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Scientists Examine the Impact of Increased Carbon Dioxide on Plants

by Stacy Kish, CSREES

Carbon dioxide is a green house gas that is believed to raise global temperatures. In the past 200 years, carbon dioxide has increased by 35 percent. Scientists are working with natural resource managers to better understand how plants respond to changes in atmospheric carbon dioxide to maximize plant productivity. >>

With funding from USDA's Cooperative State Research, Education, and Extension Service (CSREES) National Research Initiative (NRI), scientists in Texas examined how carbon dioxide affects water retention in tallgrass prairies.

As temperatures increases, water evaporates more rapidly. In plants, water is lost through the stomata, the small pores on the underside of leaves that allow the plant to breathe. Transpiration is the evaporation of water

from the plant. Evapotranspiration is the water lost through both transpiration and the evaporation of water from surrounding soil.

As temperatures and atmospheric carbon dioxide increase, many scientists are concerned how these changes will affect plants. Scientists have known for some time that increased concentrations of carbon dioxide causes the stomata to close, resulting in lower transpiration rates and increased water efficiency in plants.

continued next page >>



Right: Elongated chambers at Temple, TX, for manipulating carbon dioxide concentration.

Credit: Scott Bauer

>> continued from previous page



Above: Tallgrass prairie vegetation exposed to different carbon dioxide concentrations.

Credit: Katherine Jones, Agricultural Research Service, Temple, TX.

References

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Information on how carbon dioxide affects transpiration at the level of plants in the field is more limited.

Wayne Polley and colleagues at the Grassland, Soil, and Water Research Laboratory in Temple, TX, used chambers to manipulate carbon dioxide in the field and measure the transpiration from tallgrass prairie plants.

Grazing lands occupy about 40 percent of the land area in the United States. In addition to being an important source of food and fiber, prairie grasses may be a valuable addition to the emerging biofuels industry. By conserving scarce supplies of water, carbon dioxide enrichment may increase the benefits society derives from grazing lands.

The researchers found that atmospheric carbon dioxide enrichment slowed plant water use and increased water retention in soils. The amount of water savings, however, is most pronounced at low temperatures.

The water saving effects of carbon dioxide variability changes with the seasons. The savings are greatest during cooler months and lower during warmer months. In addition, leaf area plays a significant role in water retention. This benefit of greater carbon dioxide may be exploited by planting crops or crop cultivars that thrive during relatively cool parts of the growing season.

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