Plants are great at storing CO2. These scientists aim to make them even better.

Researchers around the world are working to improve plants' ability to combat climate change.

Editor's note: This article was originally published at Ensia

Many strategies aimed at mitigating global warming involve huge shifts in human behavior: stop burning coal for electricity, stop driving gas-powered cars, stop destroying rainforests. These are all necessary — and all involve complex political, cultural and socio-economic hurdles for humans. But what if we could also change the behavior of a far more pliant group of organisms, those that *consume* the carbon dioxide we emit? It's a demand-side approach to reducing the threat of climate change, and lately it's been gaining some extra research steam: capturing and storing that excess carbon by boosting the capacity of nature's own carbon-storing technology, plants.

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The planet's plants pull CO_2 out of the atmosphere and store it in their leaves, stems and roots. Some of that carbon makes its way into the soil, and some of that soil carbon is ultimately mothballed for millennia.

These days, though, "we as humans are putting up so much CO_2 that the Earth is not able to compensate," says Wolfgang Busch, a plant biologist with the Salk Institute for Biological Studies in La Jolla, California. Busch is working on a new project: to design plants that can suck even more CO_2 out of the atmosphere and lock it away for centuries.

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Scientists at the Salk Institute in La Jolla, California, are working to boost plants' ability to store carbon. (Image credit: Salk Institute)

"We're not trying to get plants to do something they don't normally do," says Busch. "We're just trying to increase the efficiency. Then we can use that to mitigate climate change."

The effort, called the Harnessing Plants Initiative, aims to generate "ideal plants" that will store carbon deep in the soil, require less fertilizer to grow, and ultimately produce food to feed the world. The idea is to "teach plants to make more of very stable forms of carbon," says Busch.

To do that, the researchers are tapping suberin, a carbon-rich, breakdown-resistant molecule produced by plants that's a primary component of cork. They're testing varieties of two species, birdsfoot trefoil and common mustard weed, from around the world to find those that have evolved to make more suberin. And they're studying the biology behind that trait. Once they've identified the genes associated with suberin production, they can use conventional breeding, genetic engineering or a combination of the two to create crops that are carbon-storage powerhouses.

The Salk project is part of "a new generation of agriculture, where it becomes important not to just look for higher yields in harvestable portions [of crops] but also to combine that with more carbon being transferred to the soil," says Christer Jansson, director of plant sciences at the Department of Energy's

Environmental Molecular Sciences Laboratory.

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Jansson is also pushing for research into a new area: the role that microbes in the rhizosphere could play. Jansson was part of an international team that developed a new strain of rice that emits very little methane while growing. (Rice paddies are one of the biggest man-made sources of methane, another greenhouse gas.) The low-methane rice contains a gene from barley that decreases the amount of carbon channeled to the plant’s roots, which in turn provides less food for methane-producing bacteria that live in the paddies. More recently, with a colleague, Sun Chuanxin, Jansson has essentially reversed the process, increasing the carbon socked away below ground. (The research has not yet been published.)

Jansson is also pushing for research into a new area: the role that microbes in the rhizosphere could play. The rhizosphere is the area of soil directly surrounding a plant’s roots, and it’s like a mini-ecosystem where the roots and the soil interact. Many types of bacteria, fungi and other microbes live there — and, says Jansson, they could be manipulated to pull more carbon into the soil.

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With roots up to 10 feet (3 meters) long, Kernza (on the right for each season, compared with annual wheat) yields abundant carbon storage as well as edible grain. (Image credit: The Land Institute)

Part of the appeal of using the rhizobial microbiome is the potential to use microbes that could both breed more productive crops and also store more carbon. “Putting carbon in the soil by itself — there’s no money in that,” says Jansson. “It has to be economically responsible for a farmer or a biotech company to invest in it.”

“The long-term goal is to generate something that could also be used to feed people.” – Julie LawAt Salk, too, the Harnessing Plants team is trying to ensure that larger roots and more suberin don’t come at the expense of crop yields. “The long-term goal is to generate something that could also be used to feed people,” says Julie Law, a plant biologist working on the project.

Busch and Law are also hoping to produce plants that can grow in marginal areas, such as the uncultivated edges of farmers’ fields, to maximize the land area devoted to storing carbon. Their goal is to make plants that are 20 times more effective at locking carbon in the soil, and to use those plants to store half of the CO_2 humans emit each year. To reach that ambitious goal, they say, would require 6 percent of the planet’s agricultural land. That could include using the plants as cover crops.

Elsewhere, scientists are working on making perennial versions of humanity’s most important food crops — all of which are annuals, meaning they must be replanted each year. Perennials have far deeper root systems and don’t need to be tilled each year, making them much better at squirreling carbon away.

The Land Institute, a sustainable agriculture organization in Salina, Kansas, is home to one such study. Scientists there have developed a new grain called Kernza, a perennial plant bred from an ancestor of wheat. Kernza’s dense roots extend 10 feet (3 meters) into the soil, locking away carbon while also helping the plant cope with drought by accessing water deeper underground.

All of these projects hold promise — and all will take not just money and manpower but an even more scarce resource: time.

“We don’t really have a lot of time for this,” Busch says of the suberin project. To develop something like this soon enough for it to work, he says, “we really will need to hurry up.”

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