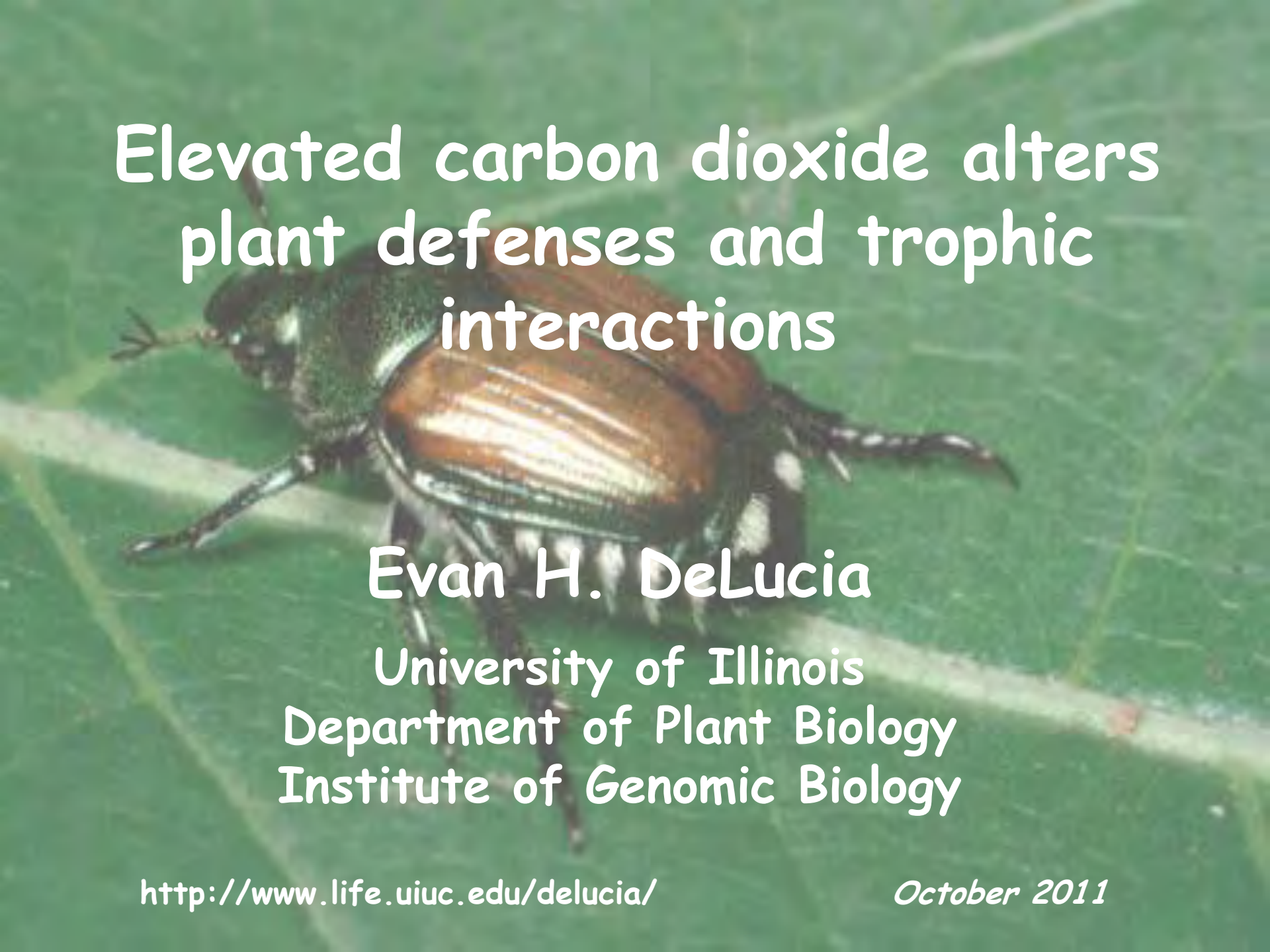

Elevated carbon dioxide alters plant defenses and trophic interactions

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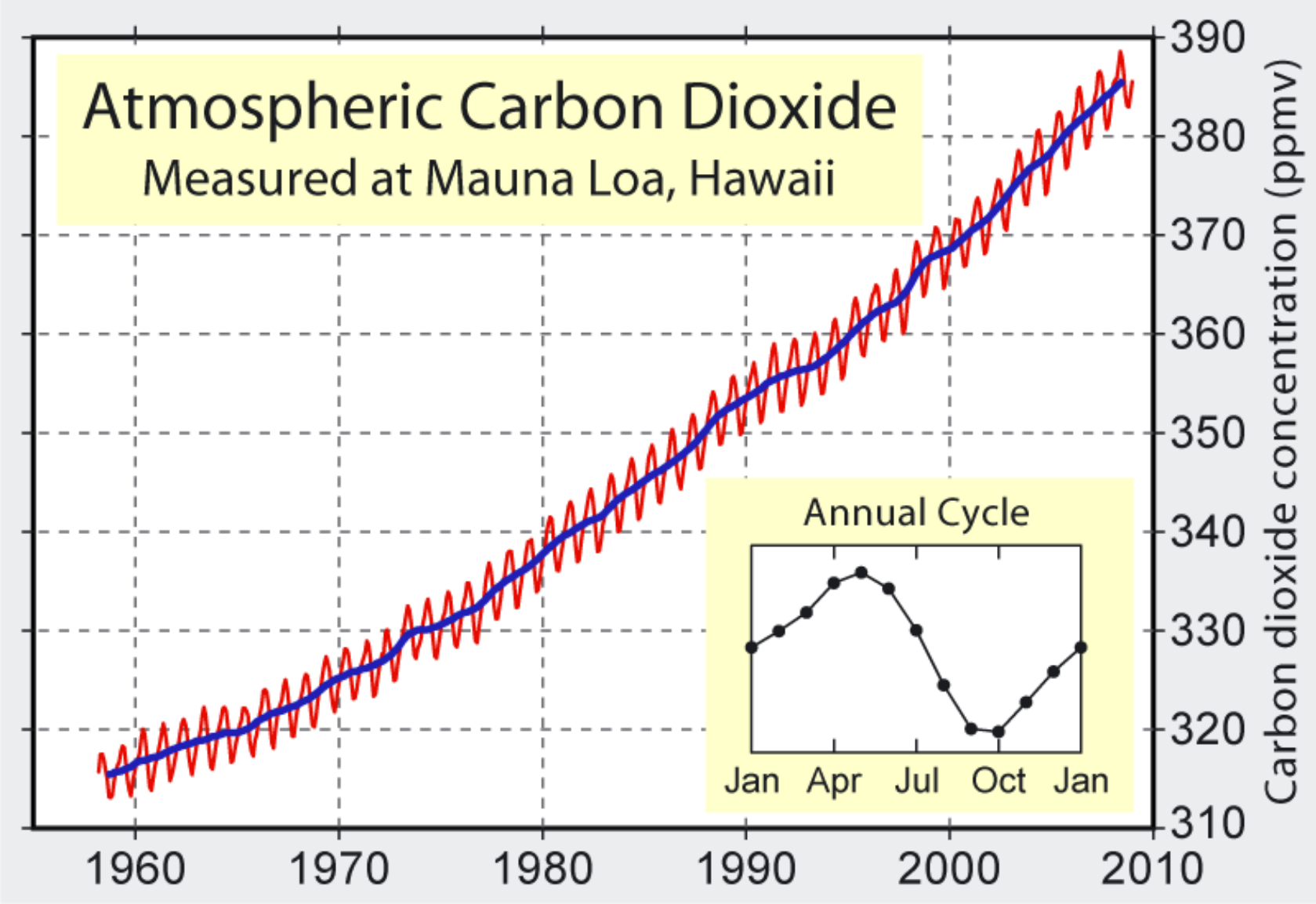
Department of Plant Biology
Institute of Genomic Biology

