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Genetically Modified Food III

Editor's Note: In last month's column, I presented a brief summary of the controversies surrounding the introduction and use of genetically modified foods. In this month's column, we will look at transgenic plants and the natural movement of plant genes.

Transgenic plants are plants that possess a gene or genes that have been transferred from a different species. Such modification may be performed through ordinary hybridization through cross-pollination of plants, but the term today refers to plants produced in a laboratory using recombinant DNA technology in order to create plants with specific characteristics by artificial insertion of genes from other species, and sometimes entirely different kingdoms.

Prior to the current era of molecular genetics starting around 1975, transgenic plants, including cereal crops, were (since the mid 1930s) part of conventional plant breeding.

Transgenic varieties are frequently created by classical breeders who deliberately force hybridization between distinct plant species when carrying out interspecific or intergeneric wide crosses with the intention of developing disease resistant crop varieties. Classical plant breeders may use a number of in vitro techniques such as protoplast fusion, embryo rescue or mutagenesis to generate diversity and produce plants that would not exist in nature.

Such traditional techniques (used since about 1930 on) have never been controversial, or been given wide publicity except among professional biologists, and have allowed crop breeders to develop varieties of basic food crop, wheat in particular, which resist devastating plant diseases such as rusts. Hope is one such transgenic wheat variety bred by E. S. McFadden with a transgene from a wild grass. Hope saved American wheat growers from devastating stem rust outbreaks in the 1930s.

Methods used in traditional breeding that generate transgenic plants by non-recombinant methods are widely familiar to professional plant scientists, and serve important roles in securing a sustainable future for agriculture by protecting crops from pests and helping land and water to be used more efficiently.

Natural movements of genes between species.

Natural movement of genes between species, often called horizontal gene transfer or lateral gene transfer, can occur because of gene transfer mediated by natural agent. This natural gene movement between species has been widely detected during genetic investigation of various natural Mobile genetic elements, such as transposons, and retrotransposons that naturally transfer to new locations in a genome, and often move to new species host over an evolutionary time scale. There are many types of natural mobile DNAs, and they have been detected abundantly in food crops such as rice.These various mobile genes play a major role in dynamic changes to chromosomes during evolution. Such genetically mobile DNA constitute a major fraction of the DNA of many plants, and the natural dynamic changes to crop plant chromosomes caused by this natural transgenic DNA mimics many of the features of plant genetic engineering currently pursued in the laboratory, such as using transposons as a genetic tool, and molecular cloning. Gene duplication and exon shuffling by helitron-like transposons generate intraspecies diversity in maize.

There is new scientific literature about natural transgenic events in plants, through movement of natural mobile DNAs called MULEs between rice and Setaria millet. It is becoming clear that natural rearrangements of DNA and generation of transgenes play a pervasive role in natural evolution.

Importantly many, if not most, flowering plants evolved by transgenesis – that is, the creation of natural interspecies hybrids in which chromosome sets from different plant species were added together. There is also the long and rich history of transgenic varieties in traditional breeding.

Deliberate creation of transgenic plants during breeding and production of transgenic plants in wide-crosses by plant breeders has been a vital aspect of conventional plant breeding. Without it, security of our food supply against losses caused by crop pests such as rusts and mildews would be severely compromised. The first historically recorded interspecies transgenic cereal hybrid was actually between wheat and rye (Wilson, 1876).

Last century, the introduction of alien probing into common foods was repeatedly achieved by traditional crop breeders by artificially overcoming fertility barriers. Novel genetic rearrangements of plant chromosomes, such as insertion of large blocks of rye (Secale) genes into wheat chromosomes ('translocations'), have also been exploited widely for many decades.

By the late 1930s with the introduction of colchicine, perennial grasses were being hybridized with wheat with the aim of transferring aids resistance and perenniality into annual crops, and large-scale practical use of hybrids was well established, leading on to development of Triticosecale and other new transgenic cereal crops. In 1985, 'Plant Genetic Systems', founded by Marc Van Montagu and Jeff Schell, was the first company to develop genetically engineered (tobacco) plants with insect tolerance by expressing genes encoding for insecticidal proteins from *Bacillus thuringiensis* (Bt).

The intentional creation of transgenic plants by laboratory based recombinant DNA methods is more recent (from the mid-80s on) and has been a controversial development opposed vigorously by many NGOs, and several governments, particularly within the European

Community. These transgenic recombinant plants (= biotech crops, modern transgenics) are transforming agriculture in those regions that have allowed farmers to adopt them, and the area sown to these crops has continued to grow globally in each of the ten years since their first introduction in 1996.

Transgenic recombinant plants are now generally produced in a laboratory by adding one or more genes to a plant's genome,and the techniques frequently called transformation. Transformation is usually achieved using gold particle bombardment or a soil bacterium (*Agrobacterium tumefaciens*) carrying an engineered plasmid vector, or carrier of selected extra genes.

Transgenic recombinant plants are identified as a class of genetically modified organism(GMO); usually only transgenic plants created by direct DNA manipulation are given much attention in public discussions.

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