Researchers develop process for 'surgical' genetic changes

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Research led by scientists at Iowa State University's Plant Sciences Institute has resulted in a process that will make genetic changes in plant genes much more efficient, practical and safe.

The breakthrough was developed by David Wright, an associate scientist, and Jeffery Townsend, an assistant scientist, and allows targeted genetic manipulations in plant DNA, which could have a huge impact on plant genetic work in the future.

Until now, when scientists introduced DNA into plants, they would randomly inject that DNA into the plant cell. There was no way of knowing if it was in the right place or if it would work until many resulting plants were tested.

The new technique harnesses a natural process called homologous recombination to precisely introduce DNA at a predetermined location in the plant genome through targeted DNA breaks generated by zinc finger nucleases. This occurs about 1 in 50 attempts and is very efficient compared to unassisted methods that allow the same changes at a rate as low as 1 in 10 million.

"I've been working in this field for 29 years, just when we started learning how to modify genes," said Townsend. "From that day, this was the goal -- to actually get the research to the point where you can have homologous recombination. Now, we've done it."

Using this process, a specific gene is located in a living cell, then a break is made in the DNA of that gene. When the cell begins to heal itself, existing DNA can be deleted or modified, or new DNA can be added near the break site. Afterward, the cell carries the genetic change and passes the change on to its offspring.

"It's like surgery, only on the molecular level," said Wright.

"It's been known for a long time that you if you make a break in a cell, you can get some DNA into that spot," said Wright. "It's just that you have three meters of DNA in a cell if you unwound it. Putting the break where you want it has always been the problem."

Zinc finger nucleases solve the problem and allows scientists to take greater advantage of homologous recombination, according to Wright and Townsend.

The research, published in the journal *Nature*, was performed in Dan Voytas' lab at Iowa State. Voytas recently left the university for a position at the University of Minnesota.

In addition to the difficulty introducing changes where researchers want them using current methods, government regulations often slow the movement of research from the lab to the field.

Wright and Townsend hope the precision of this technique will speed the regulatory process.

"In the random process, regulators would say, 'You really don't know what you're doing,'" said Townsend. "With this new technology, we can tell them, 'The genome looks like this, this is exactly the change we want to make.'

"That's the power of this technology. It makes it (genetic engineering) practical and much safer. It was impractical, and now it is practical."

There are many applications for this that could allow stunning advances for many crops, according to Wright and Townsend.

For instance, canola is a commodity grown for its oil, just as soybeans. However, after the oils are extracted, soybean meal is sold as feed. Once oils are extracted from canola, the meal has a much lower value as a livestock feed due to several factors, including the presence of the chemical sinapoylcholine, also called sinapine.

The new technique could allow scientists to remove the genes that make sinapine. The result would be a more versatile canola product.

Farmers, especially in the upper Midwest and Canada, would benefit from this new market for canola meal.

Other plants could benefit as well.

Removing the genes that are responsible for peanut allergies, or removing genes that produce harmful chemicals or anti-nutritionals in other crops are just a few of the immediate crop improvements that Wright and Townsend envision for this technology.

Source: Iowa State University (news : web)

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