Ugandan scientists use CRISPR in pioneering research to breed hardier cassava

Ugandan scientists have begun moving gene extracts into cassava cells in a first-of-its-kind research trial using the CRISPR-Cas9 gene editing tool to develop varieties that can resist cassava brown streak disease (CBSD).
“We are not only looking at disease resistance,” Dr. John Odipio, a plant biotechnologist and gene editing expert at the National Crop Resources Research Institute (NaCRRI) at Namulonge, said. “An independent group [in the United States] already demonstrated control for CBSD using genome editing.”

Instead, the scientists are using genome editing to develop varieties that can resist the disease and fight off the white flies that spread the virus between plants.

Cassava is a staple food for most households in sub-Saharan Africa, comprising 30 to 50 percent of all calories consumed in the region. But yields have not increased in the last 25 years, partly because of plant viruses that make the crop unpalatable for consumption.

The scientists will also study genes that control flowering in cassava for speedy breeding, in addition to creating a variety that is resistant to CBSD.

“One of my PhD research objectives already identified genes that make cassava flower. The ongoing research is identifying genes that prevent cassava from flowering,” Odipio told the Alliance for Science.

“Gene editing will be used to de-activate such flower repressing genes and in the process cause early flowering for use in production of cassava seeds and potential new varieties,” he said.

Odipio said validation of results for flowering genes was “ongoing and promising.”

CRISPR-Cas9 is a powerful genome editing tool for introducing genetic changes into crop species. It is very accurate, which gives it an edge over the genetic modification methods previously used to try and solve the challenge of CBSD, Odipio said.

Dr. Henry Wagaba, an expert in gene silencing at the agricultural institute, said the researchers are still at the platform stage where “we have to wait and see whether the genes we have transferred [into cassava cells] can grow into new plants.”

“After this we have to assess whether the new plants contain the [desirable] gene and it is doing what we want it to do,” Wagaba said. “We have to assess whether or not it is a good trait before we can transfer the plant into the soil.”

The researchers will need authorization from the institutional biosafety committee at the National Agricultural Research Organization (NARO), which coordinates with the national biosafety committee, before they can move the new plants from test tubes into soil and eventually into field trials.

The scientists at NaCCRI announced last year that they planned to use CRISPR to understand

sequences in cassava that can help resist pests and diseases affecting the plant.

But they only recently started their research.

“We are a government entity. So the process may not be swift in terms of procurement and all,” Wagaba said. “We started moving genes into cassava cells in January. But we are hopeful that eventually we shall get a variety with an exceptional ability to do better than the others.

“Maybe in six months or so we can really say we have something going on here,” he added.

Odipio said the long growth cycle of cassava also makes it hard to get fast results. “The cultivar-dependent nature of cassava transformation excludes some of the promising varieties from planned research.”

There are other challenges related to funding and lack of a legal framework to guide Uganda’s use of biotechnology.

Uganda’s failure to adopt a biosafety law “has demotivated researchers and scared away [the] donor community,” Odipio said.

“As a country and continent, we shall lose on the benefit associated with timely development of climate-smart crops or super varieties combining high-yielding, early-maturating, nutrient-rich and resilience traits using cutting edge technologies,” he said.

“We need [an] enabling environment through enactment of the biotech law and increased financial support from our own government to aid detailed research for developing improved crop and animal varieties/breeds.” Odipio said. “Having the law would help deregulate the advanced lines from banana, cassava, maize and rice, thus increasing food and income security. The current support from [the] donor community is insufficient for scientists to realize the full potential of biotechnology and its products.”

But all hope is not lost.

President Yoweri Museveni called the ruling National Resistance Movement [NRM] caucus last month to meet, discuss and pass the country’s long-stalled genetic engineering regulatory bill, renewing hope that the nation will finally have a law to guide usage of new technologies.

And the research at Namulonge is collaborative. So even if the country doesn’t have a legal framework in place by the time the research is complete, the rest of the continent and globe can benefit from the innovation.

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