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Editorial

Polyploidy in plant breeding and genetics

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EDITORIAL NOTE

Polyploidy is a key driver in both wild and farmed plant evolution. The expansion of plant organs ("gigas" effect), buffering of harmful mutations, enhanced heterozygozygosity, and heterosis are some of the most important implications of polyploidy for plant breeding (hybrid vigor).

Polyploidy occurs when cells divide abnormally, either during mitosis or, more typically, during metaphase I of meiosis (it may arise from the failure of chromosomes to separate during meiosis or from the fertilisation of an egg by more than one sperm). In addition, several substances can cause it in plants and cell cultures: the most well-known is colchicine, which can cause chromosomal doubling, but its usage may have other, less evident side effects. Oryzalin will also double the content of existing chromosomes.

In highly differentiated human tissues such as the liver, heart muscle, bone marrow, and placenta, polyploidy occurs. It may be found in the somatic cells of certain animals, such as goldfish, salmon, and salamanders, but it's most prevalent in ferns and blooming plants (see *Hibiscus rosa-sinensis*), both wild and farmed. Wheat, for example, has diploid (two sets of chromosomes), tetraploid (four sets of chromosomes) with the common names of durum or macaroni wheat, and hexaploid (six sets of chromosomes) with the popular name of bread wheat after millennia of human hybridization and alteration. Many of the genus *Brassica's* agriculturally significant plants are also tetraploids. Ploidy levels in sugarcane can be higher than octaploid.

Polyploids are classed as either euploids or aneuploids based on their chromosomal composition. The bulk of polyploids are euploids.

Autopolyploidy occurs when all of the genomes of a polyploid species are identical, and the scenario is referred to as autoploidy. AAAA Autoploidy, for example, has played a modest influence in the development of plants. Autopolyploids make only a small percentage of today's crop species.

Allopolyploidy occurs when all of the genomes of a polyploid species are not similar. Allopolyploids have genomes from two or more species. (For instance, AA and BB.) Today's allopolyploids are most likely the result of chromosome doubling in F1 hybrids between two independent species belonging to the same genus or two different genera. Because they are synthesised by man from two separate genus or species of plants, allopolyploids generated by man are known as synthetic allopolypoids.

The term mesopolyploid is frequently applied to animals that have undergone whole genome duplication, triplification, or other forms of whole genome multiplication in recent history, such as during the previous 17 million years. Paleopolyploidy is the outcome of genomic duplications that happened millions of years ago (MYA). A single species' genome may be doubled (autopolyploidy), or two species' genomes could be combined (allopolyploidy).... Paleopolyploidy has been researched extensively in plant lineages.

Polyploidy is common in plants, and it has been a major source of speciation in the angiosperms. Allopolyploidy, or the doubling of chromosomes in a hybrid plant, is particularly essential. A hybrid is normally sterile because it lacks the homologous pairs of chromosomes essential for effective gamete production during meiosis. However, if the plant doubles the chromosomal set acquired from each parent through polyploidy, meiosis can occur, as each chromosome will have a homologue produced from its duplicate set.

As a result of polyploidy, the previously sterile hybrid becomes fertile, gaining the status of a whole species different from either of its parents. Polyploidy is thought to have given rise to up to half of all known angiosperm species, including some of the most cherished by humans. Plant breeders use this method by treating desired hybrids with substances that promote polyploidy, such as colchicine.

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