Carbon Dioxide Rise May Alter Plant Life, Researchers Say

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In the last century, roughly the industrial age, atmospheric carbon dioxide has increased to about 350 parts per million from about 280 parts per million. In the latter half of the next century, many scientists say, it will reach 600 to 700 parts per million if the current rate of increase continues.

Scientists have established that doubled concentrations of the gas would have startling effects on the growth of many types of plants, greatly increasing rates of photosynthesis and agricultural yields. One survey of 700 agronomic studies by Dr. Bruce Kimball at the Phoenix laboratory found that crop yields improved by 34 percent where carbon dioxide was doubled.

Trees and plants usually grow taller, produce more and bigger branches, flowers and fruit, display more and thicker leaves with more chlorophyll and send out more extensive root systems to search out more nutrients in the soil. Scientists have also established that increased carbon dioxide causes small pores on the outside of leaves, called stomata, to close slightly. This reduces the amount of moisture lost from the leaf to the atmosphere, enabling the plants to withstand drought better.

A number of studies have suggested that the carbon dioxide increases of the last few years are stimulating a worldwide surge of plant growth. Some scientists say this is reflected in increased widths of tree rings and in changes in the number of stomata on plant leaves.

But the chief evidence comes from studies by a number of independent researchers in the late 1980's showing that terrestrial vegetation in the Northern Hemisphere is absorbing more and more carbon dioxide in the spring and early summer and releasing more to the atmosphere as plants die in the fall.

"This tells me the biosphere as a whole is being stimulated," said Dr. Idso. "More carbon dioxide is being taken out of the atmosphere and more is being put back in; the biosphere breathes once a year and is breathing deeper."

Although plants emit oxygen as part of photosynthesis, he said, the amount added to the atmosphere because of increased growth would not be enough to have a significant effect on the vast pool of oxygen that animals breathe.

The Caveats

Not All Plants Respond Alike

Not all plants are taking in carbon dioxide at the same rate. The difference shows up most broadly between two main classes of plants, C3 and C4, so named because of differences in the way they absorb carbon dioxide. In the first stage of absorption, C3 plants manufacture a molecule with three carbon atoms, while C4 plants manufacture a four-atom molecule. The C4 molecule is part of a chemical mechanism, or "pump," that enables the plant to assimilate carbon dioxide more efficiently.

Lacking the more efficient mechanism of the C4 plants, the C3's depend on simple diffusion of carbon dioxide through their tissues. Higher concentrations of the gas in the air aid this diffusion, but make less difference to a C4 plant. The result is that C3's benefit more than C4's from the higher concentrations.

of the Smithsonian Environmental Research Center at Edgewater, Md., have studied the effects of increased carbon dioxide on naturally growing C3 and C4 marsh grasses for the last four years. Surrounded by special chambers that allow the plants to be saturated with carbon dioxide, the C3 grasses showed increases in photosynthetic rates and mass of 60 to 80 percent. The C4 grasses showed no increase. Both species demonstrated greater efficiency in water use. Other species of C4 plants show some increase in growth amid increased carbon dioxide, but generally the C3's outperform them. Among C3's are many important field crops, including wheat, rice and soybeans, although a few field crops, like sugar cane and corn, are C4's. Virtually all trees and most broadleaf plants are C3's, while grasses may be either.

Some scientists say that with increased carbon dioxide, C4 crops will find it more difficult to compete with C3 weeds and vice versa.

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