Michael Riedijk says that his team wants to work with Chilean scientists and will make all the data from its experiment public. The foundation plans to hold its own forum later, but if scientists aren't willing to engage, he says, "we'll just move on without them".

Researchers worldwide have conducted 13 major iron-fertilization experiments in the open ocean since 1990. All have sought to test whether stimulating phytoplankton growth can increase the amount of carbon dioxide that the organisms pull out of the atmosphere and deposit in the deep ocean when they die. Determining how much carbon is sequestered during such experiments has proved difficult, however, and scientists have raised concerns about potential adverse effects, such as toxic algal blooms. In 2008, the United Nations Convention on Biological Diversity put in place a moratorium on all ocean-fertilization projects apart from small ones in coastal waters. Five years later, the London Convention on ocean pollution adopted rules for evaluating such studies.

Because Oceaneos's planned experiment would take place in Chilean waters, it is allowed under those rules. Riedijk says that the foundation will voluntarily follow international protocols for such studies; it is unclear whether that will allay fears that the group is promoting an unproven technology, rather than conducting basic research.

Philip Boyd, a marine ecologist at the University of Tasmania in Hobart, Australia, wants to see the foundation publish research based on lab experiments before heading out into the field. "If they are a not-for-profit scientific venture that wants to partner with academics, then surely transparency is their best foot forward," he says.

Oceaneos's links to a 2012 iron-fertilization project off the coast of British Columbia, Canada, have made some researchers wary. In that project, US entrepreneur Russ George convinced a Haida Nation village to pursue iron fertilization to boost salmon populations, with the potential to sell carbon credits based on the amount of CO_2 that would be sequestered in the ocean. News of the plan broke after project organizers had dumped around 100 tonnes of iron sulfate into the open ocean. In the years since, scientists have seen no evidence that the experiment worked.

"If they want to partner with academics, then surely transparency is their best foot forward."

Riedijk says he was intrigued when he read about the Haida experiment in 2013, and contacted one of its organizers, Jason McNamee. McNamee later served as chief operating officer of Oceaneos Environmental Solutions — which Riedijk co-founded — before leaving the company last year.

Despite the Haida project's problems, Riedijk says that ocean fertilization merits further research: "If this actually does work, it does have global implications." Oceaneos Environmental Solutions has developed an iron compound that can be consumed efficiently by phytoplankton, he adds, but he declined to release details. Riedijk also says that the foundation is working on a method to trace the movement of iron up the food chain and into fish populations.

In the meantime, scientists say that it will be difficult to get solid data from the Oceaneos foundation's planned experiment. The geology off the Chilean coast, and the patterns of currents there, create a mosaic of low- and high-iron waters. Anchovies, horse mackerel and other fish move freely between these areas.

And adding iron could shift the location and timing of phytoplankton blooms to favour fast-growing species, says Adrian Marchetti, a biological oceanographer at the University of North Carolina at Chapel Hill. One of those, the diatom *Pseudo-nitzschia*, produces domoic acid, a neurotoxin that can kill mammals and birds. Oceaneos's experiment will probably increase plankton growth in low-iron waters, Marchetti says, "but it's not to say that that is actually good for the higher levels of the food chain". ■

GENETICS

CRISPR editing seeks the perfect tomato

Geneticists correct harmful interaction of two desirable plant mutations.

BY HEIDI LEDFORD

From giant fruit to compact plants, today's tomatoes have been sculpted by thousands of years of breeding. But mutations linked to prized traits — including one that made the fruit easier to harvest — yield an undesirable plant when combined, geneticists have found.

It is a rare example of a gene harnessed during domestication that later hampered crop-improvement efforts, says geneticist Zachary Lippman of Cold Spring Harbor Laboratory in New York. After identifying the mutations, he and his colleagues used CRISPR gene editing to engineer more-productive plants — a strategy that plant breeders are eager to adopt.

"It's pretty exciting," says Rod Wing, a plant geneticist at the University of Arizona in Tucson. "The approach can be applied to crop improvement, not just in tomato, but in all crops."

Tomatoes have been bred for thousands of years.

PHILIPPE HUGUEN/AFP/GETTY

Lippman knows his way around a tomato farm. As a teenager, he spent his summers picking the fruit by hand — a chore he hated. "Rotten tomatoes. The smell lasts all day long," he says. "I would always pray for rain on tomato-harvest day."

But years later, his interest in the genetics that control a plant's shape led him back to tomato fields, to untangle the genetic changes that breeders had unknowingly made.

