Researchers discover how to control zinc in plants: Could help the world's malnourished

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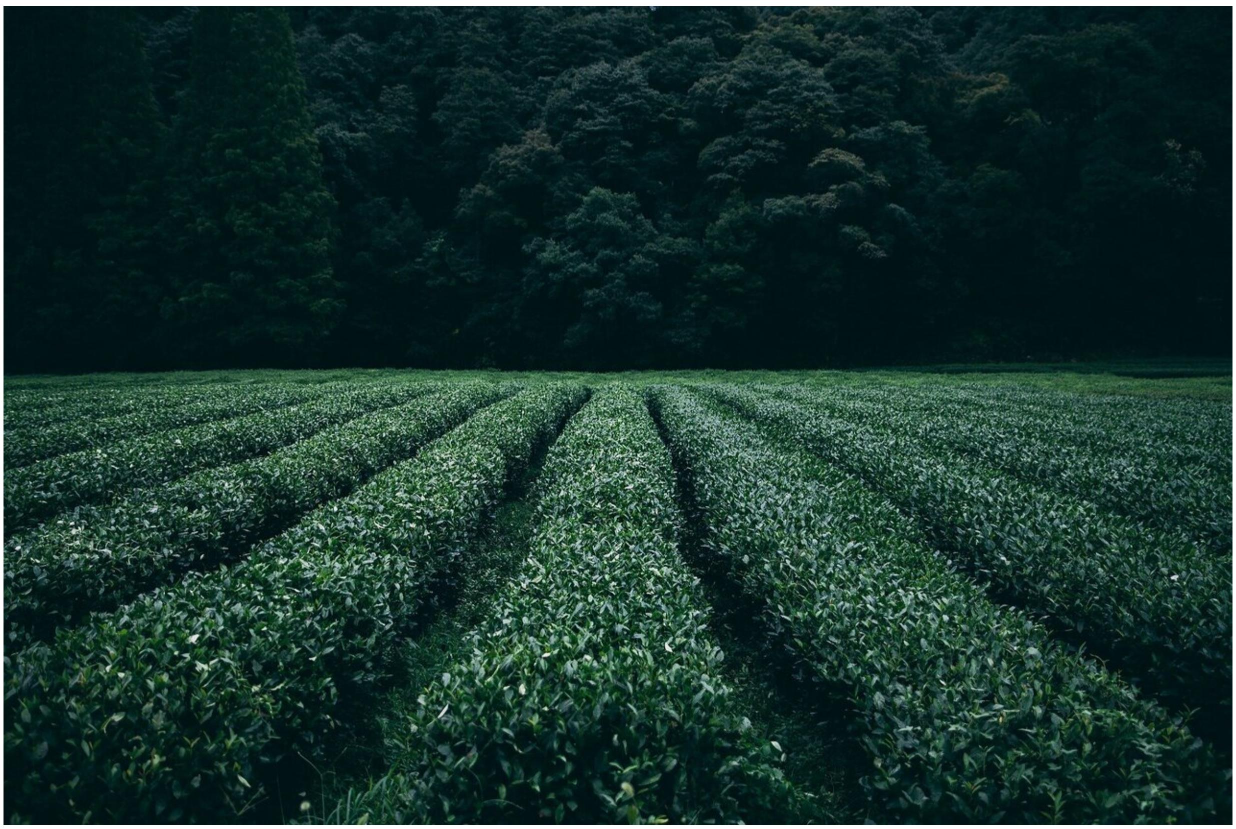

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Over 2 billion people worldwide are malnourished due to zinc deficiency. Led by the University of Copenhagen, an international team of researchers has discovered how plants sense zinc and use this knowledge to enhance plant zinc uptake, leading to an increase in seed zinc content by 50 percent. The new knowledge might one day be applied towards the cultivation of more nutritious crops.

A deficiency of zinc and other essential dietary nutrients is one of the greatest causes of malnutrition worldwide. More than two billion people are estimated to suffer from zinc deficiency, a problem that can lead to impaired immune systems, mental disorders and stunting. Among other things, malnutrition can be caused by infertile agricultural land, which affects the nutritional content of staple crops such as rice, wheat and maize.

But imagine that it was possible to flip a switch in crops, at the seed stage, that prompted them to turbocharge their intake of zinc, iron or other nutrients, and cause them to absorb more nutrients than they would otherwise. Researchers at the University of Copenhagen's Department of Plant and Environmental Sciences have done just that using the thale cress plant (Arabidopsis thaliana).

"For the first time ever, we have demonstrated that, by using a molecular 'switch' in the plant, we can cause the plant to absorb more zinc than it would otherwise, without apparent negative impact on the plant," states the study's lead author, Associate Professor Ana Assunção of the University of Copenhagen's Department of Plant and Environmental Sciences.

Plants absorbed 50 percent more zinc

Zinc benefits humans by helping to maintain a wide array of chemical processes and proteins running within our bodies. Should these processes cease to function properly, we become prone to illness. For plants, the absence of zinc primarily impacts growth, which is adversely affected in the absence of zinc.

Researchers have long attempted to understand how plants increase and decrease their zinc uptake. Ana Assunção and her colleagues have become the first to identify two specific proteins from thale cress that act as zinc sensors and determine the plant's ability to absorb and transport zinc throughout plant tissue.

By changing the properties of these sensors, or molecular "switch", that control a tightly connected network of zinc transporters, the researchers succeeded in getting them to absorb more zinc.

"Simply put, by making a small change in the sensor, we've led the plant to believe that it was in a permanent state of zinc deficiency. This kept the plant's zinc uptake machinery swiched-on and resulted in an increase of zinc content in the seeds by as much as 50 percent compared to a normal plant," explains Grmay Lilay, the study's first author, Postdoc at Assunção's Lab .

Up next: rice and beans

The researchers have demonstrated that it is possible to increase zinc-absorption in their experimental plant, but the next step is to reproduce the results in real crops. And the researchers are already well on the way to doing so.

"We're currently working to recreate our results in bean, rice and also tomato plants. Should we succeed, we'll realize some interesting opportunities to develop more nutritious and biofortified crops. Biofortification is a sustainable solution to improve micronutrient content in human diet," says Associate Professor Assuncao.

In the long term, the researchers' results could be applied by using CRISPR gene editing or by selecting naturally occurring crop varieties with a particularly good ability to absorb nutrients like zinc. "The availability of enormous genomic resources will assist our efforts in finding crop varieties that are likely to display higher zinc accumulation, " concludes Grmay Lilay.

More information: Grmay H. Lilay et al, Arabidopsis bZIP19 and bZIP23 act as zinc sensors to control plant zinc status, *Nature Plants* (2021). DOI: 10.1038/s41477-021-00856-7

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