Adams, John

From: Craig Idso Ph.D. [CraigIdso=energy-facts.org@mail21.wdc01.mcdlv.net] on behalf of Craig Idso Ph.D. [CraigIdso@energy-facts.org]
Sent: Wednesday, May 01, 2013 6:09 AM
To: Adams, John
Subject: CO2, the Tomato Yellow Leaf Curl Virus, and Tomato Productivity

May 1, 2013

To: Energy Consumers

From: Craig Idso Ph.D.

Subject: **CO_2, the *Tomato Yellow Leaf Curl Virus*, and Tomato Productivity**

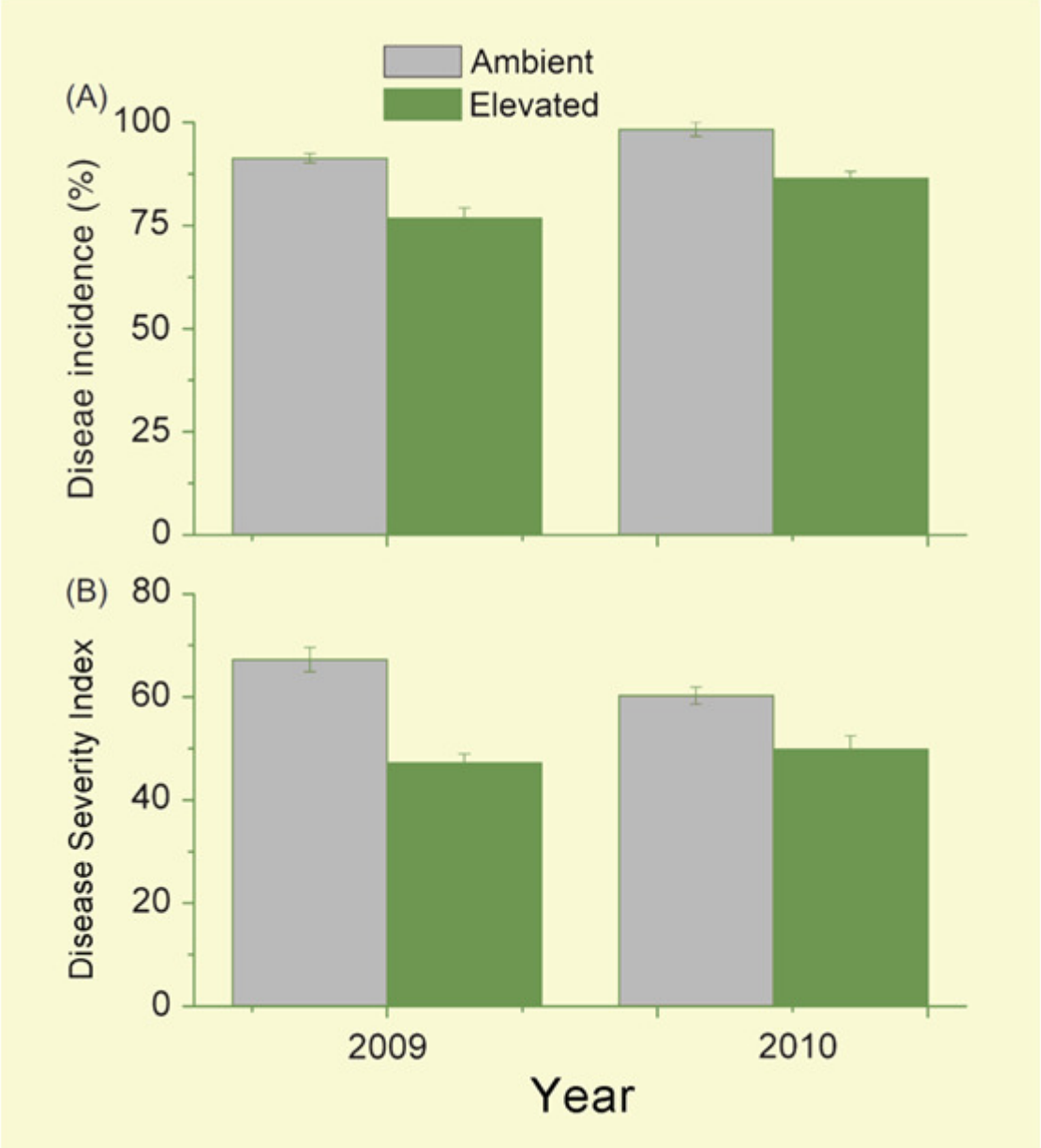
Can enriching the air with more CO_2 compensate for the reduction in tomato productivity caused by a debilitating virus? In a word, *yes*!

