

Lesson 8: Plant Genetics

Many factors contribute to the high production levels of quality food crops in the U.S. One very important factor is the application of knowledge gained through research in plant genetics. In this lesson, plant genetics, genetic engineering, and their effects on plant production will be discussed.

Inheritance

Inheritance is a term used in plant genetics that refers to the transmission of genes from one generation to the next. The genetic makeup of a plant determines the expression of traits (e.g., yield potential, flower color, and leaf structure). Many plant characteristics are transmitted from one generation to another. Genes are the smallest unit of inheritance, which transmit genetic information between generations.

Environmental factors will ultimately determine the extent to which the genetic potential of a plant is expressed. However, the genetic makeup of each plant dictates the potential for the expression of each plant characteristic.

Researchers have begun to manipulate the genetic makeup of plants. Desirable traits are retained, while undesirable traits are eliminated. Genetic manipulation involves the transfer of genetic material from one generation of plants to the next.

DNA and Genes

Chromosomes are located within the nucleus of each plant cell. Chromosomes consist of a sequence of DNA (deoxyribonucleic acid). Within the DNA chain, there are specific function-controlling segments called genes. Genes are the parts of a chromosome that determine individual plant characteristics. The overall function and importance of DNA is that it serves as a coding mechanism for heredity. DNA also contains information to control the synthesis of enzymes that control the basic metabolic processes of all cells.

Genetic Engineering

In 1866, an Austrian monk by the name of Gregor Mendel published a scientific paper reporting the results of his experiments. Mendel had been researching plant genetics and how specific characteristics are passed from generation to generation. Since Mendel's time, much work has been done in the area of plant genetics.

During the process of pollination, plants either self-pollinate or cross-pollinate to reproduce. This process involves sexual fusion of male and female cells. (Refer to Lesson 7 for more information on sexual reproduction). Humans can intervene in this process of pollination by controlling and directing the cross-pollination of specific plants. Genetic engineering is quite different from controlling the pollination process. Genetic engineering is the process of transferring genes from one organism to another. This process can develop new plants known as somatic hybrids.

Biotechnology Benefits Crop Production

The term biotechnology is often used in a discussion of genetics or genetic engineering. Biotechnology is the use of technology in the study and research of living beings and life processes. Researchers use biotechnology in the study of plants for many reasons. Using biotechnology in plant production, researchers can genetically manipulate the production of crop plants. This manipulation has led to increased production levels to meet the growing demand for food. Genetic engineering can reduce the amount of time required to change the genetic makeup of a plant species. These new plants are known as somatic hybrids.

Genetic engineering can also increase beneficial characteristics of plants. Insects and diseases can decrease plant growth and food production. Introducing disease-resistant traits into plants through genetic engineering can enable plants to produce under adverse conditions.

Ethics

Genetics is basic to all living organisms. Therefore, the genetic engineering techniques used on lower life forms

Plant Science

are theoretically applicable to higher life forms. Ethical considerations are important factors to consider when making decisions about genetic engineering. Genetic manipulation changes the makeup of a living organism from an occurrence in nature to a product of science. Consideration of the motives for the research, safety during the research, and application of the findings must be part of the decision making process. Social and consumer acceptability, environmental impact, and the costs versus the benefits of genetic engineering should also be considered. Genetic engineering has become a controversial issue in scientific research. However, there is usually less public concern with genetic engineering in the plant kingdom than in the animal kingdom.

With a continually growing world population, the need for food confronts everyone daily. Plant scientists, geneticists, and agriculturalists work to address specific food shortage problems. Not all countries are able to produce adequate amounts of food crops, yet the need for food for their citizens is very real. Working with genetic engineering, modified plants can be developed to grow and produce in harsh environments. Genetic research with plants is conducted to find more efficient ways to produce quality food crops.

Summary

Plant genetics is a highly technical area of science. Research on the inheritance of specific traits, DNA, genes, and genetic engineering of desirable traits continues to address the growing need for food through plant production. As plant geneticists work toward improving plants, ethical considerations must be an integral part of that process.

Credits

Agrios, G.N. *Plant Pathology*. 3rd ed. New York: Academic Press, 1988.

Cooper, E.L. *Agriscience: Fundamentals and Applications*. Albany, NY: Delmar Publishers Inc., 1990.

McPheeters, Ken. *Introduction to Plant Biotechnology*. College of Agriculture, University of Illinois: Vocational Agriculture Service, n.d.

Sattelle, D.B. *Biotechnology in Perspective*. New York: VanNostrand Reinhold Co., 1988.