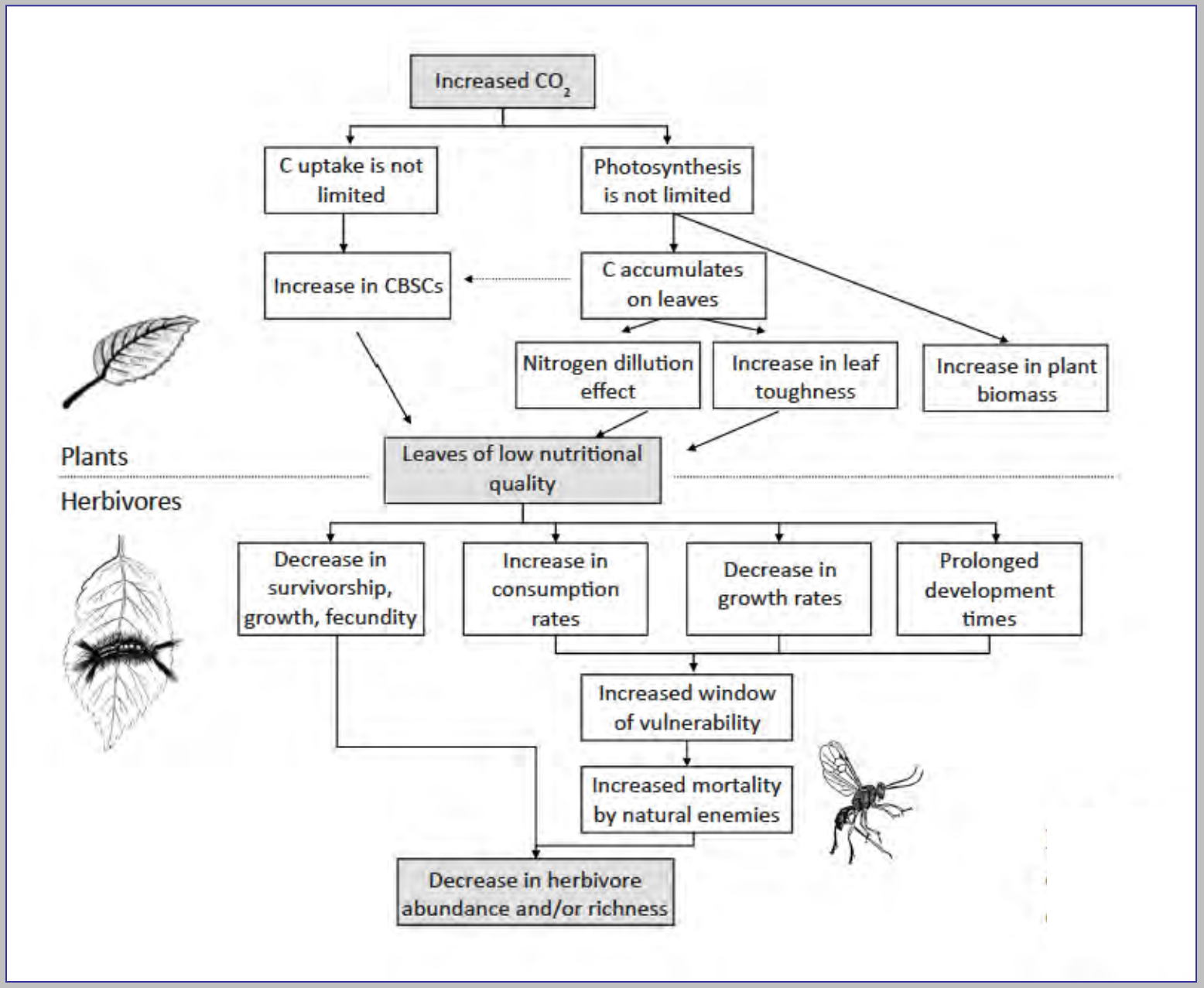
http://www.life.uiuc.edu/delucia/

October 2011

Human activities are increasing CO_2 in the atmosphere

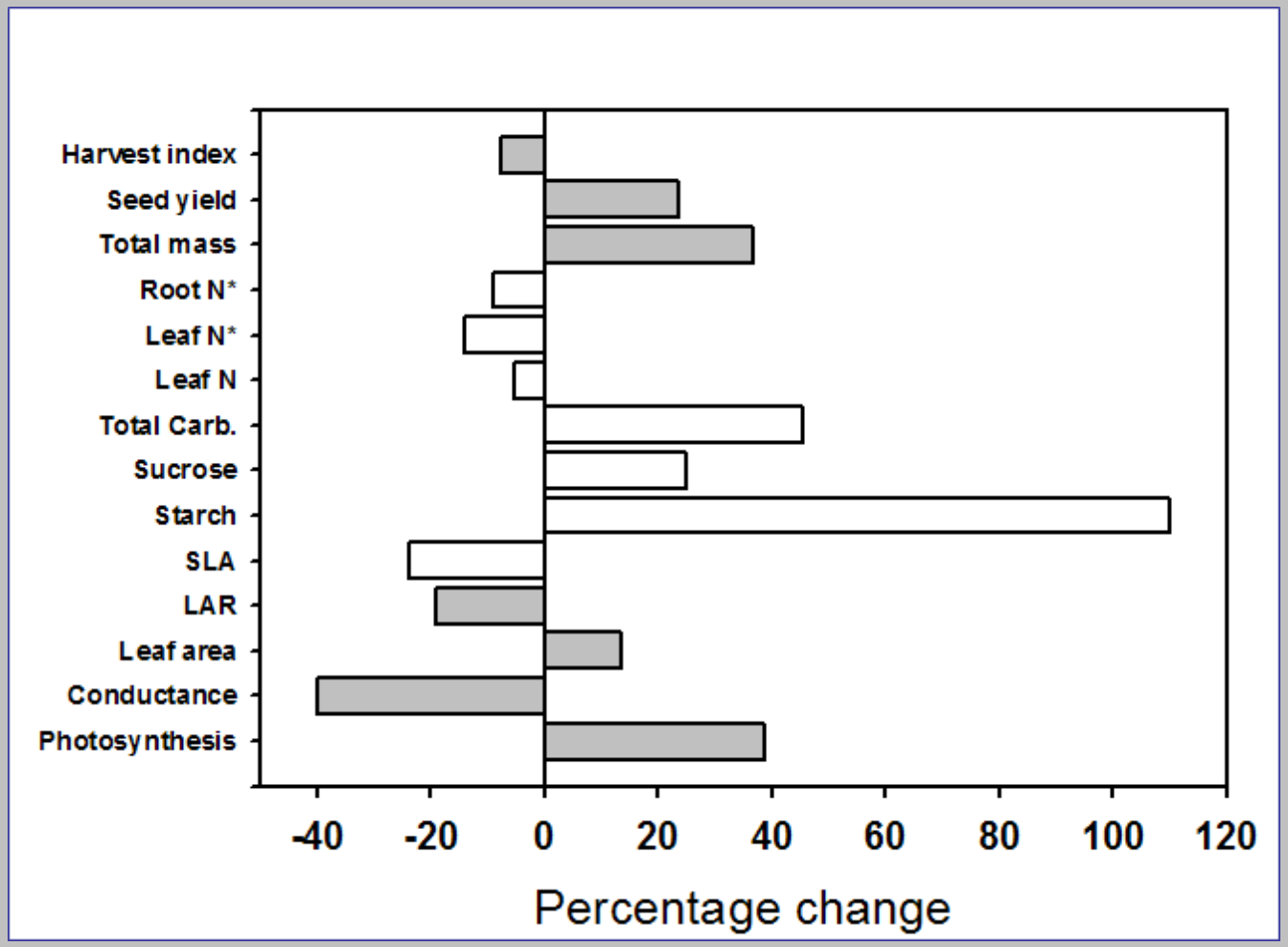


http://en.wikipedia.org/wiki/File:Mauna_Loa_Carbon_Dioxide.png



T Cornelissen (2011) Neotropical Ecology 40:155

Elevated CO_2 affects nutritional quality of soybean leaves



Ainsworth *et al.* 2002. Global Change Biology 8:695

Cotrufo *et al.* 1998. Global Change Biology 4: 43*

The Compensatory Feeding Hypothesis:

Growth under under elevated CO_2 reduces N concentration and increases the C:N ratio of foliage;

