GM Food Newsletter

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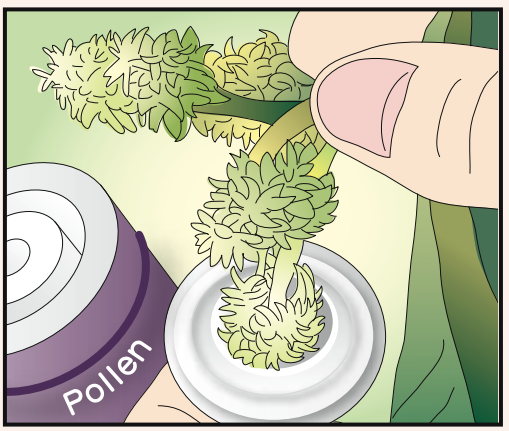
Techniques for Plant Breeding

In view of the safety concerns over genetically modified (GM) food, we have discussed, in some previous issues, the potential risk and safety assessment of food derived from genetic engineering. In this issue, we are going to introduce some alternatives to genetic engineering that can be used to facilitate breeding of crops with desired traits.

Humans love to try foods of better quality and taste. Genetic engineering is one way of achieving that, but there are other breeding techniques that may achieve the same purpose. Here we present three breeding methods that can be used to develop plant cultivars with beneficial traits.

1. *Controlled Pollination: Restoring the American Chestnut Tree*



American chestnut was once a common tree in the United States. However, the arrival of a lethal fungal disease killed almost every American chestnut tree throughout the eastern United States. To develop chestnut trees that are resistant to the disease, the American chestnut sought the help of their Chinese counterpart. It was crossed with the Chinese chestnut (the source of resistance) through controlled pollination – a kind of Sino-US collaboration.

During the process of controlled pollination, pollen from one chestnut tree is artificially transferred to the female reproductive organ of another tree to bring together desired traits from the two parents to the offspring. After fertilisation, offspring resistant to the disease will be selected. As crossing between two plants will inevitably transfer some undesired traits to the progenies, these unfavourable characteristics are removed by conducting repeated crossing between the resistant offspring and the American chestnut to produce trees that are genetically American chestnut except they are disease resistant.

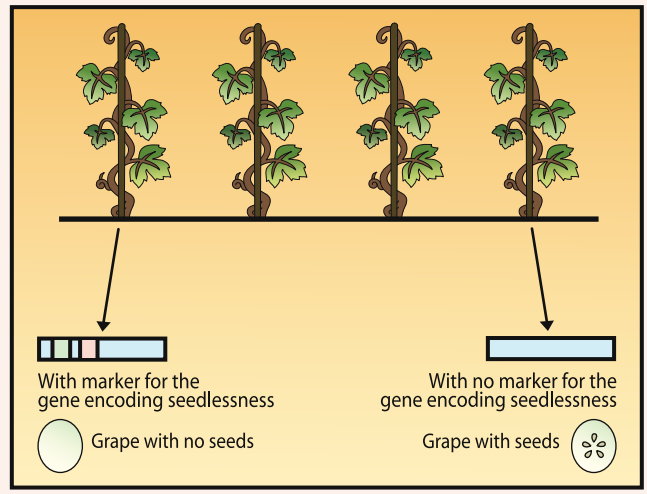
2. *Mutation Induction: Space Breeding*

Use of controlled pollination relies very much on the genetic variability from the wild species or from other cultivars. To expand the genetic pool for crop improvement, we can think beyond the constraints of Earth. Space breeding is one of the possible means that may be employed where mutation may be artificially introduced.

Space breeding is the technique of sending seeds into the space in a recoverable spacecraft or a high-altitude balloon. In the strong-radiation space environment, seeds may undergo mutation. Upon returning to the Earth, the seeds will be planted to generate a large pool of mutated plants from which individuals with desired characteristic can be selected. This technique has been adopted in the Mainland for more than two decades. Seeds of different varieties of crops, vegetables, fruits and some endangered forest trees were carried aboard the Shenzhou spacecrafts into the space. Rice and bell peppers grown from space seeds were reported to produce higher yield after mutation induction.

3. *Marker Assisted Selection: Facilitate Breeding of Seedless Grapes*

Traditionally, breeders select plants based on their visible or measurable traits. However, this will be time-consuming if the traits are difficult to measure and/or are evident only at late developmental stages. For example, seedless grape cultivars can only be selected when a grapevine produces bunches which usually takes three to four years after planting. Marker assisted selection (MAS) can facilitate breeders to produce seedless grapes without waiting years to see the actual fruits on vines.



To achieve this purpose, the magic is to use something called genetic marker. Genetic markers are DNA sequences located near to the desired genes (gene coding for seedlessness). Since the markers and the gene of interest are in close proximity, they tend to stay together as each generation of plants is produced. This can help breeders to predict whether a grapevine will produce seedless fruits with basic molecular techniques. If the marker for the gene encoding seedlessness can be found, it is very likely the grapevine seedling will produce seedless fruits.

Comparison with Genetic Engineering

Because the above-mentioned breeding techniques make use of plants' own DNA, not DNA from other species, they stand to be less controversial and well-accepted by the public.

However, there are limits to the use of these breeding methods. For example, controlled pollination may not be suitable for breeding if a needed character is not available in the population. Also, the successful rate of developing desired cultivars with the randomly induced mutation is rather low. Fortunately, these limitations may be complemented by other breeding techniques, such as genetic engineering which allows precise modification of genetic materials and introduction of specific characteristics from other species.

Above all, the greater understanding in agricultural biotechnology in recent years has led to new breeding methods with advantages over some traditional ones. Instead of replacing the conventional methods, the newly developed techniques complement them to make plant breeding more efficient and cost effective. With all these techniques, we can look forward to seeing more varieties of food in future.

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