Scientists have "hacked" photosynthesis, and it could help them speed up food production

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[Photosynthesis](http://en.wikipedia.org/wiki/Photosynthesis) is the crucial process by which plants convert sunlight, water and air into energy and food - and scientists from the US and UK have now taken the first step towards speeding the process up using enzymes from blue-green algae.

This is an important breakthrough that could lead to new ways to feed the world’s growing population. "Hearing the results of this experiment for the first time was definitely one of those 'Eureka!' moments you live for as a scientist," Maureen Hanson, a plant geneticist at Cornell University in the US who led the research, [told William Herkewitz for *Popular Mechanics*](http://www.popularmechanics.com/science/health/genetics/turbo-tobacco-faster-photosynthesis-17217730).

For decades scientists have seen room for improvement in the photosynthesis process - mainly in the activity of an enzyme called[Rubisco](http://en.wikipedia.org/wiki/RuBisCO). Rubisco is the protein that converts CO2 into sugar, and is possibly the most abundant protein on Earth, accounting for up to half of all the soluble protein found in leaves.

But the reason it’s so common is because it’s not very efficient - and researchers have long been searching for a way to boost its output. Scientists estimate "that tinkering with Rubisco and ways to boost the concentration of carbon dioxide around it could generate up to a 60 percent increase in the yields of crops such as rice and wheat,” [writes Heidi Ledford for*Nature.*](http://www.nature.com/news/hacked-photosynthesis-could-boost-crop-yields-1.15949) This would also reduce fertilizer needs and help free up agricultural land. However, up until now there hasn't been much success in attempts to manipulate Rubisco.

In this new research, the international team decided to take the Rubisco from a small but super efficient organism - the cyanobacterium [*Synechococcus elongatus*](https://microbewiki.kenyon.edu/index.php/Synechococcus_elongatus)*.*

They then engineered the Rubisco gene into the genome of a tobacco plant's chloroplast - the organelle in plants where photosynthesis occurs. They discovered that these plants were able to confer CO2 into sugar faster than normal tobacco, a sign that photosynthesis had been sped up.

"This is the first time that a plant has been created through genetic engineering to fix all of its carbon by a cyanobacterial enzyme," [said Hanson in a press release](http://phys.org/news/2014-09-efficient-photosynthesis.html). "It is an important first step in creating plants with more efficient photosynthesis." Their results are [published in *Nature.*](http://www.nature.com/nature/journal/vaop/ncurrent/full/nature13776.html#affil-auth)

So what made them succeed where so many others had failed? Importantly, they add two extra bacterial proteins to the crops. Some received a bacterial protein that’s thought to help Rubisco to fold properly, while another group received a bacterial protein that structurally supports Rubisco. Hanson[told journalist Herkewitz from *Popular Mechanics*](http://www.popularmechanics.com/science/health/genetics/turbo-tobacco-faster-photosynthesis-17217730)that this is likely to have helped the tobacco plant utilize the more efficient Rubisco.

The results suggest that if blue-green algae Rubisco was engineered into crops, it could lead to faster food production. But, and this is a big but, there is still a lot more research to be done.

At the moment the algal Rubisco, while more efficient, can waste energy by reacting with oxygen rather than CO2. Currently the scientists are overcoming this by growing the plants in chambers that maintain artificially high CO2 levels, but that’s obviously not a long-term solution.

Usually the blue-green algae overcome this problem by creating structures called carboxysomes around their Rubisco enzymes, creating a CO2-rich environment, but obviously this isn't something that occurs naturally in tobacco plants.

But there is hope - [in June, the team reported](http://www.nature.com/news/hacked-photosynthesis-could-boost-crop-yields-1.15949) that they’d engineered tobacco plants that could generate carboxysome-like structures. So the next step is to try to engineer the algal Rubisco enzyme into these plants to see if this helps to make them more efficient.

The scientists used tobacco plants for this experiment as their genome is so well studied, but this technique will also need to be tested in food crops if we have any hope of using it to help us increase our food production.

**Sources:** [*Nature,*](http://www.nature.com/news/hacked-photosynthesis-could-boost-crop-yields-1.15949)[Phys.org](http://phys.org/news/2014-09-efficient-photosynthesis.html)and [*Popular Mechanics*](http://www.popularmechanics.com/science/health/genetics/turbo-tobacco-faster-photosynthesis-17217730)

QUESTIONS:

1. What could be changed about the first sentence of this article to make it more specific?

2. How does CO2  get converted to glucose?

3. What evidence was given that using the special blue-green algae enzyme worked?

4. Should we genetically modify crops like rice & wheat to increase their yield? Why/why not?

5. Why couldn’t we replicate the results of this study in the field right now? Give 3+ reasons.