Research Into Use

Clean-gene technology has promise for safe genetically-modified crops

An easy and efficient way to develop genetically-modified crops that are 'biosafe' is now available. People worldwide are reluctant to accept genetically-modified foods because they are afraid they might contain genes resistant to antibiotics or herbicides, which could be harmful.

The clean-gene technology has great potential for Asian and African research programmes that aim to improve rice by genetic methods. It can also be readily used to improve crops grown by poor farmers in China, India and South Africa - important staples, such as maize and wheat, orphan crops, such as millet, cowpea and sorghum, and many fruits, nuts and vegetables. Laboratories in Asia, Africa, the USA and the UK are already using this process.

Clean-gene technology

Clean-gene technology is a safe way to genetically modify crops. This means that crops do not carry what are called 'selectable marker genes', such as genes resistant to antibiotics or herbicides.

Clean-gene technology is a process that transforms plants using two separate vectors, one carrying the transgene and the other carrying the selectable marker gene. The transgene has the desirable feature that needs to be added, and the selectable marker gene allows scientists to identify the transgenic plants. During the transformation, a bacterium called *Agrobacterium tumefaciens* integrates the two vectors. In roughly half the cases, the two vectors are integrated at different locations in the plant genomes. This means the vectors can be segregated from each other at the next generation.

Around two percent of rice progeny plants produced by clean-gene technology are free of selectable marker gene at the first generation. So, it's an easy and efficient way to genetically modify plants safely.

Photo: S. Mann

The clean-gene technology was developed using rice. However, the technology is generic and can be applied to all sexually propagated plants - maize, wheat, millet, cowpea, sorghum, trees and vegetables.

Previously, selectable marker genes in transgenic plants prevented acceptance of genetically-modified crops in both the developing and developed world. Now, because genes resistant to antibiotics are absent, the risk of transfer of resistance to antibiotics from crops to man and animals is eliminated. Similarly, the absence of herbicide resistant genes eliminates the risk of gene transfer to wild plant relatives and prevents the development of super-weeds. Now these problems can be avoided, the possibilities of developing transgenic crops to reduce poverty are wide open.

Know-how and transformation vectors freely available

The know-how for clean-gene technology is described in scientific publications and transformation vectors are freely available. There are no barriers to the spread of the technology. The clean-gene technology does not impinge on intellectual property rights or existing transgenic strategies for crop improvement. Clean-gene binary vectors for plant genetic transformation have already been distributed free of charge through material transfer agreements to scientists in developing countries.

Scientists quick to take up clean-gene technology

Although the first scientific paper on clean-gene technology was only published in 2004, scientists have been quick to ask for binary vectors so that they can use the clean-gene technology in plant molecular breeding programmes. For example, researchers in China, India, the UK and the USA are now using clean-gene binary vectors for crop improvement. This is good news as it generally takes years for new technologies to be taken up in crop transformation programmes. But the quality, reproducibility and safety of the safe clean-gene technology means that it's set to become the international standard for producing genetically-modified plants. This is because it meets the requirements of national biosafety regulations and policies on the release of genetically-modified crops.

Genetically-modified rice resistant to nematodes ready to go

The John Innes Centre in the UK has already produced genetically-modified rice resistant to nematodes and free of selectable marker genes. But there is huge untapped potential. The technology could be used to improve local Asian and African rice cultivars as well as other crops important for poor farmers. Crops such as insect-resistant cotton and maize, now grown by millions of poor farmers in China, India and South Africa, could be readily improved by clean-gene technology.

For more information

For further technical information go to the RIU online database at **www.researchintouse.com/database** and type in **PSP18** or email **riuinfo@nrint.co.uk**

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