

CO₂ ENRICHMENT AND GRAIN YIELDS IN SOYBEANS, WHEAT AND CORN

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ABSTRACT

It is well accepted that C₃ crops have increased growth, biomass, and yield under enriched CO₂ environment. However, only small responses to CO₂ enrichment are observed for C₄ crops. The magnitude of the effect of CO₂ enrichment on crops is not well known yet due to experimental differences among the various CO₂ enrichment studies. So far, only few studies were carried out under field conditions with full season CO₂ exposure. In order to better estimate the impact of future atmospheric CO₂ increases, on grain yields, on C₃ and C₄ crops, field studies were conducted using open-top chambers to mimic atmospheric CO₂ concentrations that are predicted to occur during the first half of the coming century (500 ppm CO₂). The experiments were conducted at USDA Beltsville Agricultural Research Center with soybeans (*Glycine Max*; C₃ crop) during 1989 and 1990, with wheat (*Triticum aestivum*; C₃ crop) during 1991 and 1992; and with corn (*Zea mays*; C₄ crop) during 1991. Crops were grown under CO₂ concentrations of ambient (350 ppm CO₂) or +150 ppm CO₂, during 12 h day⁻¹, from early growth until physiological maturity. The impact of CO₂ enrichment on soybeans grain yield was not significant in either 1989 (~+10%, $p=0.42$) or 1990 (~+8%, $p=0.37$). However, CO₂ enrichment had a significant impact on wheat grain, increasing grain yield by ~12% ($p<0.05$) when combined over years. Corn grain yield was unchanged under CO₂ enrichment. The results indicated that CO₂ enrichment had a physiological beneficial effect in wheat and soybeans (C₃ crops) but not in corn (C₄ crop), however, future changes in atmospheric CO₂ concentrations may be escorted by other factors such as rising temperature, air pollution, and diseases, that are likely to have a negative impact on agricultural production.