

Greenhouse 'time machine' sheds light on corn domestication

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Smithsonian archaeologist, Dolores Piperno, measures a teosinte plant growing under past climate conditions. Credit: STRI photographer Sean Mattson

A grass called teosinte is thought to be the ancestor of corn, but it doesn't look much like corn at all. Smithsonian scientists were surprised to find that teosinte planted in growth chambers under climate conditions that simulate the environment 10-12,000 years ago looks more like corn. This may help to explain why early farmers chose to cultivate teosinte and

lends support to the idea that teosinte was domesticated to become one of the most important staple crops in the world.

By simulating the environment when [corn](#) was first exploited by people and then domesticated, Smithsonian scientists discovered that corn's ancestor; a wild grass called teosinte, may have looked more like corn than it does today. The fact that it looked more like corn under past conditions may help to explain how teosinte came to be selected by early farmers who turned it into one of the most important staple crops in the world.

The vegetative and flowering structures of modern teosinte are very different from those of corn. These and other differences led to a century-long dispute as to whether teosinte could really be the ancestor of corn.

But new findings reported in the journal *Quaternary International* show that teosinte may have looked very different in the past. "We grew teosinte in the conditions that it encountered 10,000 years ago during the early Holocene period: temperatures 2–3 degrees Celsius cooler than today's with atmospheric [carbon dioxide](#) levels at around 260 parts per million," said Dolores Piperno, senior scientist and curator of archaeobotany and South American archaeology at the Smithsonian's National Museum of Natural History and the Smithsonian Tropical Research Institute, who led the project. "Intriguingly, the teosinte plants grown under past conditions exhibit characteristics more like corn; a single main stem topped by a single tassel, a few, very short branches tipped by female ears and synchronous seed maturation.

After the Industrial Revolution, carbon dioxide rose to today's 405 parts per million, the level in the control chamber where teosinte plants look like plants in the wild today—tall, with many long branches tipped by tassels and seed maturation taking place over a period of a few months.

Co-author Klaus Winter usually studies the effects of rising [atmospheric carbon dioxide](#) levels on tropical plants as a senior staff scientist at STRI. Piperno and Winter devised a scheme to essentially travel back in time by comparing plants grown in modern conditions with plants grown in the early Holocene chamber.



Corn's wild ancestor, teosinte, is shown growing under modern (chamber on the left) and under past (chamber on the right) climate conditions. Smithsonian scientists Dolores Piperno (right) and Irene Holst (left) with Klaus Winter and Owen McMillan (not shown) wondered if teosinte might show phenotypic plasticity -- change its growth form -- when exposed to different environmental conditions. Credit: STRI photographer, Sean Mattson

"Now it appears to be an open question when in the Holocene teosinte became the plant very distinctive from maize in vegetative architecture and inflorescence sexuality that we see today and use as the baseline for

research on maize domestication," said Piperno. "When humans first began to cultivate [teosinte](#) about 10,000 years ago, it was probably more maize-like—naturally exhibiting some characteristics previously thought to result from human selection and domestication. The environment may have played a significant, if serendipitous, role in the transition through inducing phenotypic plasticity that gave early farmers a head start."

Phenotypic plasticity is an organism's ability to change in response to the environment, causing genetically identical organisms to look very different when they live in different conditions. As they formulate a "new modern evolutionary synthesis," in part with concepts that Darwin could not have known of, evolutionary biologists continue to debate the importance of the environment and plasticity on evolutionary change and the origins of the diverse forms of life on Earth today. However, new evidence shows that these environmental–phenotypic interactions are in a growing number of organisms. This is one of the first studies to examine the influence of these processes on plant domestication.

"Extending these concepts to domestication research allows anthropologists to become more fully engaged in modern evolutionary theory and practice," Piperno said.

More information: Piperno, D.R., et al., Teosinte before domestication: Experimental study of growth and phenotypic variability in Late Pleistocene and early Holocene environments. *Quaternary International* (2014). www.sciencedirect.com/science/.../S104061821300983X

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