…to meet their nutritional needs, leaf-chewing insects such as grasshoppers and caterpillar larvae generally consume more leaf area when they are fed plants that have been grown under elevated CO_2.

Johnson & Lincoln, 1990, 1991

Lindroth *et al.*, 1993, 1995

The Compensatory Feeding Hypothesis:

Growth under un
concentration and
foliage;

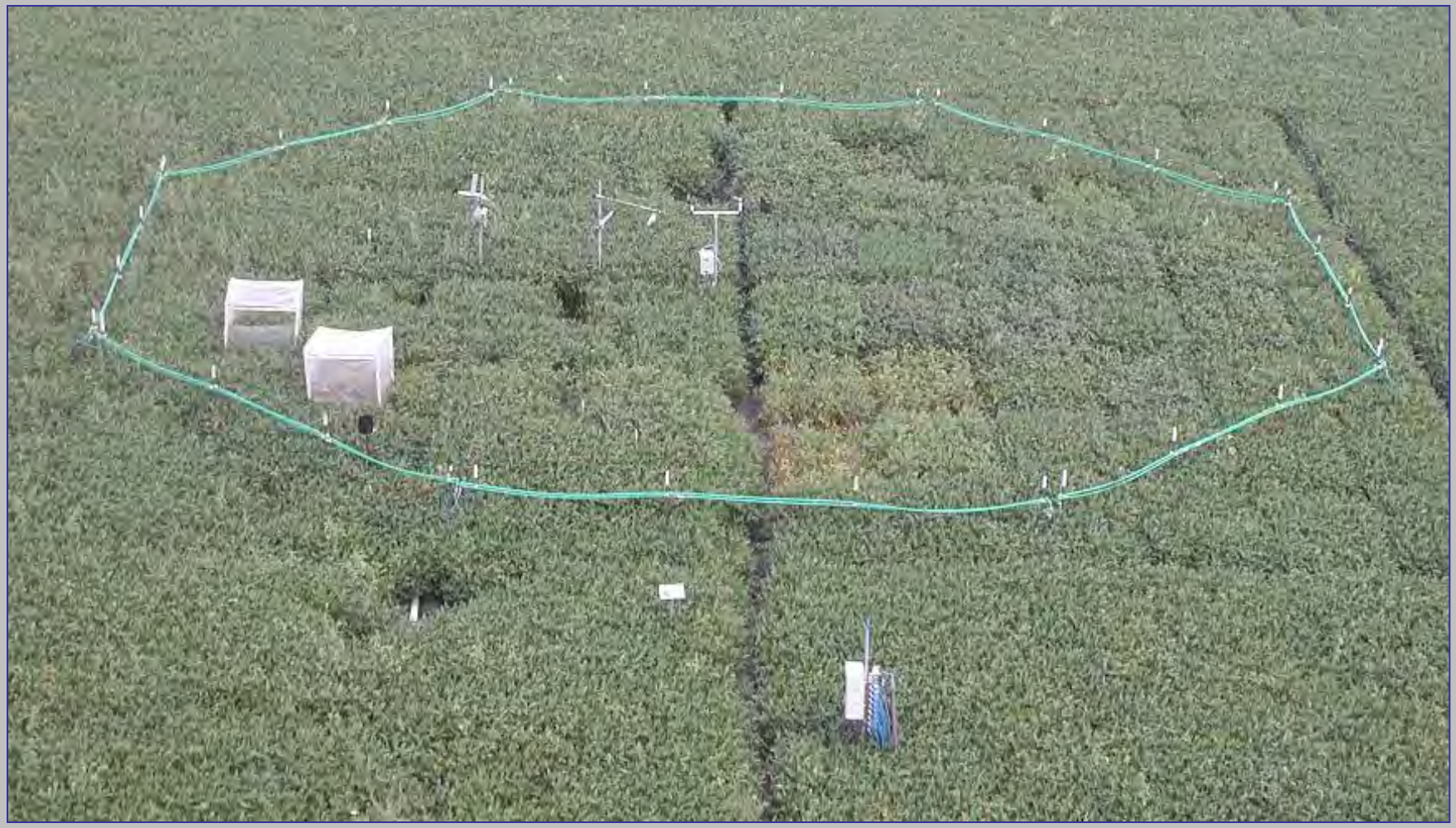
…to meet their
insects such as g
larvae generally
they are fed plant
under elevated CO_2.

But what about chemical defenses (Bidart-Bouzat) and biogenic volatile organic compounds (Yuan et al.) ???

