

Lesson 1: Traditional Plant Breeding

Traditional plant breeding technologies are described in this lesson. Basic breeding practices include natural crossbreeding, selective breeding, and hybridization. Modern plant biotechnology is founded in plant breeding practices that are thousands of years old.

Natural Crossbreeding

Natural crossbreeding is the name for the reproductive process in which two plant varieties, which have different genotypes, sexually reproduce without human intervention. Natural crossbreeding allows the random mixing of genes to occur within a species. Desirable and undesirable traits are combined within the plant species. Plants that receive more vigorous genes generally grow and reproduce better than plants that do not. Weaker plants will therefore very gradually diminish in number as stronger plants dominate. This gradual improvement of the species can be accelerated through selective breeding practices.

Selective Breeding

Selective breeding is the process of identifying plants with desirable traits and causing them to reproduce. Plants are selectively bred mainly for two reasons: to increase the production of the useful parts of the plant or to increase the ability of a plant to withstand harsh environments, disease, or plant pests. Selective breeding can be done asexually or sexually. Many horticulture crops are reproduced asexually. Most field crops have traditionally been reproduced by sexual breeding methods, but more recently the asexual method of plant tissue culture has been used. Sexual breeding methods include inbreeding and hybridization. Inbreeding is the crossing of closely related plants to cause their offspring's traits to become more homozygous. Hybridization occurs when two inbred plants that are genetically different are crossed to produce plants that are superior to both the parent plants.

Advantages and Disadvantages of Selective Breeding

Selective breeding has two advantages. It allows the plant breeder to increase the occurrence of desired plant traits; typically, the most important trait is crop yield. Selective breeding also helps to make the performance of a crop more predictable since the selected plants are multiplied by controlling their pollination to produce a more uniform crop of seeds. This seed crop is sold to farmers who produce the final product.

Selective breeding also has some disadvantages. While the occurrence of desired traits increases, the occurrence of undesirable traits may also increase. As the selected plants are bred, the plants become more homozygous for both desired and undesired traits. A second disadvantage is that the genetic diversity of a crop species decreases as more similar plants are selected. Some native varieties of crops have been lost due to the extensive use of fast-growing high-yield varieties that crowd out the plants that grow more slowly. Another disadvantage of selective breeding is that the uniformity of the crop plants can increase insect problems. Insects that like a certain crop can multiply quickly when the crop is more uniform and cause a greater amount of crop damage.

Hybrids

Hybrids are plants produced by crossing two inbred lines of plants that are greatly different genetically. Before a hybrid is produced, inbreeding is used to develop a consistent plant phenotype. Breeders force a plant to self-pollinate and then force its offspring to do the same. They repeat this process five to seven times so that the plants will consistently express the same phenotype.

Breeders use three common methods to produce a hybrid seed. The first method is called a single cross. When inbred plant Z is crossed with inbred plant Y, the result is a single cross hybrid, ZY. The second method

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of hybridization is called a three-way cross. A three-way cross is made by taking a single cross ZY and crossing it with another unrelated inbred plant X to produce a three-way cross hybrid, ZYX. The third type of hybridization is the double cross. In a double cross, breeders make two single crosses, and then they cross the two single cross hybrids.

A hybrid generally displays more vigorous growth than both of its parents. This extra vigor in its growth is called hybrid vigor, or heterosis. However, hybrid plants usually either are sterile or

produce offspring that do not perform well and are inferior to the hybrid. Extensive work must continually be done to supply hybrid seed to producers.

Summary

Breeders have replaced natural crossbreeding of plants with selective breeding and hybridization to produce superior plants. These crop development methods have laid the foundation for the modern methods of plant development--plant tissue culture and genetic manipulation.

Credits

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