New African cassava resists devastating viruses

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Plant scientists at ETH Zurich have developed a new African cassava preferred by consumers and farmers that is resistant to the two major virus diseases in Africa. Now they want to test the resistant cassava in Africa.

Cassava is one of the most important crops in tropical countries, particularly in Sub-Saharan Africa. However, plant viruses are threatening cassava production and with it the staple food of hundreds of millions of people. Under the leadership of Wilhelm Gruissem, Professor of Plant Biotechnology and his senior scientist Dr. Hervé Vanderschuren, researchers at ETH Zurich have used gene technology to develop a new cassava variety that is resistant to the feared cassava brown streak virus. The virus infects the edible starchy roots and turns them brown, which makes the roots unpalatable for consumers. The virus originated in East Africa and is threatening to spread to Central and West Africa.

Developing immune cassava using small RNAs

In order to make cassava resistant to the brown streak virus, the researchers modified the genetic make-up of one variety of cassava to produce small interfering RNA molecules (siRNA). The plant produces the siRNA naturally after virus infection, but the researchers have now tricked cassava to produce the siRNA in all of its parts before the virus can infect it. As soon as the virus attacks the plant, the short siRNA

stops the virus by attaching to the genome of the virus that is also made of RNA. This prevents the virus from multiplying and spreading throughout the plant.

Glasshouse trials have shown that the new gene producing the siRNA protects cassava effectively from the virus. Even several months after infection of the transgenic cassava plants with the brown streak virus, the scientists did not find any evidence that the virus could multiply. The production of the siRNA does not affect cassava itself. It grows normally and produces healthy roots. The researchers targeted a part of the virus RNA genome that has been highly conserved during evolution and thus only very rarely changes. This should make it more difficult for the virus to adapt to the siRNA-mediated immunity.

Resistance to another cassava virus remains

The researchers used the Nigerian TME 7 variety, also known as "Oko-iyawo". This variety is naturally resistant to cassava mosaic disease, which is caused by another virus that is severely impacting cassava production all of Africa. Prof. Wilhelm Gruissem explains that this resistance is not changed by the new resistance to the brown streak virus. The brown streak virus is most likely transmitted by the same silverleaf whitefly (Latin: Bemisia tabaci) that also spreads cassava mosaic disease. This tiny insect sucks on plant juices, and in doing so transmits the viruses into the cassava plant. "The silverleaf whitefly population has hugely increased in recent decades", emphasises Prof. Willhelm Gruissem, "and is posing a greater threat than ever to the growth of cassava." He adds that it is difficult to control the whitefly, even if African farmers can afford to buy insecticides. "This is why it is much more efficient and more environmentally friendly to protect cassava against viruses using genetic modification."

Preferred variety extended

The ETH Zurich scientists chose TME 7 from dozens of potential varieties because TME 7 is popular among consumers and farmers and has the best prerequisites for successful cultivation. As the next step, Prof. Gruissem and Dr. Vanderschuren, together with colleagues in Africa, want to test if the improved cassava variety in the field remains resistant to both viruses under natural conditions. The Fiat Panis Foundation in Germany, which has supported cassava research at ETH, has already reserved funding for field experiments. The ETH Zurich scientists are also actively engaged in transferring the technology to interested research institutes in Africa to develop virus resistance in local varieties preferred by consumers in their countries.

More information: Vanderschuren H, Moreno I, Anjanappa RB, Zainuddin IM, Gruissem W. Exploiting the combination of natural and genetically engineered resistance to Cassava mosaic and cassava brown streak viruses impacting cassava production in Africa. *Plos One*. Published online: September 25, 2012. dx.plos.org/10.1371/journal.pone.0045277

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