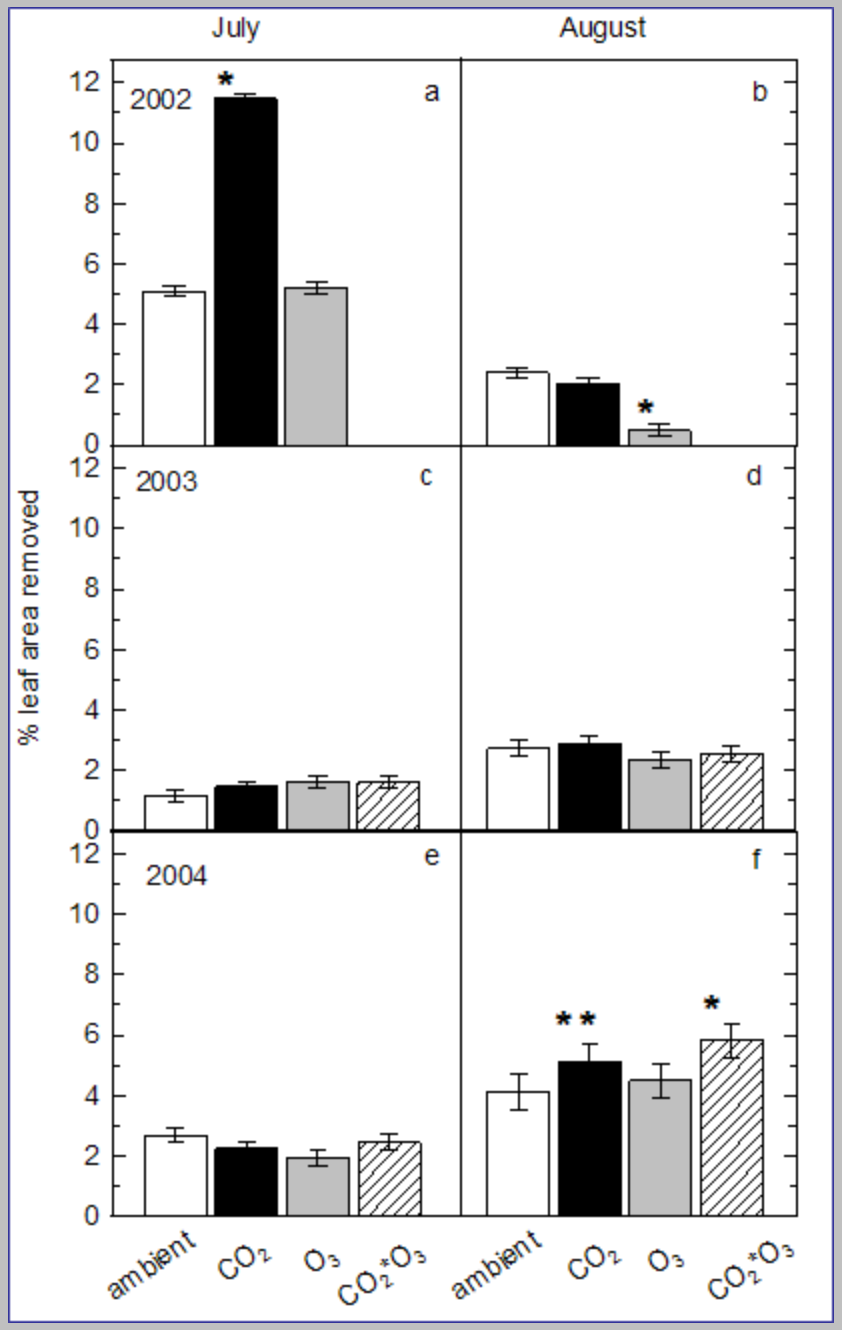
Johnson & Lincoln, 1990, 1991

Lindroth *et al.*, 1993, 1995

Soybean Free Air Concentration Enrichment - SoyFACE

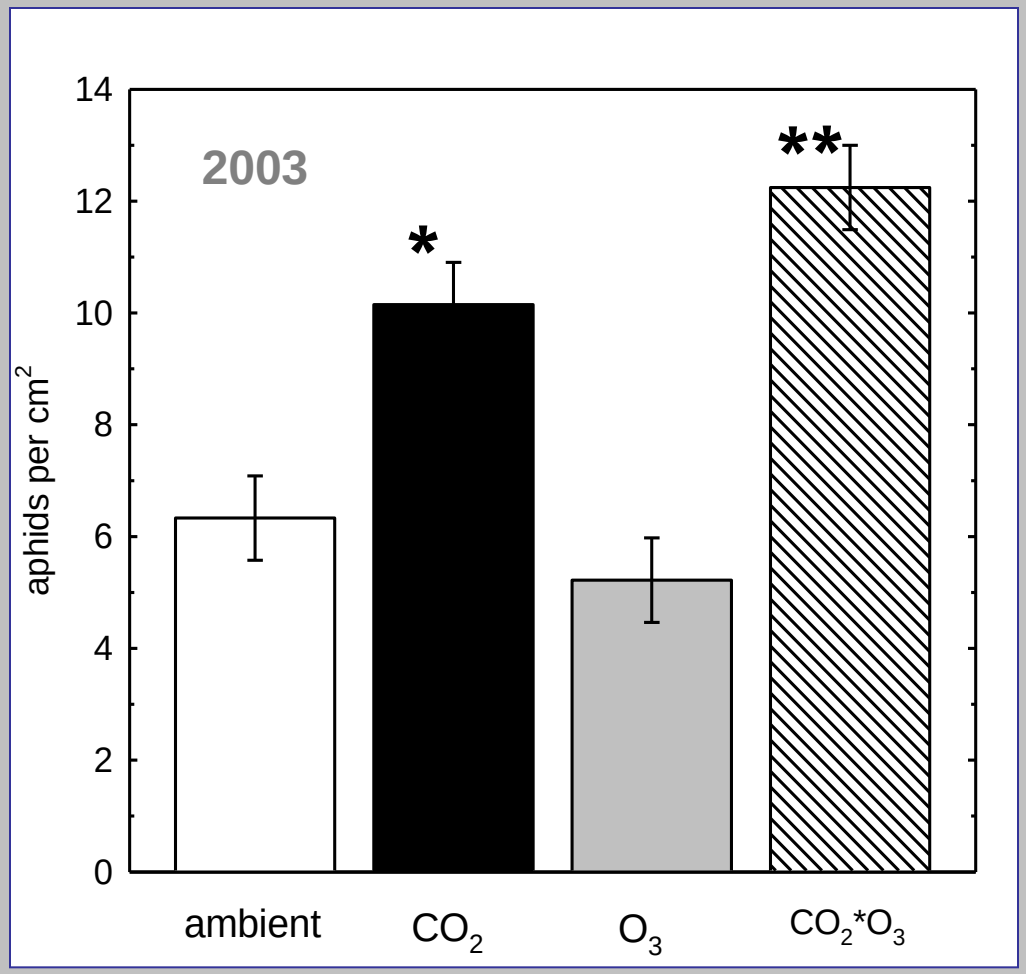


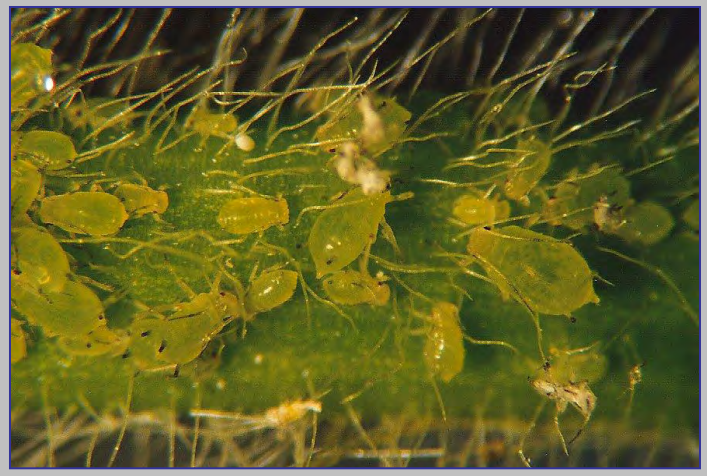
Leaf damage is greater under elevated CO_2.



Hamilton *et al.* 2005, Dermody *et al.* 2008

Total number of aphids were greater on leaves grown elevated CO_2.

