How could climate change alter our diets?

December 1 2022

Credit: OLEH SLEPCHENKO/Shutterstock.com

As climate change alters rainfall and temperatures, and provokes heat waves and droughts, the quality and quantity of crops suffer. Such changes to yields could significantly jeopardize food security for the

world's growing population.

One response is to change which crops are grown where; another is to create more resilient crops. But how far can we push this and with what implications for the human diet?

How bad is the current situation?

There is evidence that some of the great strides to increased crop yields over the last decades are slowing down. "Wheat yields used to increase by an average of 1–1.5 % annually," says Bucher. "This seems to have plateaued, with wheat breeding lines projected to lose almost 4 % of yield for every 1 °C temperature increase."

Climate change increases climate variability, leaving breeders uncertain whether to prioritize tolerance to drought, flooding or disease.

Bucher has investigated ways to build climate resilience into staple crops like rice and wheat, based on how plant genomes rearrange themselves in response to climate-related stressors.

In a study published in *Nature Communications*, Bucher's team tested the new crop breeding method on wheat, rice and soybean, in simulated conditions of extreme heat and drought. "We got good results for rice and wheat, but soybean remained stubborn. It might work on a wider range of soybean varieties or with different treatments," says Bucher.

But even if these breeding methods prove effective, is there a point where the trade-offs required, for example to taste, make it undesirable?

In classical crop breeding, targeting desired traits reduces overall breeding efficiency. If an elite crop variety is bred with an old variety, to

introduce disease resistance for instance, almost all of the elite variety's accumulated gains are lost. Recovery would require years of repeatedly cross-breeding the offspring with elite material.

Consequently, using pre-existing genetic diversity from gene banks is slow and tedious. "Traditional crop breeding is hit and miss. Novel breeding methods, such as ours, accelerate the process, getting a desirable trait from an old variety directly into a new one, without crossing both," explains Bucher.

Gene editing is now also increasingly offering breeders another alternative.

What are the implications for our diets?

With so many variables at play, it is difficult to know where limits to crop adaptation might lie.

"There are undoubtedly limits that ultimately can't be exceeded, but we have to push those as much as possible," adds Bucher. The good news is that necessity really might prove the mother of invention.

"Novel crop breeding techniques could actually increase the diversity of cultivated plants. For the first time, we could, for example, domesticate Akkoub, an edible thistle-like plant or distant relatives of rice and tomatoes. Giving us a richer diet and greater agricultural biodiversity," remarks Bucher.

This could also prove beneficial to European food security, especially for plant-based proteins, as currently Europe imports over 30 million tons of soybeans, primarily as livestock feed.

"This isn't sustainable. I'm surprised by the lack of European investment

in innovative crop breeding methods. We need to rapidly adapt crops to Europe's different climatic regions," notes Bucher.

Beyond agriscience

The recent war in Ukraine has both reduced the availability of wheat and resulted in hiked energy prices, in turn impacting other food production. In Europe, this is felt most acutely with vegetables and fruit, crucial for healthy diets but reliant on significant amounts of energy.

"Tomato prices have exploded by 32–67% driven largely by increased greenhouse heating costs. In response, we could breed cold-tolerant tomatoes. Novel crop breeding methods have enormous potential that we should be tapping to increase European food security," adds Bucher.

But bearing in mind agriculture's significant greenhouse gas emissions, perhaps it is also relevant to ask the inverse question: How might our diets alter climate change?

"Simply consuming less meat would have a significant impact. Fortunately, younger generations seem to be doing this. The answer needs to be multipronged," concludes Bucher.

More information: Tianyi Zhang et al, Climate change may outpace current wheat breeding yield improvements in North America, *Nature Communications* (2022). DOI: 10.1038/s41467-022-33265-1

Provided by CORDIS