Responses of Agricultural Crops to Free-Air Carbon Dioxide Enrichment. (A03-kimball170754-Oral)

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Abstract:

Over the past decade, free-air CO2 enrichment (FACE) experiments have been conducted on wheat, perennial ryegrass, and rice, which are C3 grasses; sorghum, a C4 grass; white clover, a C3 legume; potato, a C3 forb with tuber storage; and cotton and grape, which are C3 woody perennials. Elevated CO2 increased photosynthesis, biomass, and yield substantially in C3 species, but little in C4. It decreased stomatal conductance in both C3 and C4 species and greatly improved water-use efficiency in all crops. Growth stimulations were as large or larger under water-stress compared to well-watered conditions. At low soil N, stimulations of non-legumes were reduced, whereas elevated CO2 strongly stimulated the growth of the clover legume both at ample and low N conditions. Roots were generally stimulated more than shoots. Woody perennials had larger growth responses. Detection of statistically significant changes in soil organic carbon in any one study was nearly impossible, yet combining results from several sites and years, it appeared that elevated CO2 did increase sequestration of soil carbon. Comparisons of the FACE results with those from earlier chamber-based results were consistent, which gives confidence that conclusions drawn from both types of data are accurate.

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