Precision breeding creates super potato

December 8 2009

These are potatoes which exclusively contain amylopectin starch. Credit: Fraunhofer IME

The skin is light brown, the meat luscious and yellow: from the outside alone, this new potato looks like any other. But on the inside, it is different. Its cells produce pure amylopectin, a starch used in the paper, textile and food industries. The new potatoes -- recently harvested and processed for the first time -- were developed by Fraunhofer researchers with the aid of a new, especially rapid breeding process.

The fall of 2009 was a truly special season for the Emsland Group: For the first time in the history of the largest German potato starch manufacturer, it processed Tilling potatoes, which exclusively contain amylopectin starch. Not only can nutritional starches for emulsifying soups and desserts be extracted from it - it can also be used for paste and

smooth coating for paper and thread production. "This potato is the first product in Germany developed by Tilling that achieves market readiness," explains Prof. Prüfer of the Fraunhofer Institute for Molecular Biology and Applied Ecology IME.

Tilling - an acronym for "Targeting Induced Local Lesions in Genomes" - is a breeding process that researchers want to use to push evolution yet another step forward. In nature, evolution proceeds slowly: Through mutation and selection, plants and animal species adapt and change. Over the course of generations, those species develop that, due to their genetic make-up, are best adapted to the prevailing environmental conditions. Others became extinct. For millennia, humans have been using this evolutionary process for their own purposes, by focusing on highly productive- - and profit yielding - species. Modern breeding processes operate the same way, though the natural mutation rate is accelerated. "With the aid of chemicals, a vast number of mutants can be rapidly obtained," says Jost Muth of IME, who participated in the development of the new potato starch. "We are working here with natural principles. In nature, sunlight triggers changes in the genome. With chemistry, we accomplish the same thing - only faster."

Until now, mutation breeding was an exhaustive process. "Growers had to bring out the mutated seeds to the field, and then wait until they reached the end of their vegetation period in order to determine if one of the genetic modifications achieved the desired result. In addition, the majority of generated mutations could not be determined, since the characteristic is only expressed in a homozygous state," explains Prüfer. His team has succeeded in accelerating the implementation. In the laboratory at IME, the mutated seeds were germinated. As soon as the first leaves appear, it's harvest time: The researchers take a leaf sample, break apart the cellular structure, isolate the genome and analyze it. This way they can find out within a few weeks if a mutation has attained the desired traits.

In a project sponsored by the "Nachwachsende Rohstoffe" agency, researchers at IME, in collaboration with the Bioplant and Emslandstärke companies, found the super potato germ. They had to examine 2,748 seedlings until just the right one was identified that exclusively produces the starch component amylopectin. From this germ, experts were able to generate the first generation of super potatoes. There are genes active in their genome responsible for the formation of amylopectin, whereas genes that trigger the formation of amylose are shut off. "Until now, potatoes always contained both starch types. Industry had to separate the amylopectin from the amylose - an energy and cost-intensive process," explains Prüfer. "With the Tilling potatoes, which only contain amylopectin, this process stage is superfluous. In Germany alone the paper and adhesives industry require 500,000 tonnes of highly purified amylopectin each year. Then there is the textile industry too, which uses the starch to glaze threats prior to weaving. The food industry is also relevant.

This fall, 100 tonnes of the new super potato that exclusively produces amylopectin were harvested. "They can be processed as usual in the production lines," reports Muth. "Special measures aren't necessary, because the Tilling potatoes are totally normal breeds that contain no genetically modified material." The example shows that conventional or modern breeding methods will lead to success if the gene responsible for the expression of a specific trait is a natural part of the plant, and is known to scientists. The gene for the production of amylose in potatoes is one such gene. "Gene technology-based processes are indispensible and it is prudent to use them, when we want to integrate genetic material into a plant genome - , for example if we develop transgenic tobacco plants producing pharmacological substances," concludes Prüfer. "When it comes to dealing with genes, there is an easy rule: as much modification as needed, but as little as possible."

Source: Fraunhofer-Gesellschaft (news : web)