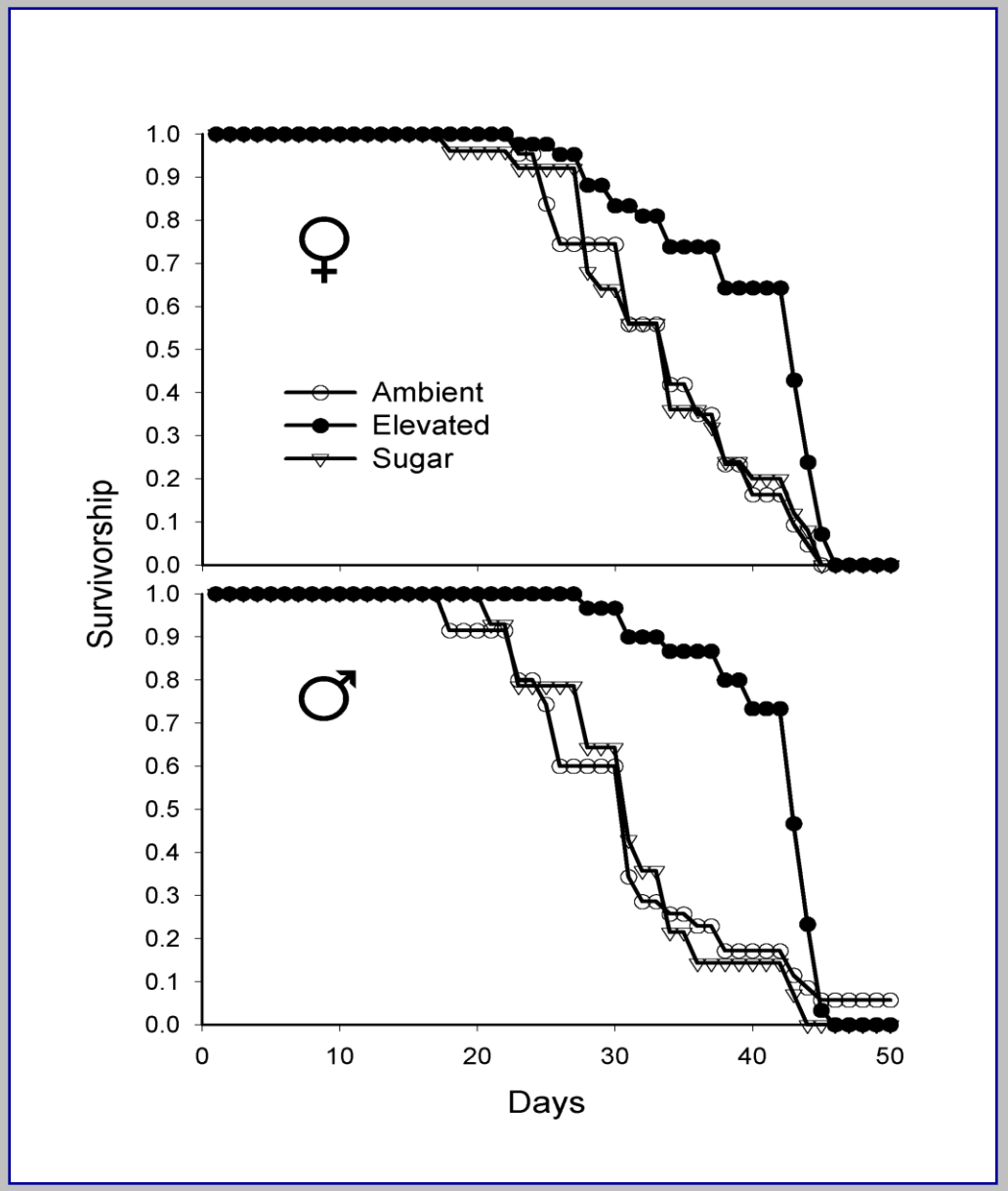




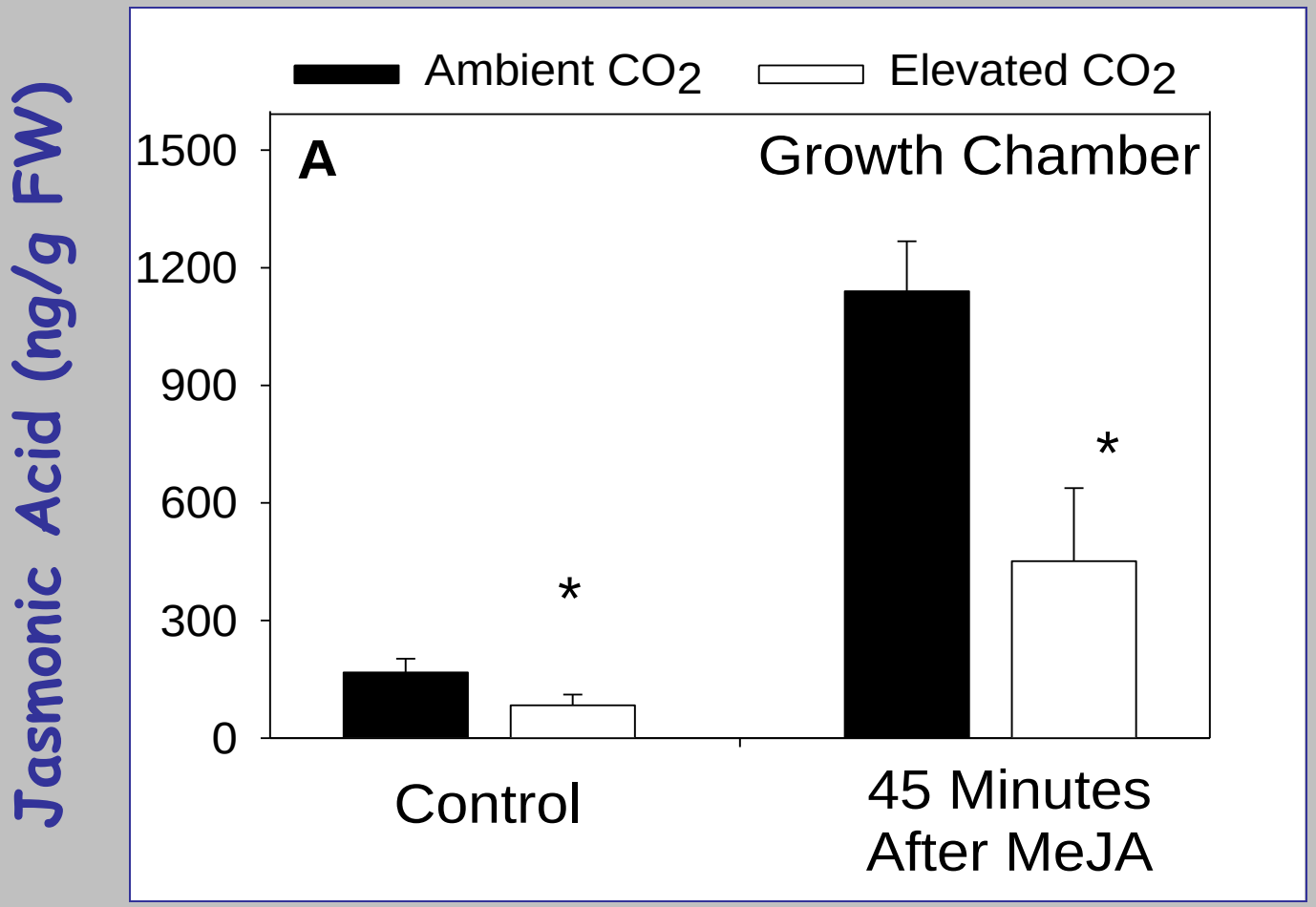
O. Dermody *et al.* 2008. API 2:125-135

Female and male beetles live longer when they consume leaves grown under elevated CO_2.