Writing as background for their important study documenting this incredible feat, authors Huang *et al*. (2012) state that the *tomato yellow leaf curl virus* (TYLCV) "is one of the most economically damaging plant pathogens in tomato worldwide, with yield losses of up to 100%." The disease frequently "causes severe damage to tomato crops in many tropical and subtropical regions worldwide (Czosnek and Laterrot, 1997; Zhou et al., 2009)," and they say that "in China, TYLCV is the most important viral pathogen of tomato in the major tomato-producing areas," citing Zhu *et al*. (2008).

In an effort to understand how plants infected with TYLCV might respond to rising CO_2 concentrations of the future Huang *et al*. grew tomato plants (*Lycopersicon esculentum*) from seed in pots filled with sterilized loamy field soil that were enclosed within ventilated insect-proof cages placed inside open-top chambers located in Xiaotangshan County, Beijing, China, where half of the cages were infected with TYLCV and the plants in both

sets of cages were allowed to grow for approximately two months in both 2009 and 2010 in ambient (normal) or CO_2-enriched air of either 363 or 758 ppm in 2009 and either 372 or 746 ppm in 2010.

The results of the analysis revealed that "elevated CO_2 decreased TYLCV disease *incidence* (by 14.6% in 2009 and 11.8% in 2010) and decreased disease *severity* (by 20.0% in 2009 and 10.4% in 2010)" (see figure below). In addition, they found that "elevated CO_2 increased tomato plant height by 40.8% and 36.5%, and increased the aboveground biomass by 23.3% and 14.3%, in uninfected plants and TYLCV-infected plants in 2009, respectively," while "elevated CO_2 increased plant height by 36.9% and 26.0% and increased the aboveground biomass by 53.9% and 28.7%, in uninfected plants and TYLCV-infected plants in 2010, respectively."



Tomato yellow leaf curl virus (TYLCV) incidence (A) and severity (B) measured on TYLCV inoculated tomato plants grown under ambient or elevated CO_2 in 2009 and 2010. As compared to ambient (normal) CO_2 concentrations, fewer plants were infected and the severity of the disease was reduced at higher CO_2 concentrations. Adapted from Huang et al. (2012).

In addition to the fact that atmospheric CO_2 enrichment significantly enhances the productivity of *uninfected* tomato plants, Huang *et al*. say their findings imply that the predicted increases in tomato productivity under normal conditions may be *further* enhanced "by reduced susceptibility to plant viruses under projected rising CO_2 conditions,"

adding that their results suggest that "yield losses caused by virus in tomato could be alleviated in the future in elevated CO_2 conditions." That's great news for tomato lovers the world over!

References:

Czosnek, H. and Laterrot, H. 1997. A worldwide survey of tomato yellow leaf curl viruses. *Archives of Virology* **142**: 1391-1406.

Huang, L., Ren, Q., Sun, Y., Ye, L., Cao, H. and Ge, F. 2012. Lower incidence and severity of tomato virus in elevated CO_2 is accompanied by modulated plant induced defense in tomato. *Plant Biology* **14**: 905-913.

Zhou, X.P., Zhang, H. and Gong, H.R. 2009. Molecular characterization and pathogenicity of *Tomato yellow leaf curl virus* in China. *Virus Genes* **39**: 249-255.

Zhu, W.M., Zhang, Y.P., Cui, H.M., Qiu, Y., Sha, K., Wan, Y.H., Zhu, L.Y., Yu, L. and Hui, Z. 2008. Molecular identification and the complete nucleotide sequence of TYLCV isolate from Shanghai, China. *Virus Genes* **36**: 547-551.