experiments for replication that use one of these techniques.

Amaral and his team expect to finish the project by 2021, with funding from the Serrapilheira Institute in Rio de Janeiro — Brazil's first private organization dedicated to supporting basic research in the natural sciences, computer sciences, engineering and mathematics. An initial 145,000-Brazilian-real (US$37,000) grant allowed the scientists to establish the project's general methodology, select experiments to analyse, and build a network of collaborators.

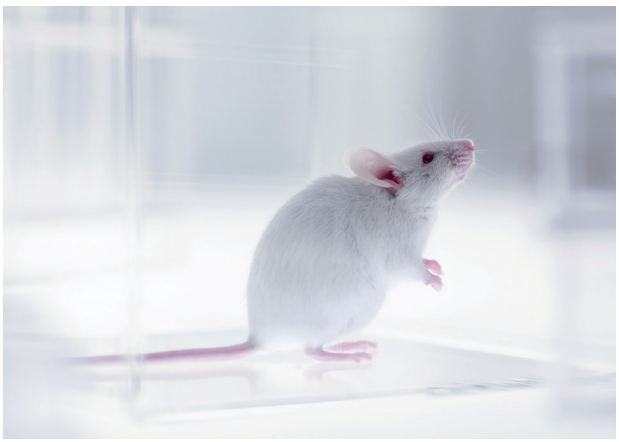
Now the project is working with participating labs to establish protocols for replication attempts, with the help of another 1,000,000-real grant from the institute, awarded in January.

The Brazilian project follows in the footsteps of several attempts to replicate scientific outcomes on a large scale. One of the first was the Reproducibility Project: Psychology, which launched in 2011. It gathered 270 scientists to replicate the results of 100 psychology articles in different journals, yielding a reproducibility rate of 36–47%. Similar initiatives in experimental economics, philosophy and social sciences arrived at replication rates ranging between 57% and 78%.

The effort's leaders hope that it will reveal ways to predict the reproducibility of scientific studies. "It might be invaluable for future decisions on how to finance and elevate science in Brazil," says Roger Chammas, an oncologist at the University of São Paulo School of Medicine and coordinator of one of the replicating labs.

Daniel Martins-de-Souza, a biochemist at the University of Campinas in Brazil, agrees. "If the project moves forward, it may aid defining which types of studies or methods have more potential to obtain new possibilities of therapy against diseases," he says. "It could guide the decision-making process of funding agencies."

Others are more sceptical. Lygia da Veiga Pereira, a geneticist at the University of São Paulo, says it is too early to tell whether the project's findings will be able to help guide future research. Still, she says, "testing how much of Brazilian science is reproducible will be a good diagnosis for us". ■



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Mouse-behaviour tests are among the experiments being replicated.

GENETICS

Russia joins global gene-editing bonanza

A US$1.7-billion programme aims to develop 30 gene-edited plant and animal varieties.

BY OLGA DOBROVIDOVA

Russia is embracing gene-editing. A 111-billion-rouble (US$1.7-billion) federal programme aims to create 10 new varieties of gene-edited crops and animals by 2020 — and another 20 by 2027.

Alexey Kochetov, director of the Siberian Branch of the Russian Academy of Sciences (RAS) Institute of Cytology and Genetics in Novosibirsk, welcomed the research programme, noting that genetics in Russia has been "chronically underfinanced" for decades.

Funding for science plummeted in the 1990s following the break-up of the Soviet Union, and Russia still lags behind other major powers: in 2017, it spent 1.11% of its gross domestic product on research, compared with 2.13% in China and 2.79% in the United States.

But some researchers doubt that the goals can be met on time, and worry that the initiative does not address the other issues they face, such as excessive bureaucracy.

It is also not clear whether the 111 billion roubles is included in the existing federal civilian-science budget — which in 2018 was 364 billion roubles, with 22 billion roubles spent on genetics research — or whether it comes in addition to that budget.

The programme, announced in April, has also attracted interest because it suggests that some gene-edited products will now be exempt from a law passed in 2016 that prohibits the cultivation of genetically modified (GM) organisms in Russia, except for research purposes. Previously, it was not clear whether gene-edited organisms were included in the ban.

"Russia is highly dependent on imports when it comes to elite crop varieties."

The 2016 law describes GM organisms as those with gene modifications "that cannot result from natural processes". But the decree that established the new programme describes gene-editing technologies such as CRISPR–Cas9 — which do not necessarily insert foreign DNA — as equivalent to conventional breeding methods.

That marks a welcome step for Russian researchers, many of whom were demotivated by the uncertainty of the 2016 ban, according to a scientist at a major institute of the RAS in Moscow who asked to remain anonymous for fear of professional repercussions.

The wording of the decree chimes with the stance of the US agriculture department, which last year said that it has no plans to regulate "plants that could otherwise have been developed through traditional breeding techniques", including gene-edited species — although the US situation is less clear with regard to animals, which the Food and Drug Administration oversees.

By contrast, a July 2018 ruling from the European Union's highest court declared that gene-edited crops are subject to the same tough regulations as conventional GM organisms — something many scientists said would hamper research.

Konstantin Severinov, a molecular geneticist who helped to develop the Russian programme, told *Nature* it is important that Russia is not sidelined in the world's "CRISPR bonanza", and that one goal of the programme is to make Russia less reliant on crops from other countries.

"Russia is highly dependent on imports ▶

BLOOMBERG/GETTY

Sugar beet is one of four crops listed as a priority for Russian gene-editing research.

when it comes to elite crop varieties," says Severinov, who splits his time between Rutgers University in Piscataway, New Jersey, and the Skolkovo Institute of Science and Technology near Moscow. "Luckily, a few RAS members managed to make the case that CRISPR–Cas9 is a good thing."

The decree lists four crops — barley, sugar beet, wheat and potatoes — as priorities. Projects to develop gene-edited versions of these crops are already under way. Scientists at RAS institutes in Moscow are developing pathogen-resistant varieties of potatoes and sugar beet. And gene-editing research aiming to make barley and wheat easier to process and more nutritious is in progress at the Vavilov Research Institute of Plant Industry in St Petersburg, and at the RAS Institute of Cytology and Genetics.

But whether Russian scientists can meet the programme's ambitious goals is unclear. Despite helping to develop the programme, Severinov — who once famously described working in Russia as like "swimming in a pool without water" — says that it does not address the "inhumanely bad" conditions for doing life-sciences research in Russia, including red tape and poor access to supplies.

Kochetov says that the initiative's goals are realistic. "The research programme will bring promising products — there's no doubt about it." He says that private companies might accelerate funding for gene-editing research now that the law is clearer. But he thinks that some legal uncertainty remains, and predicts that further regulation will be required to bring to market any organisms developed under the programme.

Yi Li, a plant scientist at the University of Connecticut in Storrs, says that the programme's launch is "a significant move" both for Russia and for the rest of the world. "This can be a very interesting development in the light of the European court of justice ruling on genome editing," he says. ■

Until June 2018, Olga Dobrovidova was employed by TASS, a state-owned news agency in Russia.