The DNA of our business

The tools of our innovation

At the heart of our business is our science. But translating science into innovation – elevating basic research into breakthrough discovery – does not come easily. Success in research is the product of commitment. It requires that many elements work in concert to do more and to do it faster. Monsanto's leadership in research exists because we have the dedicated people, cutting-edge tools, and proven experience to make science work in new ways for agriculture.

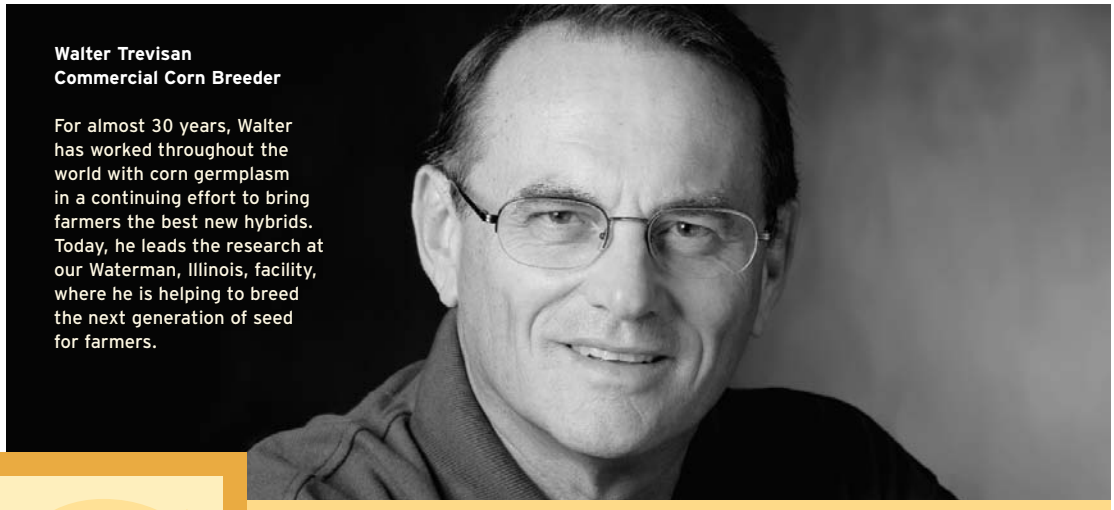
In this section, we break down the tools of innovation and show you the sophisticated interaction between these tools as they are applied to bring new products forward in a company that sells seeds and traits.

The value we bring to farmers

We're an agricultural company, and we take our cue from our customers. We recognize Monsanto's business is successful only when farmers are successful. So our focus is on applying innovation and technology to make our farmer customers more productive and profitable. The research engine that we've assembled allows us to bring farmers better technology faster than ever before. For each project that becomes a commercial product, we draw upon a different combination of resources and tools. Part of our leadership advantage is the breadth of our technology resources. All of them allow us to offer our customers new options that translate into new value.

The tools of our innovation

We currently invest more than $1.5 million a day to discover and bring to market the innovative technologies our customers tell us make a difference. The technology tools we use are described here by the people who use them every day. While others in the market may be moving to some of the same technology tools, we believe what differentiates us is that we bring these tools together in an integrated system that reflects our customer focus.



Walter Trevisan
Commercial Corn Breeder

For almost 30 years, Walter has worked throughout the world with corn germplasm in a continuing effort to bring farmers the best new hybrids. Today, he leads the research at our Waterman, Illinois, facility, where he is helping to breed the next generation of seed for farmers.

Germplasm

Germplasm is the genetic raw material contained in all the plants of a species. Within the germplasm are the basic characteristics that make plants what they are. Breeding is based on using germplasm to find the best combinations of characteristics that can make plants perform better.