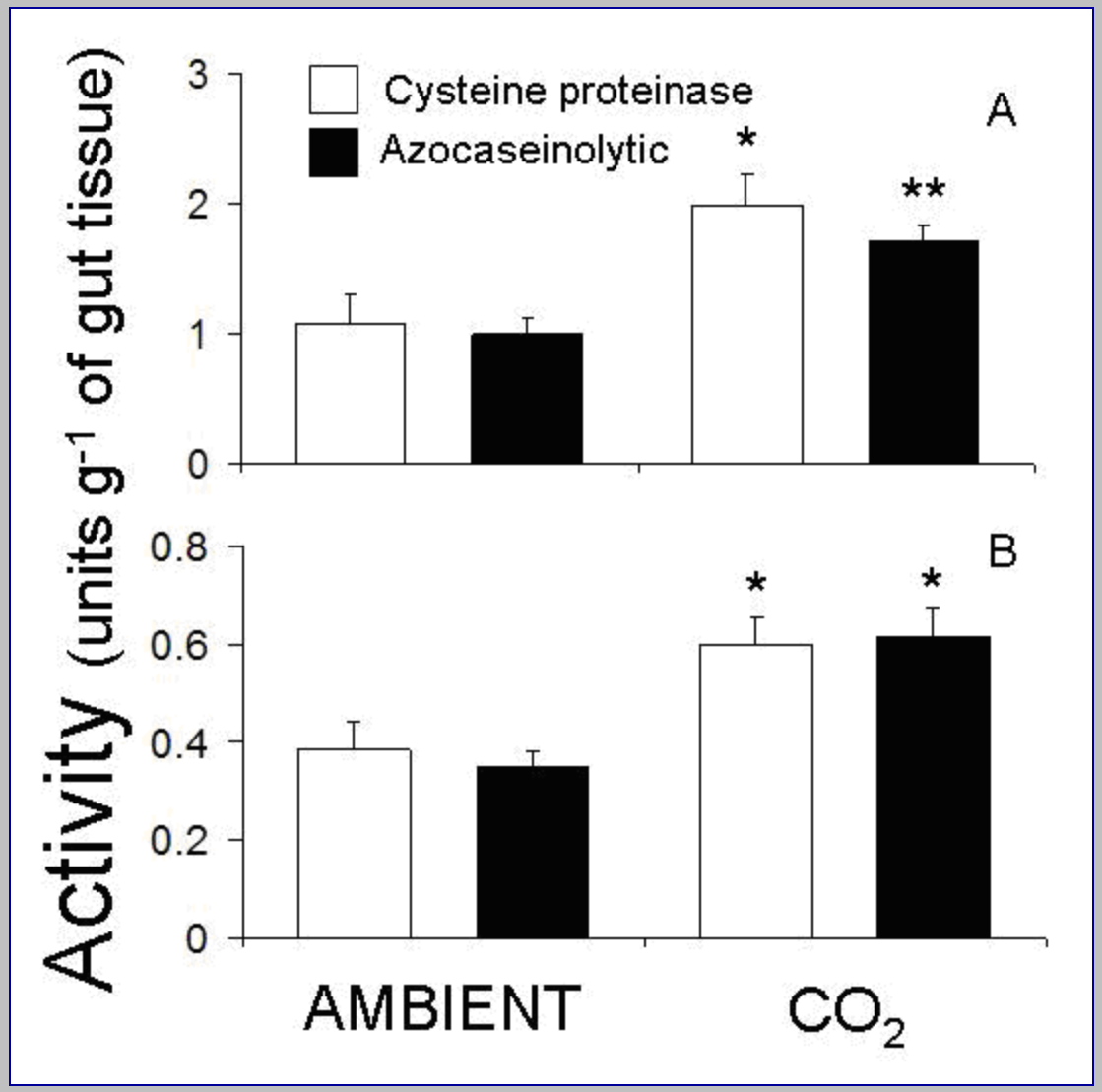
B. O'Neill *et al.* 2008. Env. Ent. 37:601-607



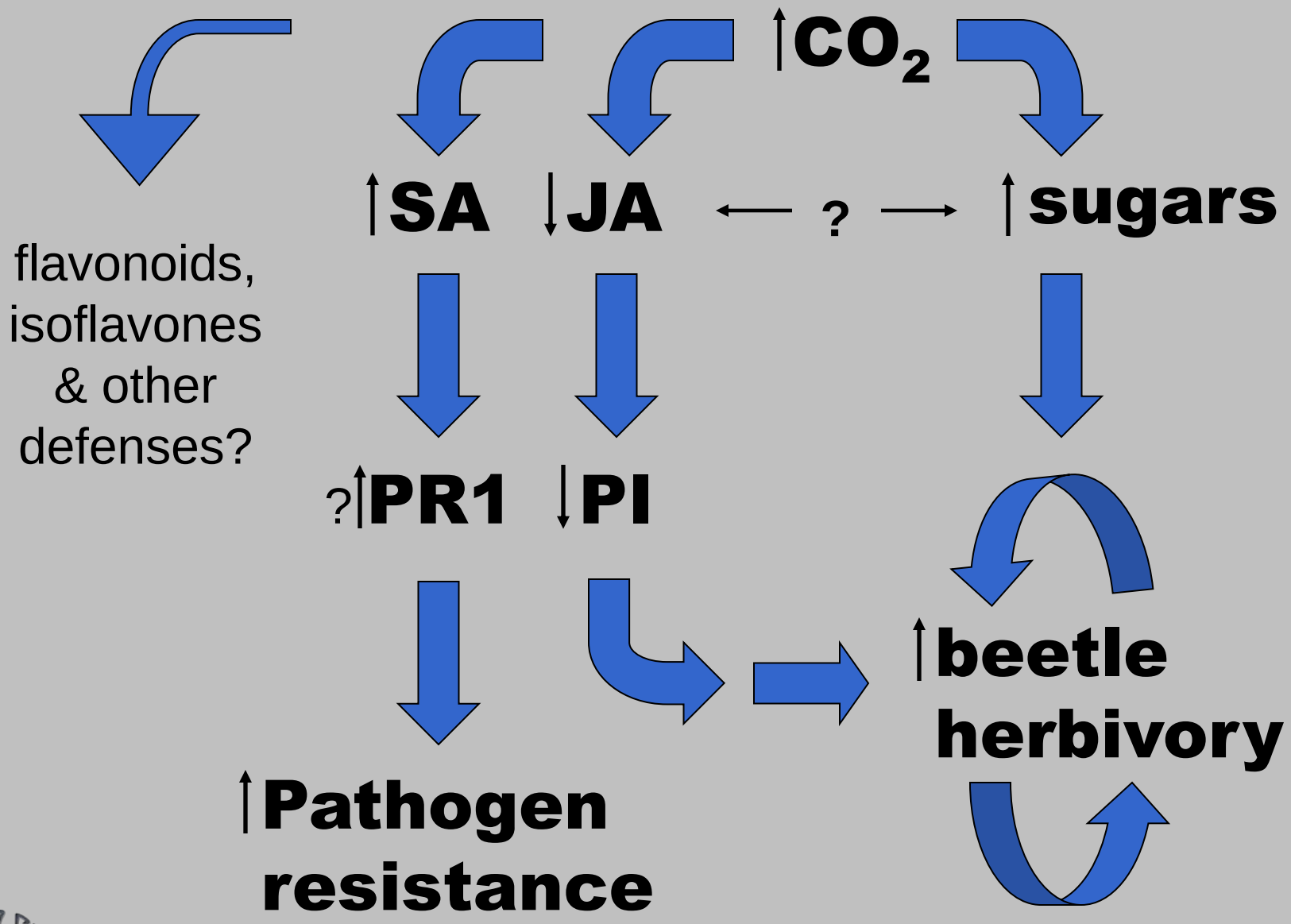
Elevated CO_2 reduced constitutive levels of JA

