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Biotech In focus

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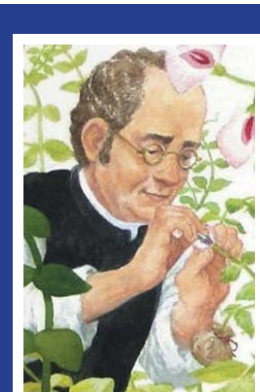
Plant Breeding Goes High-Tech

In our last installment, we met a family of tomato growers. Through them, we learned that for thousands of years, farmers have saved seeds from plants with useful traits to sow for the next year's crop.

At first, the farmers could choose the female, the seed-bearing parent, for traits they found desirable. Once farmers learned that pollen is the male parent, they could cross-breed two top-quality parents to produce even better seeds. Plant breeding flourished. After a while, our family of farmers could order tomato seeds by mail, as plant breeding and seed production became a commercially viable option.

One plant breeder who changed the world was Gregor Mendel, an Austrian monk. He discovered in the 1860s that traits didn't blend in the offspring like two different colors of paint. Instead, traits stayed intact and would reappear unchanged in later generations. By the early 1900s, scientists studying heredity showed that these traits identified by Mendel are carried on each cell's chromosomes; we now know that traits are the visible signs of having particular genes.



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MUTAGENESIS BREEDING

Plant breeders realized that damaging the chromosomes could create new traits, some of which were useful! Since the 1920s, plant breeders have used technology to mutate (change) the DNA in plant chromosomes. Plants or seeds are exposed to radiation or DNA-damaging chemicals; the survivors are then cross-bred, and the offspring are examined for useful mutations. This approach, called **mutagenesis breeding**, became a routine component of traditional plant breeding, and has given us thousands of new food, fiber, and ornamental crops, including seedless red grapefruit, disease-resistant pear, and high-yielding wheat and rice. As dramatic as causing mutations may sound, the technology produced many useful outcomes for agriculture.

Propagation

Twentieth-century science has also improved on another trick that's as old as farming itself. Some crop plants are difficult to breed, but easy to propagate. This means that if you take roots, stems, or suckers from the plant and put them in the ground, they'll produce a new plant that has the same genes as the old plant.

Tissue Culture

Taking this technique into the lab, scientists use healthy plant tissues to grow baby plants in a disease-free environment until they are big enough to survive in the field. This process is called tissue culture, or micro-propagation. In Hawaii, this method is being used to supply banana growers with plantlets that are free of the Banana Bunchy Top Virus.

Hybrids

Tissue culture can also be used to cross two different but related plants that can't mate without human help. The grain triticale, a hybrid of wheat and rye, was created this way.

For our family of tomato growers, the late 20th century offered many tools to improve their yields per acre. In addition to modern plant breeding, they probably relied on ammonia-based fertilizer to feed their plants, insecticides to keep their plants from being eaten, and herbicides to minimize the need for weeding. But pests and diseases have their own way of dealing with crops and pesticides by developing resistance and overcoming many control measures people apply. What new challenges would the next years bring, and how would the farmers meet those challenges?