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What is Agricultural Biotechnology?[1]

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Biotechnology, specifically genetic engineering, is the manipulation of an organism's DNA in order to direct that organism to perform a specific and useful task. This is usually accomplished by transferring a section of DNA, or gene, from one organism to another. In agriculture, plant biotechnology is used for crop improvement. Historically, traditional breeding has been used for crop improvement, but traditional breeding can be a long, tedious and imprecise process. In comparison, genetic engineering for crop improvement may be faster and more precise. Some examples of crop improvement through genetic engineering include resistance to insects, tolerance to herbicides, immunity to disease, and enhanced nutrition.

DNA contains genes that are responsible for heredity. Genes contain information leading to characteristics of an organism that are passed from parents to offspring through reproduction. For example, genes determine the color of a butterfly's wings or the sex of a human baby. Genes provide the information that a cell needs to make proteins; proteins are then used to provide structure and function for an organism. Basically, genes are blueprints that tell the cell how to build proteins, just as a contractor would use blueprints to build a house. Genetic engineering is possible because DNA is a universal blueprint that all cells from any organism can read.

Transferring genes between organisms is nothing new; genes are transferred all the time through sexual reproduction. Throughout history humans have selected for the most desirable traits in plants and animals through traditional breeding. Through traditional breeding, two plants with different desirable traits are selected and bred in hopes that the offspring will possess the desirable traits of each parent. Unfortunately, through traditional breeding it is not possible to control which genes are transferred from the parents to the offspring and the results are often uncertain. Many crosses between plants with differing genes may be necessary to obtain the desired results. The time frame gets even longer if traits from multiple plants are to be combined. It may take many years of tedious labor in order to obtain a crop that has all of the desired traits. An additional drawback to traditional breeding is that it is only possible to combine genes between organisms of the same species.

Unlike traditional breeding, genetic engineering makes it possible to specifically select exactly the

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traits desired and insert the genes that code for them into the plant. Genetic engineering allows scientists to know exactly which genes they are inserting into the genetic code of the plant. In addition, the genes do not have to be from the same species. A desired trait from a bacterial or mammalian gene may be inserted into a plant. Since all organisms read DNA the same way, a gene from the DNA of one organism can be inserted into the DNA of another organism.

Bt Corn is an example of how a gene from a bacterium may be inserted into a plant. *Bacillus thuriengensis*, referred to as Bt, is a naturally occurring soil bacterium that produces a protein that is toxic only to certain insect larvae and nothing else. Scientists can produce a “clone”, or identical copy, of the gene that produces this protein and insert it into the DNA of a corn plant. Since the DNA from both organisms is the same language, the corn plant can read the Bt gene and produce the same protein. Whenever the specific insect larva feeds on a corn plant containing the Bt geane, it consumes the protein and dies, thus reducing costly crop damage and the need for harmful chemical insecticides.

Agricultural biotechnology allows direct manipulation of the genetic code of plants and can result in rapid improvements like never before. Using genetic engineering, desirable traits can efficiently be into plants. By taking advantage of the universal nature of DNA, genes from various sources in order to produce better crops.