

BIOTECHNOLOGY SEEDS

From lab to farm

It's in the genes. Making better seed varieties has everything to do with better genes. These genes are the codes of instruction found in every living thing – codes that tell organisms to make substances for growth, survival and many other functions or traits. Plant biotechnology has enabled researchers to take beneficial genes from selected organisms and introduce them into plants, thus making better varieties. Some examples include biotechnology crops that are resistant to pests, more nutritious, or contribute to end products of other industries, such as biofuels.

It's not easy. Making biotechnology seeds available to farmers across the world involves a long, costly process. Product development from the gene discovery phase to seed commercialisation takes about 10 years, costs roughly US \$100 million, and requires regulatory review and compliance at various stages. Tests during product development consider intended use of the product, plus ethical, environmental, food and feed safety implications.

It's rewarding. Despite the challenges, the plant science industry and a number of public research institutions continue producing better seeds through modern biotechnology – by far the only viable technology for transferring desirable genes between unrelated organisms. Results deliver significant benefits to farmers and their customers. In the Asia-Pacific region, farmers are increasingly planting biotechnology crops on millions of hectares of land, year after year.






It's a packaged deal. The responsibility of biotechnology seed developers continues long after seeds have been distributed. They must ensure that national biosafety measures and other compliance requirements are observed. And that is called product stewardship – the responsible and ethical management of a biotechnology product from discovery or development through to its ultimate use.

It's a bright future. The future promises many new biotechnology crop varieties, with benefits for farmers, consumers and economies around the world. But first, every product will pass through many development phases, rigorous safety tests and strict regulatory review. That's what it takes to make better seeds through biotechnology. There are no short cuts. And stewardship is key to making it work.



Biotechnology Stewardship across the Product Lifecycle

Biotechnology Seeds: Regulatory Controls from Discovery to Production

Phase	Activities	Safety and Regulatory Controls
<p>Gene Discovery</p> 	<ul style="list-style-type: none"> • Gene identification. Researchers screen for genes that could give crops beneficial traits – better growth, better nutrition, better by-products, and more. • Concept testing. Developers study technical feasibility of the biotechnology product. 	<p>Lab research</p> <ul style="list-style-type: none"> • Concept/strategy/choice of genes • Source of genes, ethics • Environmental consideration of gene or crop
<p>Plant Development</p> 	<p>Early Gene Research</p> <ul style="list-style-type: none"> • Gene design. The gene is packaged in a way that 'works' when introduced to a plant. • Transformation. The gene is inserted in a plant variety. Products are called transformed or transgenic plants. <p>Early Development</p> <ul style="list-style-type: none"> • Greenhouse trials. Performance of transgenic plants is evaluated in greenhouse conditions. Top performer is selected. • Field trials. Performance of a transgenic plant is evaluated in open fields under strict regulatory compliance. <p>Advanced Development</p> <ul style="list-style-type: none"> • Variety development. Transgenic plant is bred with superior varieties, producing seeds with a combination of desired traits. • Regulatory data generation. Evaluation data for scientific review of the biotechnology product is generated. <p>Regulatory Submission</p> <ul style="list-style-type: none"> • Data Submission. Test data for transgenic plants is submitted to various authorities. • Review. Regulators decide whether to approve biotechnology seeds for planting and other intended uses (e.g. food and feed). 	<p>Field work</p> <ul style="list-style-type: none"> • Agronomic traits • Genetic stability • Environmental impact <p>Advanced safety testing</p> <ul style="list-style-type: none"> • Food safety <ul style="list-style-type: none"> • <i>Nutritional composition</i> • <i>Allergenicity</i> • <i>Toxicity</i> • Feed safety • Environmental safety
<p>Seed Production</p> 	<ul style="list-style-type: none"> • Field production. Developers mass-produce biotechnology seeds for distribution. • Preparing for marketing/distribution. Biotechnology seeds are packaged for sale to farmers through distribution channels. 	