

BEYOND GLOBAL WARMING: ELEVATED CARBON DIOXIDE IS HEATING UP ECOSYSTEM DAMAGE BY INVASIVE INSECTS

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ABSTRACT

Elevated levels of atmospheric carbon dioxide (CO₂), a consequence of anthropogenic global climate change, can have profound effects on the interactions between crop plants and insect pests and may promote yet another form of global change—the rapid establishment of invasive species. Elevated CO₂ increased the susceptibility of soybean plants grown under field conditions to the invasive Japanese beetle (*Popillia japonica*) and to a variant of western corn rootworm (*Diabrotica virgifera virgifera*) resistant to crop rotation by down-regulating gene expression related to defense signaling (*lox7*, *lox8*, and *acc-s*). The down-regulation of these genes in turn reduced

the production of cysteine proteinase inhibitors (CystPI), specific deterrents to coleopteran herbivores. Beetle herbivory increased CystPI activity to a greater degree in plants grown under ambient CO₂ than under elevated CO₂. Gut cysteine proteinase activity was higher in beetles consuming foliage of soybeans grown under elevated CO₂ than in beetles consuming soybeans grown in ambient CO₂, consistent with enhanced growth and development of these beetles on plants grown in elevated CO₂. These findings suggest that predicted increases in soybean productivity under projected elevated CO₂ levels may be reduced by increased susceptibility to invasive crop pests.