

Anthropogenic Changes in Tropospheric Composition Increase Susceptibility of Soybean to Insect Herbivory

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ABSTRACT Increased concentrations of CO₂ and ozone are predicted to lower nutritional quality of leaves for insect herbivores, which may increase herbivory as insects eat more to meet their nutritional demands. To test this prediction, we measured levels of herbivory in soybean grown in ambient air and air enriched with CO₂ or O₃ using free air gas concentration enrichment (FACE). Under open-air conditions and exposure to the full insect community, elevated [CO₂] increased the susceptibility of soybeans to herbivory early in the season, whereas exposure to elevated [O₃] seemed to have no effect. In the region of the canopy exposed to high levels of herbivory, the percentage of leaf area removed increased from 5 to >11% at elevated [CO₂]. We found no evidence for compensatory feeding at elevated [CO₂] where leaf nitrogen content and C:N ratio were unaltered in plants experiencing increased herbivory. However, levels of leaf sugars were increased by 31% at elevated [CO₂] and coincided with a significant increase in the density of the invasive species *Popillia japonica* Newman (Japanese beetle). In two-choice feeding trials, Japanese beetles and Mexican bean beetles (*Epilachna varivestis* Mulsant.) preferred foliage grown at elevated [CO₂] to foliage grown at ambient [CO₂]. These data support the hypothesis that the increased level of sugar in leaves grown at elevated [CO₂] may act as a phagostimulant for the Japanese beetle. If these results apply more widely to soybean production, the expectation of agricultural yield increases as a result of increasing elevated [CO₂] may need to be reevaluated.

KEY WORDS elevated CO₂, elevated ozone, Japanese beetle, free air gas concentration enrichment, *Popillia japonica*