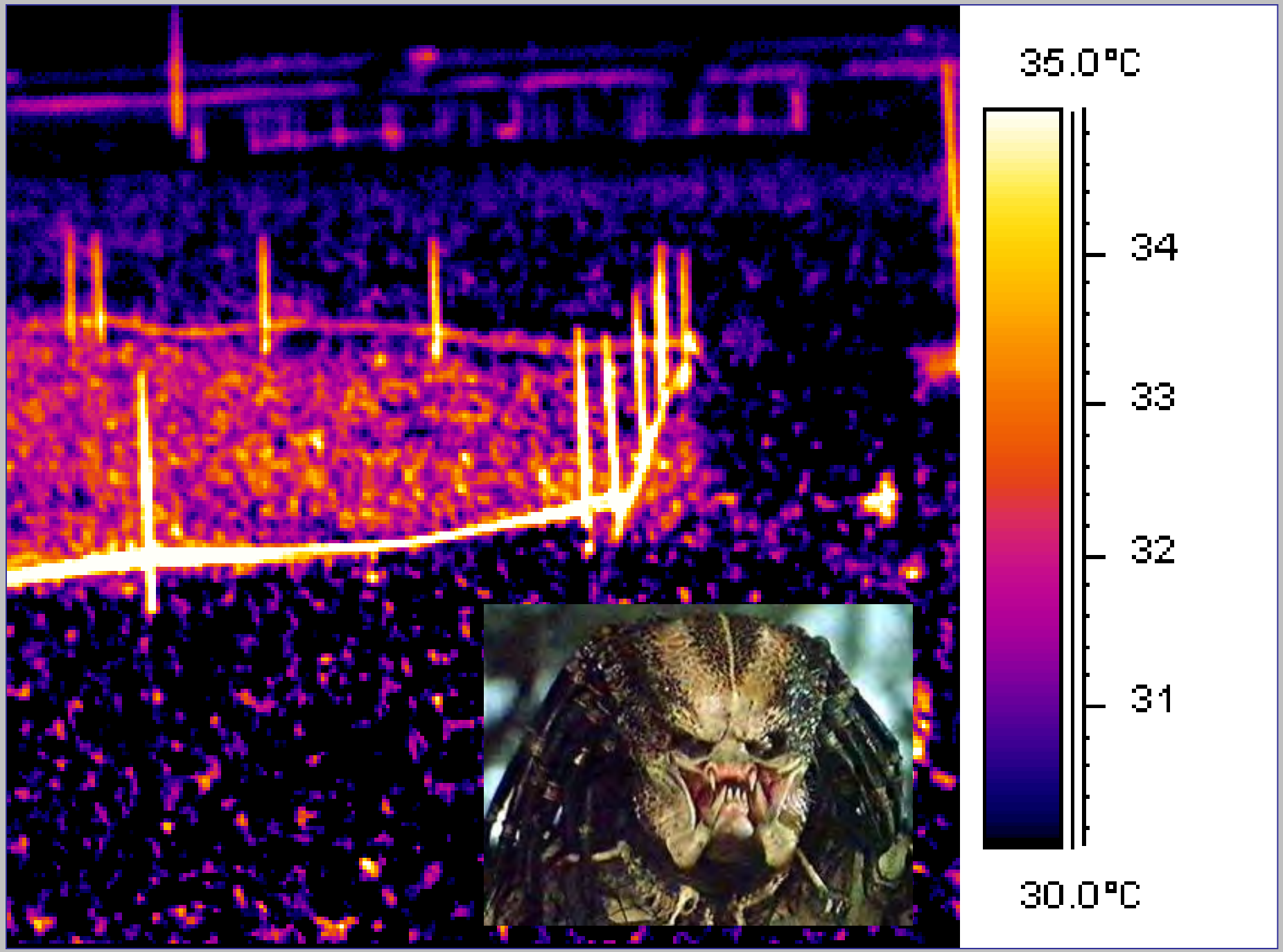


Casteel, unpublished

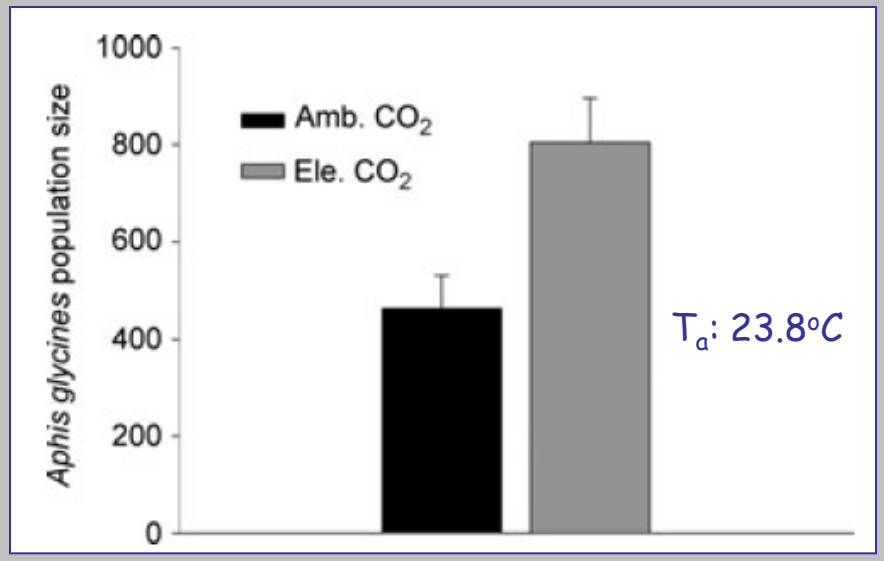


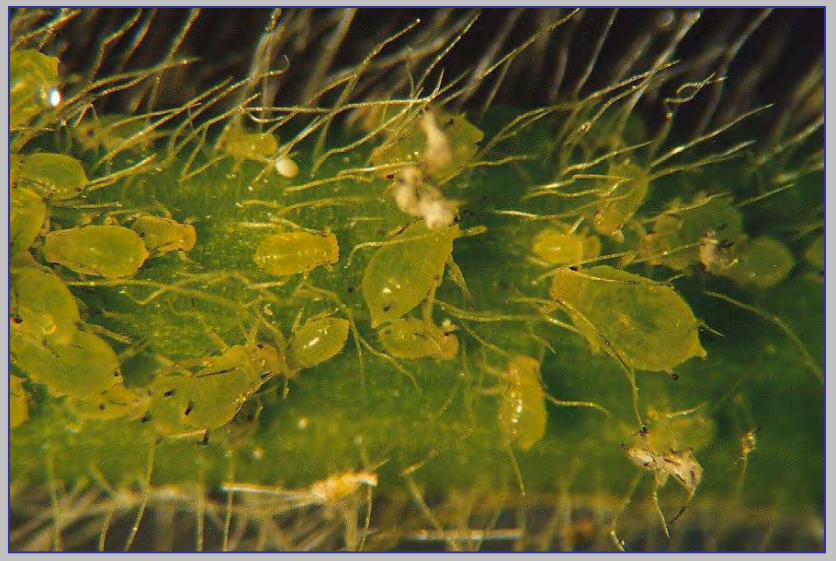
Zavala J.A. et al. PNAS 2008;105:5129-5133

