Designing a more productive corn able to cope with future climates

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An international research team has found they can increase corn productivity by targeting the enzyme in charge of capturing CO2 from the atmosphere.

Maize, or corn, is a staple food for billions of people around the world, with more maize grown annually than rice or wheat. In Australia, maize has the widest geographical spread of all the field crops, but it remains a small crop compared to wheat or rice. However, it is a crop that has all the key elements to become the food and fuel crop of the future.

"We developed a transgenic maize designed to produce more Rubisco, the main enzyme involved in photosynthesis, and the result is a plant with improved photosynthesis and hence, growth. This could potentially increase tolerance to extreme growth conditions," said lead researcher Dr. Robert Sharwood from the ARC Centre of Excellence for Translational Photosynthesis, led by The Australian National University (ANU).

"There is an urgent need to deliver new higher-yielding and highly adapted crop species, before crops are affected by the expected climate change conditions. These conditions will increase the threats against global food security, and the only way to prepare for them is through international research collaborations."

Every plant on the planet uses photosynthesis to capture carbon dioxide from the atmosphere, but not all plants do it in the same way. Plants like wheat and rice use the ancient, less efficient C3 photosynthetic path, while other plants such as maize and sorghum use the more efficient C4 path.

C4 plants include some of the world's most important food, feed and biofuel crops, accounting for 20-25 percent of the planet's terrestrial productivity. These plants are specially adapted to thrive in hot and dry environments, like the ones that are expected to be more prevalent in future decades.

Central to this process is Rubisco, the main enzyme of photosynthesis, which is in charge of converting CO_2 into organic compounds. In C4 plants, Rubisco works much faster and they are more tolerant to heat and drought through better water use efficiency.

"Maize has one of the most efficient Rubiscos and they need less nitrogen to work. So, our main question was, if we increase Rubisco content in maize, what would it do for the plant? We found that by boosting Rubisco inside the maize cells, we get an increase in crop productivity," said co-researcher David Stern, from the Boyce Thompson Institute an affiliate of Cornell University.

This is a very exciting finding, because it shows that there is room for improvement even in the more productive C4 crop species.

"In our study we improved CO_2 assimilation and crop biomass by 15%, but now we know that we can also increase the pool of active Rubisco and these numbers will increase even higher," said Dr. Sharwood.

"Our next step is to do field trials to see how our maize behaves in real field conditions. We have tested them in glasshouse and cabinet conditions, but now we need to go into the next phase," said Dr. Sharwood.

This research is published in *Nature Plants*.

More information: Coralie E. Salesse-Smith et al, Overexpression of Rubisco subunits with RAF1 increases Rubisco content in maize, *Nature Plants* (2018). DOI: 10.1038/s41477-018-0252-4

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