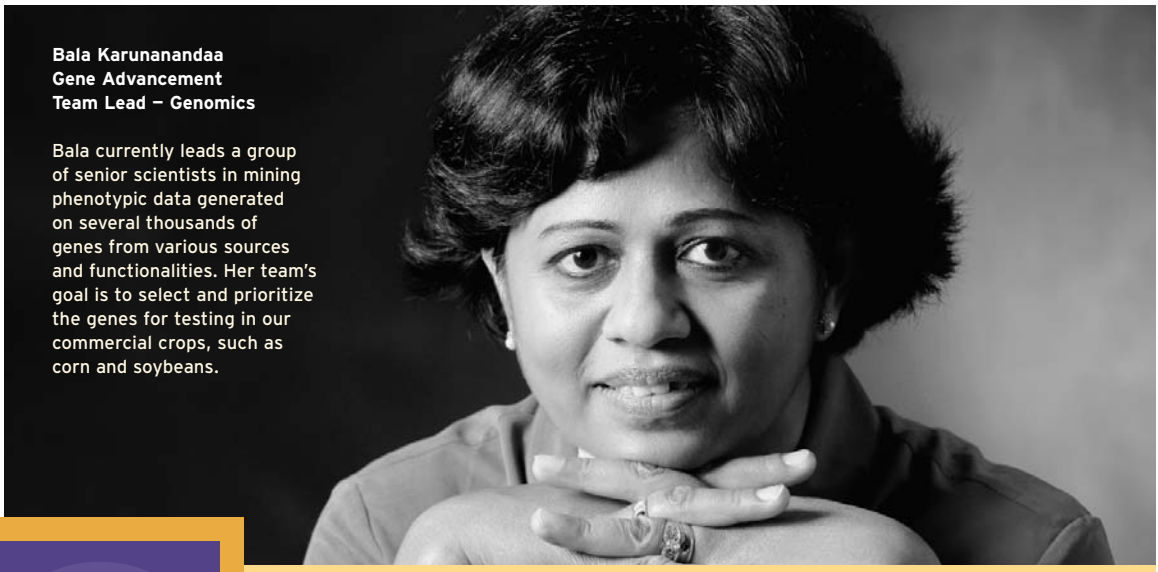
Germplasm is the building block of Monsanto's seeds-and-traits business

To many people, seed is seed. Not so for farmers. Every type of seed is different. The characteristics a corn farmer in Iowa needs in his seed may be vastly different than the characteristics a corn farmer needs in Colorado. In fact, the characteristics the Iowa farmer needs are less likely to come from corn in Iowa than from places like Asia or South America.

Why is germplasm important for Monsanto?

Seed germplasm in crops is analogous to bloodstock in thoroughbred race horses. Thoroughbred breeders breed the fastest race horses to get the benefit of their genes into the next generation. In the same way, seed breeders tap into the best pool of genes to create even better seed combinations. We target characteristics such as disease tolerance, heat and cold tolerance, and high yield potential to create a seed package that gives farmers reliable yield and boosts their profitability.

Our germplasm bank – assembled from six continents and across all our crop areas – has greater breadth and depth than any other germplasm bank in the industry. Every year, our breeders exchange more than a million different "packages" of germplasm material, creating a global network to breed seed for local farmers. The strength of our germplasm allows us to deploy the other tools in our arsenal to breed the highest-performing products, which are the commercial gems.



Bala Karunanandaa
Gene Advancement
Team Lead – Genomics

Bala currently leads a group of senior scientists in mining phenotypic data generated on several thousands of genes from various sources and functionalities. Her team's goal is to select and prioritize the genes for testing in our commercial crops, such as corn and soybeans.

Genomics

Genomics is one of the tools we use to mine germplasm. We find the best combinations of characteristics that can be bred or introduced into plants for better products. Genomics allows us to map the genes of a plant to understand their structure and the role they play in the plant's function.

Genomics probes germplasm to unlock its value

Using automated, high-volume screening, we sequence literally hundreds of thousands of different genes. Everything else in the technology toolbox stems from the genomics blueprint of a plant.

The map of a plant's genome sets in motion two research pathways. First, gene sequencing can identify very specific genes and their potential function. Those genes become targets for new traits, fueling our biotechnology research. Second, these maps provide insight into the order and relationships of certain sequences of genes. Through testing, those relationships yield markers that provide virtual signposts for certain characteristics. Breeders can use those markers within the germplasm to identify the best commercial prospects.

