# How CRISPR rice could help tackle climate change

Can gene-editing technology CRISPR create new crops that help fight climate change as they grow? That's what a group of researchers hopes to do with $11 million in funding from the Chan Zuckerberg Initiative. The funding will go toward efforts to enhance plants – starting with rice – and soil so that they're better at trapping carbon dioxide. The effort, which was announced last week, is being led by the Innovative Genomics Institute, which was founded by Nobel laureate and co-inventor of CRISPR Jennifer Doudna.

"[Jennifer] and I saw eye to eye on climate and how big of a problem it is in the world. And we just didn't want to sit on the sidelines anymore," says Innovative Genomics Institute (IGI) executive director Brad Ringeisen.

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Climate experts overwhelmingly agree that the only way to truly tackle climate change is to reduce the amount of greenhouse gas emissions we're sending into the air as we burn fossil fuels to generate electricity or power trains, planes, and cars. But humans have already dumped so much planet-heating pollution in the atmosphere that we also need to find ways to clean up some of the existing mess and prevent even more catastrophic climate change. One way to accomplish that is through plants. Plants naturally take in a common greenhouse gas, carbon dioxide, during photosynthesis. Eventually, they transfer that carbon into the soil.

CRISPR can be used to make precise changes in a plant's genome to produce desired traits. There are three targets for gene editing in IGI's carbon removal mission. It starts with trying

to make photosynthesis more efficient in plants so that they're even better at capturing as much CO2 as possible. Second, IGI is interested in developing crops with longer roots. Plants transfer carbon into the soil through their roots (as well as from the rest of their bodies when they die). Longer roots can deposit the carbon deeper into the soil so that it isn't so easily released into the atmosphere again. A similar effort to influence plants' genes and develop crops with more robust roots is underway at the Salk Institute for Biological Studies, which received $30 million from the Bezos Earth Fund in 2020.

That brings us to the third arm of IGI's research: boosting the soil's capacity to store, rather than release, greenhouse gasses. Soil doesn't typically hold onto carbon for very long. It escapes back into the atmosphere through soil microbes' respiration as they break down plant matter. And techniques used in modern agriculture, like tilling, accelerate this process and allow soil to lose more of its carbon. One potential outcome of IGI's CRISPR research, according to Ringeisen, is a product that could be added to the dirt to nurture a soil microbiome that holds onto carbon longer.

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These are all heavy lifts that are still a very long way from fruition. The $11 million from the Chan Zuckerberg Initiative funds three years of research, and Ringeisen expects "real world impact by seven to 10 years." Even if they are successful at genetically engineering plants and soil microbes within that timeframe, scaling up to have a meaningful impact on the climate will still be a huge challenge.

"Plants are already extremely efficient carbon fixing machines, resulting from millions of years of evolution, so I still remain to be convinced that CRISPR can do much to improve carbon sequestration at the scale we need," César Terrer, an assistant professor at MIT who leads a lab focused

on plant-soil interactions, writes to *The Verge* in an email.

Terrer is not involved in the project, but he was previously a fellow at one of the institutions involved, the Lawrence Livermore National Laboratory, “and if someone can do this [it’s] them,” he writes. Still, he cautions that focusing on ways to engineer nature to help us with climate change can be a distraction from the more urgent need to cut greenhouse gas pollution in the first place.

Agriculture is already responsible for its own enormous carbon footprint — much of it coming from livestock and fertilizer. Rice cultivation is also a big culprit for methane emissions since soggy rice paddies are an ideal home for methane-producing microbes. IGI is working on this problem as well, again looking at altering roots and microbes in the soil.

The rice genome is easier to manipulate than other crops, according to Ringeisen, in part because it’s already been studied a lot and is well understood. One of the scientists involved in IGI’s initiative is Pamela Ronald, whose research is widely known for leading to the development of rice varieties that tolerate flooding for much longer than other types using a different type of genetic engineering that’s more like precision breeding. That rice is now grown by more than 6 million farmers across India and Bangladesh, according to Ronald’s laboratory at the University of California, Davis.

*IGI’s work won’t stop with rice*

IGI’s work won’t stop with rice. Sorghum is another prime candidate for gene editing to boost carbon removal, according to Ringeisen. He’s also hopeful that any new varieties they develop will come with extra incentives for farmers, like more abundant harvests that result from more efficient photosynthesis. But that’s still a few years in the future. IGI hopes to begin international field trials with farmers about three years after their research into CRISPR rice gets underway.

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