In the 1950s, researchers found a new trait in a wild relative of tomatoes growing in the Galapagos Islands: it lacked the swollen part of the stem called the joint.

Joints are weak regions of the stem that allow fruit to drop off the plant. Wild plants benefit from dropping fruit because it helps seed dispersal. But with the advent of mechanical tomato pickers, farmers wanted their fruit to stay on the plant. Breeders rushed to incorporate the 'jointless' trait into their tomatoes.

But this trait came with a downside. When it was crossed into existing tomato breeds, the resulting plants had flower-bearing branches that produced many extra branches and looked like a broom, terminating in a host of flowers. The flowers were a drain on the plant's resources, diminishing the number of fruit it produced. Breeders selected for other genetic variants that overrode this defect. But decades later, Lippman's team went looking for the genes behind this phenomenon.

TWO RIGHTS THAT MAKE A WRONG

The researchers had previously screened a collection of 4,193 varieties of tomato, looking for those with unusual branching patterns (Z. B. Lippman *et al. PLoS Biol.* **6,** e288; 2008). From that collection, they tracked down variants of two genes that, together, caused extreme branching similar to what plant breeders had seen. One of the two genes, the team reports in a paper published online in *Cell* on 18 May, is responsible for the jointless trait (S. Soyk *et al. Cell* http://doi.org/b7gp; 2017).

The other gene favours the formation of a large green cap of leaf-like structures on top of the fruit — a trait that was selected for thousands of years ago, in the early days of tomato domestication. The benefits of this trait are unclear, Lippman says, but it may have helped to support heavier fruit.

With these genes uncovered, his team used CRISPR–Cas9 editing to eliminate their activity, as well as that of a third gene that also affects flower number, in various combinations. This generated a range of plant architectures, from long, spindly flower-bearing branches to bushy, cauliflower-like bunches of flowers. Some of the plants had improved yields.

The findings should help to quell lingering doubts among plant breeders that negative interactions between desirable genetic traits are a force to be reckoned with, says Andrew Paterson, a plant breeder at the University of Georgia in Athens. The idea has been controversial, he says, because the effects have been difficult to detect statistically.

Lippman's team is now working with plant breeders to use gene editing to develop tomatoes with branches and flowers optimized for the size of the fruit. Plants with larger fruit, for example, may have better yields if they have fewer flowering branches than those with smaller fruit.

"We really are tapping into basic knowledge and applying it to agriculture," says Lippman. "And ironically, it happens to be in the crop that I least liked harvesting on the farm." ■

THOMAS PETER/REUTERS

China has boosted its security presence in the Xinjiang region, home to a large Uighur population.

HUMAN RIGHTS

China set to expand DNA database

Purchase of sequencers feeds fears about nation's intentions.

BY DAVID CYRANOSKI

Police in the northwestern region of Xinjiang, China, have been collecting DNA samples from citizens and are now ramping up their capacity to analyse that genetic cache, according to evidence compiled by activists and details gathered by *Nature*.

The advocacy group Human Rights Watch reported last month that Xinjiang authorities intend to accelerate efforts to gather blood samples from the region's large population of Muslim Uighur people. China's government has cracked down on Xinjiang's separatist movement in recent years, so the prospect of a DNA database there has stoked fears that authorities could use it as a political weapon.

"Our concern is that there is widespread collection of DNA without legal protection and without telling people," says Maya Wang, a researcher for Human Rights Watch in Hong Kong and the author of the report.

In its report, the organization said that Xinjiang's police had ordered 12 DNA sequencers. *Nature* has confirmed the order and learned, from documents and interviews with those involved in the transaction, that the police have purchased enough machines to process up to 2,000 DNA samples per day. The police department hung up when *Nature* rang to ask about the reason for the purchase.

That capacity goes well beyond what would be needed for routine forensics, says Sumio Sugano, a genomics researcher at the University of Tokyo. "It's definitely the kind of capacity that can be used to build a database," says a source familiar with the equipping of forensics laboratories in China, who did not want to be identified. "They are building a laboratory," he suggested after being shown the full purchase order for the sequencing equipment.

According to a sales officer at a firm involved in the procurement, Xinjiang police have purchased eight sequencers produced by Thermo Fisher Scientific in Waltham, Massachusetts. The machines can be used to look at short stretches of DNA that tend to vary between individuals and are typically used in forensic DNA fingerprinting to match samples collected from a crime scene with individuals listed in a database (or even their close relatives). The police also purchased four domestically produced sequencers made for the same purpose.

Nature has learned that Xinjiang officials have also bought a 'next generation' ▶