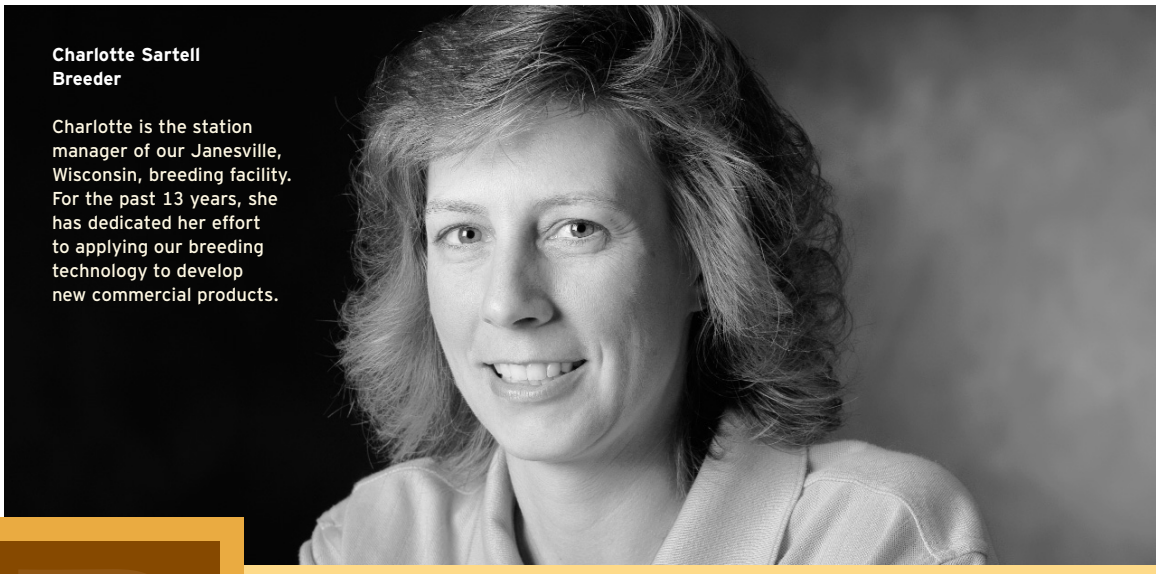
How does genomics apply to biotechnology?

Fundamentally, we search for new product opportunities by working backwards from a problem. We first identify a need and then look for ways we can use our tools to address it. As we learn about the function of particular genes through many different components of genomics function – including sequence analysis, expression profiling, phenotypic data analysis, and systems biology – we uncover genes that can become targets to address a particular problem. Genomics provides us with the tools and methods to characterize genes from a variety of sources and assign the relevant function based on their sequence characteristics. Using our biotechnology tools, we can introduce these genes into the crops where they can make a difference.

The automated systems central to genomics work have revolutionized almost every aspect of our research work. We've brought a new level of standardization to everything from the tools that make genes perform better to the quality testing we do to evaluate product candidates.

How do markers work?

Markers are simply pieces of DNA that indicate where genes are located. Through sequencing, we generate tens of thousands of random markers. Through breeding experiments, we can start correlating those random markers with specific traits. We basically create an idealized map of a crop plant, identifying the markers for the key traits we want to breed for. Then we screen our germplasm against the idealized map, so our breeders can find the germplasm with the unique combinations of genes that will deliver the traits they need.



Charlotte Sartell
Breeder

Charlotte is the station manager of our Janesville, Wisconsin, breeding facility. For the past 13 years, she has dedicated her effort to applying our breeding technology to develop new commercial products.

B

Breeding

Breeding is the process of cross-pollinating plants with desirable qualities to develop improved plants in successive generations that combine all the desirable traits in a single individual. Molecular breeding is an enhanced tool that involves the use of DNA markers for genes in combination with physical measurement of traits to accelerate selection in plant breeding programs.

Breeding, as we use the term, encompasses both **conventional breeding** and **molecular breeding** – or marker-assisted breeding. Breeding is one of the two core platforms of Monsanto's technology pipeline.

