

# Higher carbon dioxide levels used on crops, examined

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Higher carbon dioxide levels in the atmosphere prompted better water use efficiency in soybean and sorghum plants, regardless of whether the crops were grown with no-till or conventional tillage, according to new ARS research. Photo courtesy of the Natural Resources Conservation Service, USDA

Crops responded positively to future levels of atmospheric carbon dioxide ( $\text{CO}_2$ ), but soil tillage practices had little effect on this response, according to a U.S. Department of Agriculture (USDA) study.

The first long-term study comparing tillage practices under high  $\text{CO}_2$  levels showed that elevated  $\text{CO}_2$  caused soybean and sorghum plants to increase photosynthesis while reducing transpiration-the amount of water

the plants release. This resulted in increased water use efficiency, whether the [crops](#) were grown with no-till or conventional tillage, according to researchers with USDA's Agricultural Research Service (ARS). ARS is USDA's principal intramural scientific research agency. This study supports the USDA priority of responding to [climate change](#).

Plant physiologist Steve Prior, plant pathologist Brett Runion, and their colleagues at the ARS National Soil Dynamics Laboratory in Auburn, Ala., found that water use efficiency response to high CO<sub>2</sub> was much greater for soybeans than for sorghum over the 6-year study.

The outdoor study was done using open-top growth chambers for exposing the crops to the higher levels of CO<sub>2</sub>. The crops were monitored for photosynthesis and transpiration during their reproductive growth stages, when water demand is highest.

The scientists compared soybean/sorghum rotations with both conventional tillage and no-till. With no-till there is no plowing, only minimal disturbance of the soil while planting seeds. The scientists also compared current ambient CO<sub>2</sub> levels—about 370 parts per million (ppm)—with levels of 720 ppm expected within this century.

With the higher level of CO<sub>2</sub>, regardless of tillage method, soybean photosynthesis increased by about 50 percent, while sorghum photosynthesis rose by only 15 percent. This was expected because crops like soybean, which have a C<sub>3</sub> photosynthetic pathway, are known to respond better to high CO<sub>2</sub> levels than crops like sorghum and corn that have a C<sub>4</sub> photosynthetic pathway. Most plants worldwide are C<sub>3</sub> plants.

Sorghum's increased water use efficiency was mainly due to less water transpired or lost through the leaf pores (stomata).

Although no-till didn't make a difference as far as crops responding to

high CO<sub>2</sub>, it can greatly reduce soil erosion, conserve [soil water](#), and increase carbon storage, among its many benefits.

The results of this research were published earlier this year in the [Journal of Environmental Quality](#).

Provided by USDA Agricultural Research Service

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