

Elevated CO₂ levels cause mineral deficiency in plants resulting in less nutritious crops

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For years, scientists have seen enhanced photosynthesis as one of the only possible bright sides of increasing levels of atmospheric carbon dioxide (CO₂)—since plants use carbon dioxide for photosynthesis, it is

anticipated that higher levels of the gas will lead to more productive plants.

In a review published in *Trends in Plant Science* on November 3, scientists from Institute for Plant Science of Montpellier in France explain why this effect may be less than expected because elevated levels of CO₂ make it difficult for [plants](#) to obtain minerals necessary to grow and provide [nutritious food](#).

"There are many reports in the literature showing that the CO₂ levels expected at the end of the twenty-first century will lead to a lower concentration of nitrogen in most plants, mainly affecting the [protein content](#) in plant products," says first author Alain Gojon, research director of France's National Research Institute for Agriculture, Food and the Environment.

"It is very important to understand why growing plants at elevated CO₂ has such a [negative effect](#) on the protein content of most staple crops and the future of food."

Plants use photosynthesis to incorporate CO₂ into sugars that they derive their energy from. However, photosynthesis does not provide plants with the key minerals they need to grow. For most plants, these minerals, such as nitrogen, phosphorus, and iron, are picked up from the soil through their root systems. Nitrogen is particularly important as it is a key building block for the [amino acids](#) that plants use to make proteins.

A nitrogen deficiency not only means that a plant will have difficulty building its tissues, but also that it will provide less nutrition to humans. "What is clear is that the nutrient composition of the main crops used worldwide, such as rice and wheat, is negatively impacted by the elevation of CO₂. This will have a strong impact on [food quality](#) and global food security," says corresponding author Antoine Martin,

researcher of the French National Center for Scientific Research.

"Two main nutrients that are essential for human nutrition may be affected by this phenomenon," adds Gojon. "The first one is proteins built from nitrogen. In developing countries this can be a big issue, because many diets in these countries aren't rich in proteins and plants grown at elevated CO₂ can have 20 to 30% less protein. The second one is iron. Iron deficiency already affects an estimated 2 billion people worldwide."

Beyond global food systems, lowered mineral status of plants at increased atmospheric CO₂ levels may lead to a [negative feedback loop](#) for mitigating climate change. "The terrestrial carbon sink associated with enhanced photosynthesis may be limited if most of the vegetation is deficient in nitrogen and other minerals, which may prevent any additional increase of CO₂ capture from the atmosphere," says Gojon.

"We would like to really understand the mechanisms that are responsible for the negative effects of elevated CO₂ on the mineral composition of plants," says Martin. "For example, we are currently exploring the natural genetic variation behind these negative effects, that could be used afterwards to improve crops nutritional value under future CO₂ atmosphere."

More information: The decline of plant mineral nutrition under rising CO₂: physiological and molecular aspects of a bad deal, *Trends in Plant Science* (2022). [www.cell.com/trends/plant-sci ... 1360-1385\(22\)00247-3](http://www.cell.com/trends/plant-sci/1360-1385(22)00247-3)

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