

Potatoes Show Promise for Meeting Climate Change Challenges

New research shows that potatoes—often cultivated as a rainfed crop with little or no irrigation—are still the go-to tuber when times get tough.

Agricultural Research Service agricultural engineer David Fleisher and colleagues wanted to measure how potato plants would respond to elevated atmospheric carbon dioxide (CO₂) levels and the increasingly erratic rainfall patterns expected to result from global climate change. So the team conducted two outdoor-chamber studies to evaluate effects of short-term drought cycles at current and elevated CO₂ levels. Fleisher and his research partners—plant physiologist Richard Sicher, soil scientist Dennis

Timlin, research leader V.R. Reddy, and research associate Jinyoung Barnaby—all work at the ARS Crop Systems and Global Change Laboratory in Beltsville, Maryland.

The studies were conducted using soil-plant-atmosphere research chambers that provided precise control over CO₂ levels, air temperature, irrigation, and humidity. The chambers contained sensors that monitored air, soil, and canopy temperatures; relative humidity; and sunlight above and below the canopy.

In both studies, 11-day drought cycles were applied before tuber formation began and around 10 days after tuber formation began. The first study ran from May 28 to August 10, and the second study ran from August 11 to October 20. Having two different study periods allowed the scientists to evaluate how variations in sunlight during the drought periods affected plant response.

The researchers observed significant differences in plant response, which they attributed to the variation in sunlight. With all other growth factors being equal, the plants in the first study—when there was more sunlight—had a 30- to 200-percent increase in total potato production, depending on CO₂ levels and water availability.

Agricultural engineer David Fleisher studies water-stressed potato plants in a soil-plant-atmosphere research chamber that controls carbon dioxide and irrigation levels. Results from the study reveal how climate change affects potato plant growth.

The team also noted that the cyclic droughts resulted in lower levels of dry-matter and leaf-area production. They concluded that drought stress before tuber formation probably enhanced the future delivery of carbon, water, and plant nutrients to the tubers instead of to the stems or leaves—and that this response increased under elevated CO₂ levels. Averaged across all drought treatments, tuber yield from plants growing under elevated CO₂ levels was as much as 60 percent greater than that from plants growing under current CO₂ levels.

“We found that, except for the most severe droughts, tuber yields under elevated CO₂ levels exceed tuber yields under current CO₂ levels,” Fleisher says. “This could be in part because plant water-use efficiency can increase under elevated CO₂ levels.”

Fleisher emphasizes that this investigation was a chamber study and not a field study. But the results suggest that growers could adapt to changing atmospheric CO₂ levels by ensuring that potato plants are adequately irrigated during crucial pre-tuber development stages. He also thinks data from the study could be used to test crop models and other tools used to assess drought management strategies under elevated CO₂ conditions.

Results from this study were published in 2013 in *Agricultural and Forest Meteorology*.—By **Ann Perry**, ARS.

This research is part of Climate Change, Soils, and Emissions, an ARS national program (#212) described at www.nps.ars.usda.gov.

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