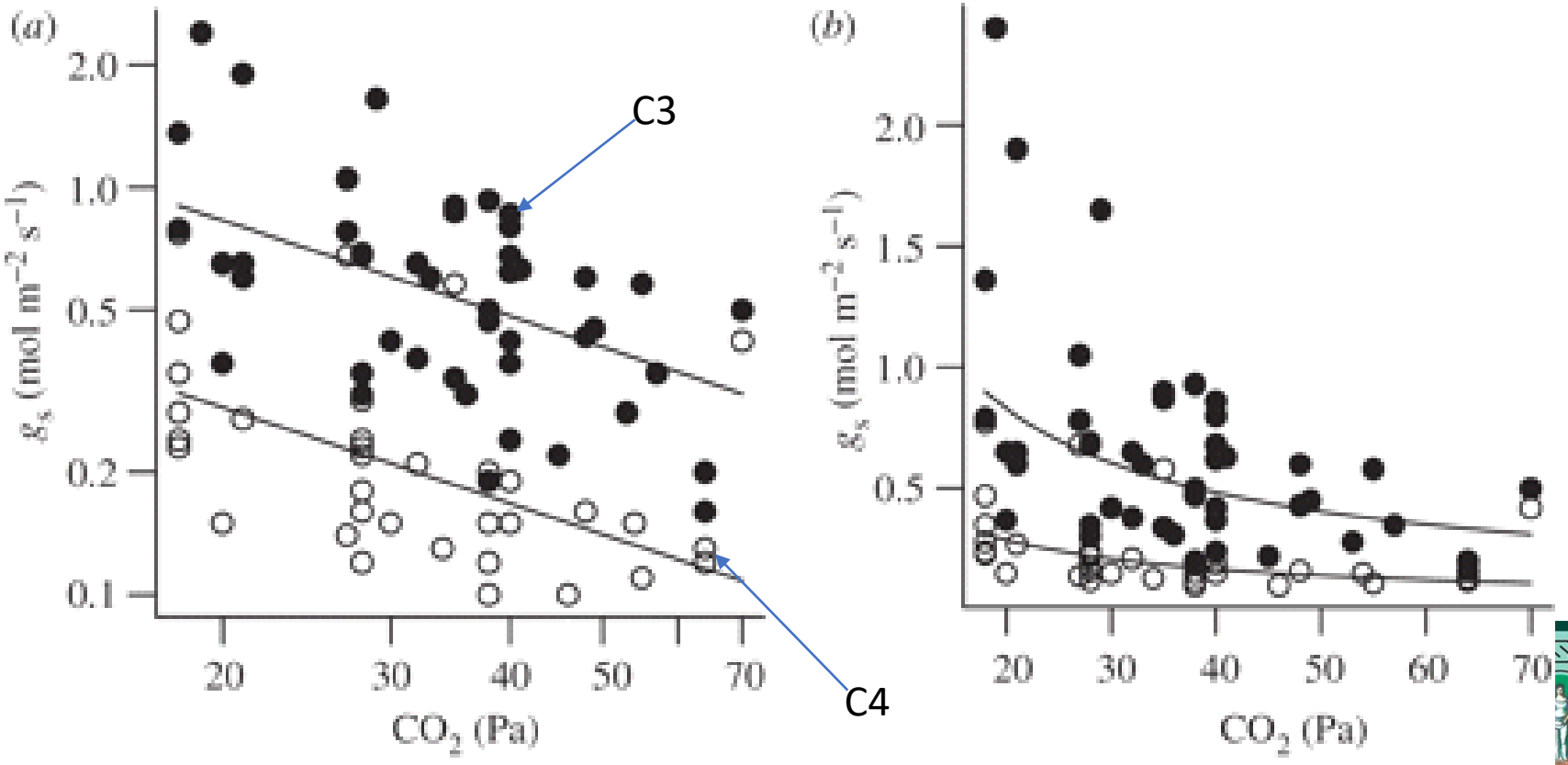
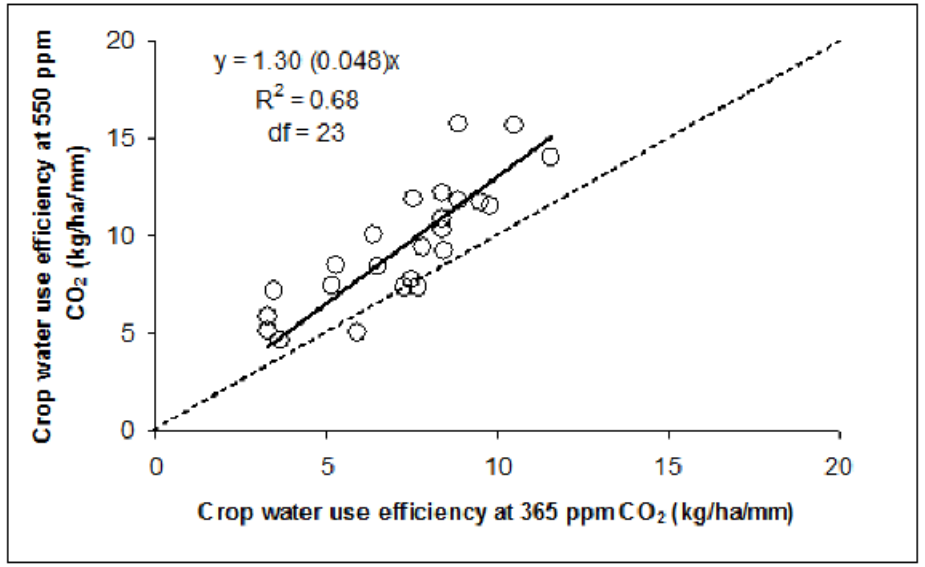


