23-million-year-old leaves hint trees might 'breathe' easier in high-carbon air

20 August 2020

Forests may be able to breathe easier as carbon dioxide levels rise – though this benefit may be overshadowed by the droughts, intensifying storms and flooding they'll face.

New research has uncovered 23-million-year-old leaves from trees alive when atmospheric carbon dioxide was higher than levels today. These mummified leaves suggests trees may 'breathe in' the carbon dioxide they need more quickly, without losing as much water, as the climate-heating gas becomes more abundant.

Speedier breathing may help trees thrive, though research has produced a mixed picture of whether increased carbon dioxide will lead to greater forest growth. The researchers also warned that today's trees don't have anywhere near as long to adapt, compared to the trees they studied.

The leaves studied in the research, published in the journal Climate of the Past, were found in the Foulden Maar crater in Otago. The site became famous last year when the local community uncovered company Plaman Resources' intention to mine the maar material as a food additive for pigs, chickens and turkeys. University of Otago researchers, including geology researcher Daphne Lee, joined the public fight to preserve the area and the mining plan was abandoned.
Due to a unique combination of circumstances millions of years ago, the newly discovered leaves were "pickled", leaving them nearly perfectly preserved for the study, Lee said.

The team, including lead author Tammo Reichgelt of the University of Connecticut, chemically analysed the preserved material and determined that the earth's atmospheric carbon dioxide was between 450 and 550 parts per million when the leaves fell into the maar.

"[This] is about 20 to 30 per cent higher than today and similar to levels projected in about two decades' time," Reichgelt said.

The structure of the ancient leaves also provided clues about the fate of today's forests as the planet warms.

Trees breathe in carbon dioxide and use it to grow leaves, wood and roots. Lacking lungs, the plants open small pores in their leaves to let the gas in. However, trees lose water for as long as these pores are ajar.

The ancient leaves found at the maar were treated, stained and examined. Based on the number, size and distribution of the breathing pores, the team determined the trees' ability to conserve water.

"Surprisingly, trees that grew around Foulden Maar 23 million years ago in higher carbon dioxide conditions appear to be better or as good at conserving water as a modern-day tree in much more water-stressed environments," Reichgelt said. "If there is more carbon dioxide in the atmosphere, a plant can obtain the same amount of carbon dioxide without wasting as much water, as its pores do not have to be open as long. What this means is that plants can effectively become more drought-tolerant."

This suggests the additional carbon dioxide in the air, while also driving climate change, could boost forest growth and cause a “global greening”, Reichgelt said.

However, the trees preserved in Foulden Maar had much longer to adapt to their warmer climate compared to today’s species, Lee said.

“What we’re doing is a very dangerous experiment... an experiment on a 10-year timescale instead of a million-year timescale.”

University of Auckland biologist Cate Macinnis-Ng said the benefit of increased carbon dioxide on plant productivity would be offset by the other negative impacts of climate change.

“We know there’s increasing extreme events, so that’s things like heat waves, droughts, fire weather and storms. All of these can have big impacts on all kinds of different ecosystems… These extreme events can wipe out any gains,” she said. “We’re seeing this global pattern of increasing mortality due to drought. We’re also seeing drought and other climate stressors can make plants more vulnerable to other things like bark beetle, kauri dieback and other pathogens.”

Some species, particularly those adapted for dry conditions, are able to more quickly respond to higher levels of carbon dioxide, Macinnis-Ng said. “Some plants are super able to change quite quickly, whereas for others it’s an evolutionary process.”

Foulden Maar was formed when magma rising from the centre of the earth met a body of water, Lee said. This resulted in a violent eruption, forming a rimmed crater. The crater, which was an estimated 250 metres deep, quickly filled with rainwater and a forest regrew around it.

“We’ve got flowers and insects that on a windy day just blew off the trees and into the lake,” she said. “The lake was small but very deep. Probably the bottom half of it at least was completely oxygen free, so anything that fell down into the lake and drifted down to the bottom is basically pickled. It’s just sat there for 23 million years until we went and dug it up. It’s very rare to have such brilliant preservation.”

The University of Otago team drilled 180m-deep cores through the crater. These cores showed very fine layers about half a millimetre thick, with lines that each represent a year “very like tree rings forming in the bottom of a lake”, Lee said.

All up, the excavated layers represent 100,000 years following the eruption. Eventually, the lake was completely covered over and the process ceased. “These maar lakes fill in and become peat swamps on top,” Lee added.

The research results demonstrate the scientific importance of Foulden Maar, she said.

“It’s the only one of its kind in the Southern Hemisphere for this time period,” she added. “I would like to have it in public ownership.”

Source: https://www.stuff.co.nz/environment/climate-news/122495433/23millionyearold-leaves-hint-trees-might-breathe-easier-in-highcarbon-air