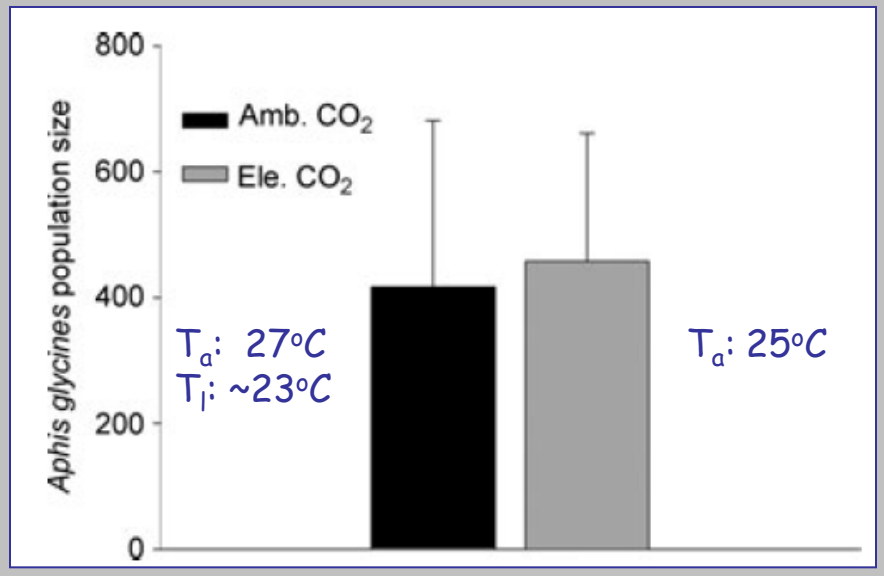

↑CO2
↑SA
↓JA
←?→
↑sugars
flavonoids, isoflavones & other defenses?
?↑PR1
↓PI
↑beetle herbivory
↑Pathogen resistance


35.0°C
34
33
32
31
30.0°C

Aphids respond to warmer leaves on plants grown at elevated CO_2.





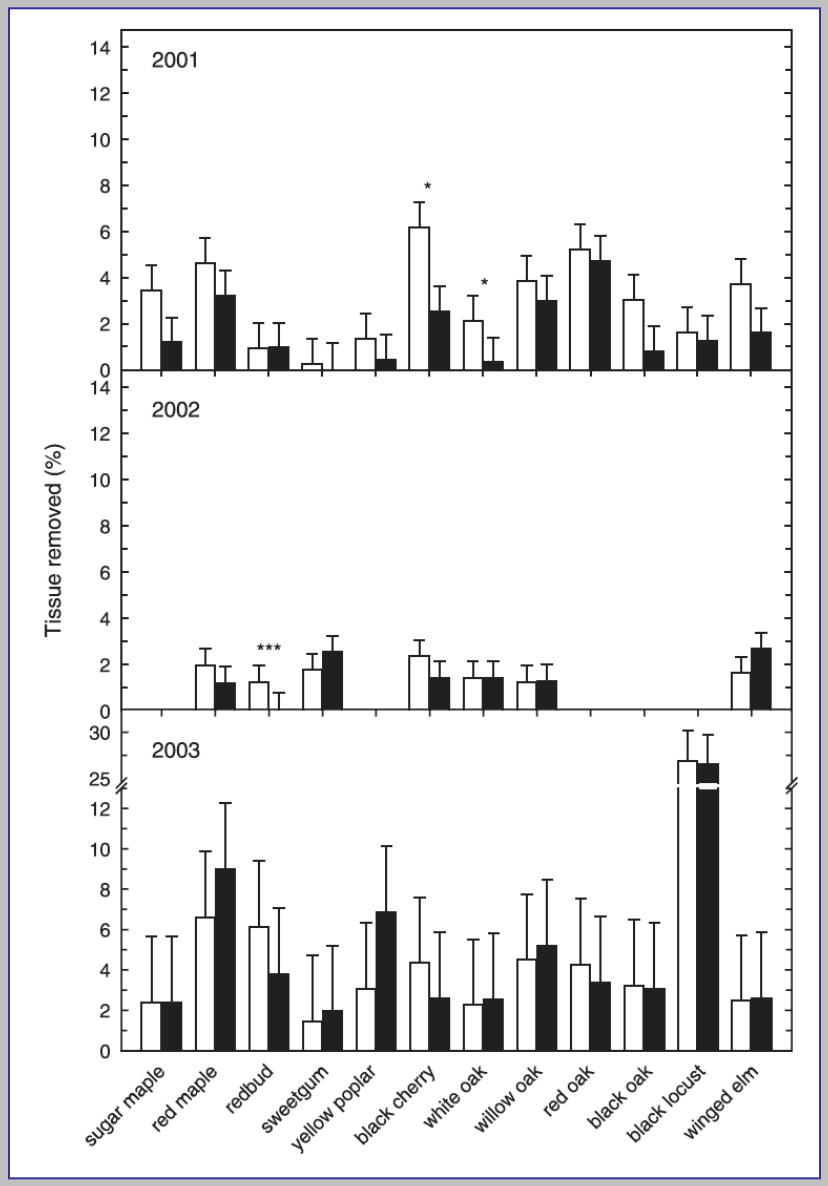


Top left: field experiment where air temperature is the same but leaf temperature is warmer under elevated CO_2.

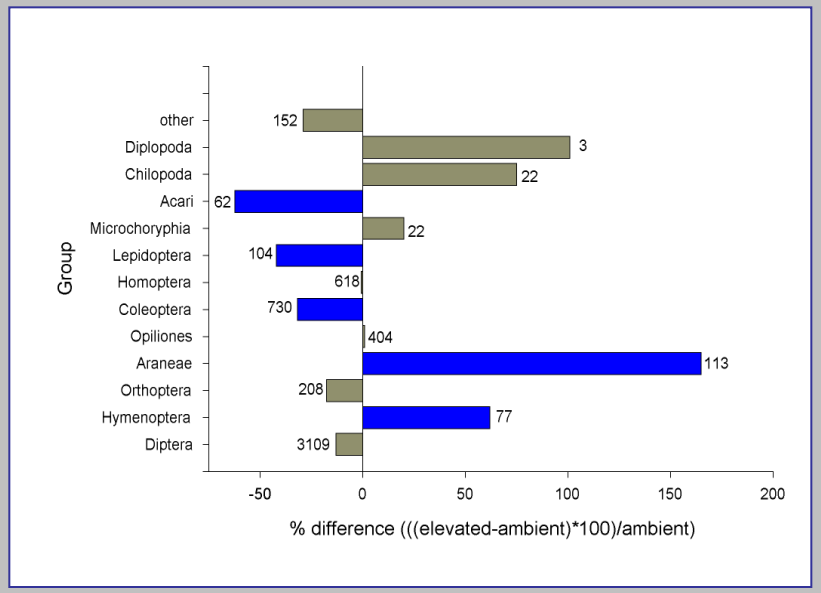
Bottom left: growth chamber experiment where air temperature is adjusted so that leaf temperature is the same across CO_2 treatments.

B. O'Neill et al. 2011 Insect Science

Herbivory in a forest understory exposed to elevated CO_2



Knepp et al. 2005, New Phyt. 167:207



J. Hamilton, unpublished

Acknowledgments

Plant-insect interactions:

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Olivia Niziolek
Jennie Tang
Arthur Zangerl
Jorge Zavala

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Damla Bilgin
Steve Clough
Darin Eastburn
Andrew McElrone

DOE
NASA
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UIUC- CRI