allele(s) one form of a gene

Autopolyploids may have a different type of genetic buffering. Most autopolyploids are highly heterozygous, with two, three, or more **alleles** represented at any one genetic locus. This may provide the organism with different avenues of response to the demands of different sets of environmental conditions. SEE ALSO CHROMOSOMES; COTTON; SPECIATION; WHEAT.

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Potato

The potato (*Solanum tubersosum*) is one of the world's most productive, nutritious, and tasty vegetables, and it is the fourth most important food worldwide regarding production (following rice, wheat, and corn). It is the most economically valuable and well-known member of the plant family Solanaceae, which contains such foods as tomatoes and peppers, and flowers such as the petunia. The edible tubers of potato are actually swollen underground stems, in contrast to the similarly appearing sweet potatoes, which have swollen roots, and are a member of the separate family Convovulaceae (morning glory family).

Early peoples in the high Andes Mountains of Bolivia and Peru, where many wild potato species grow, likely selected the potato as a food about ten thousand years ago. This is a time when many crops were believed to have been selected in Andean South America, and dried potato remains date from about seven thousand years ago from caves in Central Peru. Wild potato species have a geographic range from the southwestern United States to south-central Chile. There is much controversy regarding the number of wild potato species, from perhaps only one hundred to over two hundred.

Unreduced gametes can be artificially induced by various compounds, most notably colchicine, which interferes with the action of the meiotic spindle normally responsible for separating chromosomes. Colchicine has been widely used by geneticists to create synthetic polyploid plants, both for experimental purposes and to introduce valuable genes from wild diploids into major crops. Synthetic polyploids developed by humans from wild plants have contributed to improvement of cotton, wheat, peanut, and other crops. One artifically induced polyploid, triticale (which combines the genomes of wheat and rye), shows promise as a major crop itself.

Finally, many crops that are grown for vegetative parts are bred based on crosses between genotypes of different ploidy, which produce sterile progeny. For example, many cultivated types of banana (*Musa* spp.) and Bermuda grass (*Cynodon* spp.) are triploid, made from crosses between a diploid and a tetraploid. In each of these crops, seed production is undesirable for human purposes, and the unbalanced genetic constitution of the triploids usually results in seed abortion. Each of these crops is propagated clonally by cuttings. This is a good example of how humans have applied basic research knowledge to improved quality and productivity of agricultural products.

Occurrence in Plants, Including Economically Important Crops. Many additional plant genomes may have once been polyploid. For example, maize has twenty chromosomes in its somatic nucleus and exhibits strict bivalent pairing—however at the deoxyribonucleic acid (DNA) level, large chromosome segments are found to be duplicated (i.e., contain largely common sets of genes in similar arrangements). In most cases, the duplicated regions no longer comprise entire chromosomes, although they may once have. Other examples of such ancient polyploids include broccoli and turnips. Hints of ancient chromosomal duplications are found in many plants and are particularly well characterized in sorghum and rice. Recent data from DNA sequencing has supported earlier suggestions from genetic mapping that even the simple genome of *Arabidopsis* may contain duplicated chromosomal segments. As large quantitites of DNA sequence information provide geneticists with new and powerful data, it is likely we will discover that many organisms that we think of as diploid are actually ancient polyploids.

Importance in Evolution. Because of the abundance of polyploid plants, it can be argued that the joining of two divergent genomes into a common polyploid nucleus is the single most important genetic mechanism in plant evolution. Geneticists have long debated whether the abundance of polyploid plants simply reflects plant promiscuity or if a selective advantage is conferred by polyploid formation. Plants appear to enjoy greater freedom than animals to interbreed between diverse genotypes, even between genotypes that would normally be considered to be different species. However, one could also envision that the presence of multiple copies of a gene in a plant nucleus offers flexibility to evolve. While mutation (changes in the genetic code) is necessary for evolution, most mutations disrupt the genetic information rather than improve it. In polyploids, if one copy of a gene is disrupted, other copies can still provide the required function—therefore there may be more flexibility to experiment—and allow rare favorable changes to occur.

The potato was not introduced into Europe until the late sixteenth century, where it was only slowly accepted as a food, and even then only by the poor. The potato is infected by many diseases and requires a lot of care. The fungal disease potato late blight was the cause of the devastating Irish potato famine that began in 1846. The famine killed more than one million people and stimulated the huge immigration of Irish people to continental Europe and the United States. SEE ALSO ECONOMIC IMPORTANCE OF PLANTS; POTATO BLIGHT; SOLANACEAE.

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Potato Blight

Potato blight (or potato late blight) is caused by a mildewlike fungus called *Phytophthora infestans* that can infect the potato foliage and its tubers. Although *P. infestans* is best known as a **pathogen** of the potato, this fungus also attacks the tomato and a number of other plants belonging to the family Solanaceae.

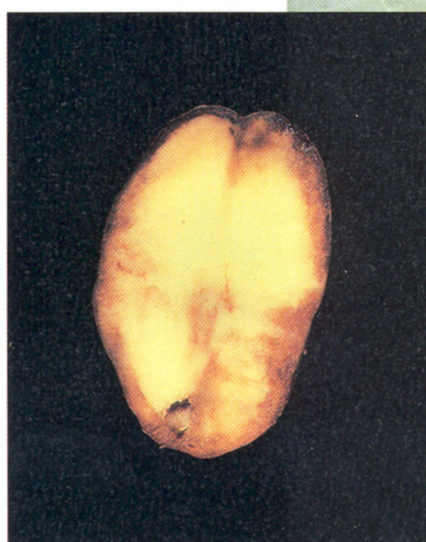
pathogen disease-causing organism

History

This disease first came to the attention of the world in the 1840s, when it suddenly appeared in Europe and caused the disastrous Irish potato famine. From Europe, the fungus spread all over the world. At first it was thought that the blight was simply due to rainy, cool weather, which caused the potato foliage to turn black and die. In 1863, a German scientist, Anton deBary, proved that *P. infestans* was the cause of the disease, and through his pioneering work, deBary established the base for a new science: plant pathology.

sporulate(s) to produce or release spores

In 1884 in France, a fungicide spray containing copper sulphate and lime, called Bordeaux mixture, was discovered to be an effective means of controlling potato blight when applied to the foliage. This was the first time a plant disease was controlled by protective spraying. During the past fifty years hundreds of chemical fungicides have been developed for the control of potato blight. In the early twenty-first century, the potato crop receives more chemicals annually than any other food plant that we grow. The annual losses due to potato late blight, including both the direct losses in yield and the expense of chemical control, amount to billions of dollars a year.



A potato diseased with potato late blight.

The Disease

P. infestans passes the winter in infected seed tubers kept in potato storages or in the soil of the potato field to be planted. As the new potato crop becomes established during a cool, wet season, the fungus emerges, **sporulates**, and attacks both the foliage and the tubers. If this favorable weather continues, the potato plants can be completely destroyed.