Relação - CO_2 X Produtividade da água

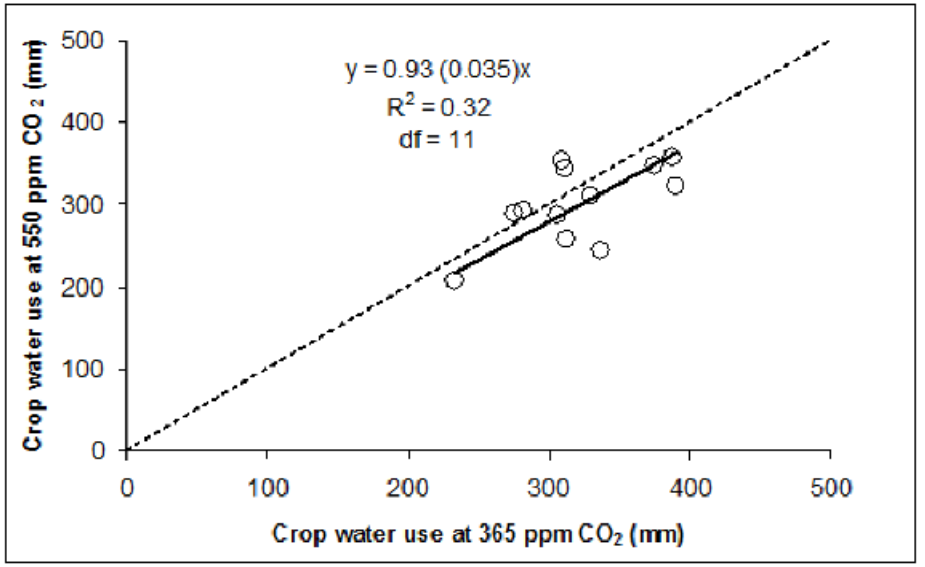
Observe que a produção de matéria seca por milímetro de agua consumido aumenta conforme sobe a concentração de CO2 no ar.

Produtividade da Água



Comparison of water use efficiency response under elevated CO_2 compared to daytime ambient conditions (365 ppm) of wheat (cv. Yitpi) showing significant (P<0.05) mean increase in water use efficiency (30%) against the 1:1 unity dashed line. Standard error of linear coefficient shown in parentheses.

Consumo Hídrico



Comparison of water use response under elevated CO_2 compared to daytime ambient conditions (365 ppm) of wheat (cv. yitpi) showing significant (P<0.10) mean decrease in water use (7%) against the 1:1 unity dashed line. Standard error of linear coefficient shown in parentheses.

Efeito da elevação da concentração de CO_2

- Ganho fotossintético nas culturas (e daninhas!) C3;
- Ganho fotossintético moderado nas culturas (e daninhas!) C4;
- Ganho na produtividade da água (eficiência de uso de água) das culturas (notadamente C4 em condição de sequeiro)