

Carbon Dioxide Rise May Alter Plant Life, Researchers Say

By WILLIAM K. STEVENS
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EVEN if rising concentrations of carbon dioxide in the atmosphere do not cause the earth's climate to warm, they will probably work dramatic changes in natural and agricultural ecosystems, plant physiologists and ecologists say.

In a research effort that has been accelerating over the last five years, scientists are uncovering intricate patterns of plant responses to higher levels of carbon dioxide. But they are a considerable distance from understanding the full range of responses or achieving a consensus on how the positive and negative effects add up on balance.

Carbon dioxide is accumulating in the atmosphere so rapidly, largely because of the burning of fossil fuels, that the global concentration will double by the end of the next century if the present rate of buildup continues, experts say. While scientists are still uncertain about the ultimate impact of the gas's heat-trapping properties on global climate, some believe that they can already detect the early stage of a worldwide explosion of vegetation stimulated by carbon dioxide, and their latest experiments suggest that astonishing developments may lie ahead.

In a controlled experiment at a Federal laboratory in Phoenix, for instance, orange trees raised from seedlings have been exposed to nearly doubled levels of carbon dioxide for the last three years. The combined volume of their trunks and branches is almost triple that of orange trees grown in normal air.

For some experts, this eye-opening growth portends major improvements in agricultural productivity, promises a lusher and more robust natural world, and suggests that burgeoning trees and other vegetation might remove enough carbon dioxide from the air to stabilize atmospheric concentrations, although at higher levels than now.

Scientists have found that plants growing amid higher carbon dioxide levels also are hardier in some respects. They use water more efficiently and because of their greater mass, they can better resist stress in general.

"I'm really sold on carbon dioxide; I think it's very beneficial," said Dr. Sherwood B. Idso of the Agriculture Department's water conservation laboratory in Phoenix, where the orange-tree experiment is under way.

But other scientists, urging caution, are not so sure, and some say it is possible that greater carbon dioxide levels may be harmful on balance. They say the growth can be limited or even canceled out by a number of offsetting factors, particularly shortages of soil nutrients. They also say a growing body of research leaves no doubt that the growth spurt induced by carbon dioxide affects some plant species much more than others, and some very little if at all. Some trees, grasses and other plants will flourish at the expense of others, they say, disrupting the ecological makeup of croplands, forests, marshes and grasslands with consequences that will reverberate through entire ecosystems.

And because the nitrogen content of unfertilized plants is diluted as carbon dioxide stimulates their growth, they say, many will be less nutritious. Experiments suggest that some insects that eat such plants do not develop properly and display higher mortality rates even if they eat much more plant material to compensate for the lower quality. This, scientists fear, could reduce insect populations and affect entire food chains.

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Scientists are also turning up evidence that increased carbon dioxide may alter the timing of plants' flowering, disrupting the interaction between some plants and their pollinators to the detriment of both.

"The consequences are unbelievably complicated and there are so many of them," says Dr. Fakhri A. Bazzaz, a plant ecologist at Harvard University who is in the forefront of research on the question. Experimental work suggests there is "no reason to be sanguine" about the responses of both natural and human-made ecosystems to higher levels of carbon dioxide, he said.

The Dynamics

Carbon Dioxide And Plant Growth

Carbon dioxide is the primary raw material used by plants in manufacturing carbohydrates from which they build their tissues and enzymes. Using energy acquired from visible light in photosynthesis, plants "fix" or capture carbon dioxide molecules from the air.

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