

Plant Breeding and Genetics

A paper in the series on The Need for Agricultural Innovation to Sustainably Feed the World by 2050

The [ultimate goal](#) of plant breeding is to develop improved crops.

- Improvements can be made in crop productivity, crop processing and marketing, and/or consumer quality.
- Crop improvement through technological innovation is facilitated, empowered, leveraged, and maximized in a number of ways.

Innovation [provides the means](#) to achieve greater gains, increase efficiency, and accelerate time to market for improved cultivars.

- Several genetic technologies have been developed to expand the range of genetic variation beyond that found in the allelic variation of native genes in diverse germplasm.
- Although breeding can be conducted without any knowledge of the actual genes causing trait variation, understanding the genetic basis of a trait can lead to more effective selection.
- For many crops, evaluations are done using homozygous lines developed by several generations of self-pollination.
- Phenotyping involves assessment of performance for the traits associated with the breeding target.
- Because hybridization can translate to yield increases of as much as 20–50% in self-pollinated or open-pollinated crops, it is not surprising that many crops are grown either significantly or predominantly as hybrids.



Approaches to [regulatory oversight](#) have varied by nation.

- As the first to approve commercialization of a GM crop, the United States adopted a product-based approach.
- Most countries that are signatories of the Cartagena Protocol, including those in the European Union, have implemented a regulatory framework that uses a process-based approach to regulatory oversight.
- Some countries developed distinctive regulatory systems integrating various elements from the United States and European Union approaches rather than focus on a single model.

New, [improved cultivars](#) can take seven to ten years to develop, or longer if “exotic” germplasm is also used.

- Although intellectual property (IP) protection offers benefits to innovators, the question arises as to whether or not innovation and development of new improved cultivars is thwarted by such practices.
- Economic studies and empirical evidence show that IP protection does not lead to a zero-sum game in agriculture.
- Intellectual property protection in the field of plant breeding, biotechnology, and seed production is necessary to attract private or commercial investments in order to stimulate innovative research that may have an element of risk in leading to delivery of high-quality and better-performing products to farmers and growers with consequent benefits to society as a whole.

Plant breeding is an [impact science](#) that is helping to feed the world while creating global businesses.

- Plant breeding science has been successful, but the rate of improvement is insufficient to create the future that humanity wants, needs, and deserves.
- Game-changing technologies must reach relevant crops that are important for the many and diverse regions and cultures of the world because realizing the gain needed in agricultural production will necessitate a broad sweep across global food production systems in grand scale.

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