New approaches have reinvented breeding

Breeding is a shorthand term that encompasses a variety of approaches that can be used to refine germplasm to select the best attributes that exist within a crop's genetic stock. Our plant breeders select desirable traits from our unique germplasm library and combine them into a single crop plant with commercial potential.

How is breeding different today?

For thousands of years, plant breeders have skillfully identified and selected plants with the best properties for cultivation. Traditional plant breeding methods have been effective, but they are slow.

Today, the use of breakthrough new technology has reinvented plant breeding. In the same time it used to take for traditional breeding work, our plant breeders can more than double the rate of "genetic gain" – the improvement in important characteristics such as yield and tolerance to environmental stress.

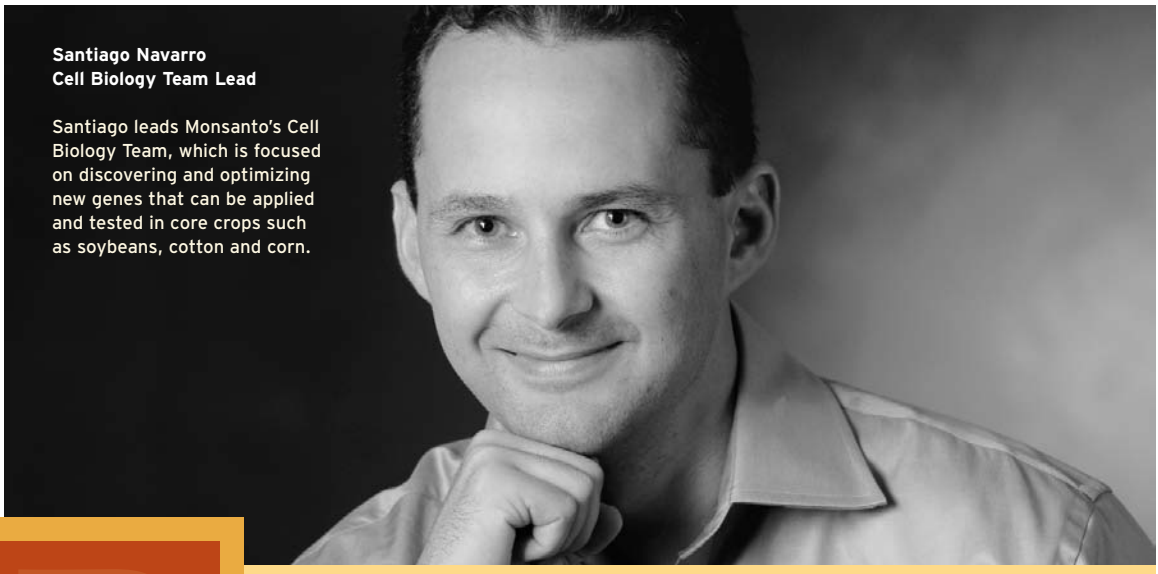
With the application of technology like computer databases, molecular markers, and the tools of analytics, breeders improve the predictability in the inheritance of traits from generation to generation. This predictability has made breeding more efficient than at any other point in history. For us, the tools of molecular breeding have entirely replaced the notion of "conventional" or traditional breeding. Our standard for breeding *is* molecular breeding.

How does breeding translate into commercial success?

Breeding technology today allows our plant breeders to make more informed decisions earlier in the process. So, by the time they get into field trials, we've already pre-screened and eliminated the least powerful breeding stock. That allows us to focus on the germplasm that has the best potential for offering a commercially viable combination of desirable traits.

The probability of finding the most effective combination of genes for a single trait controlled by just 20 genes is less than one in a trillion. With markers and other breeding technologies, however, we can get to that best combination faster, improving those one-in-a-trillion odds to as good as one in five.

The upshot is that we identify better products faster. Compared with conventional breeding, our breeding program today, is doubling the rate of improvement in key genetic characteristics such as yield and important agronomic traits.



Santiago Navarro
Cell Biology Team Lead

Santiago leads Monsanto's Cell Biology Team, which is focused on discovering and optimizing new genes that can be applied and tested in core crops such as soybeans, cotton and corn.

Biotechnology

Biotechnology is the application of scientific knowledge to transfer beneficial genetic traits to enhance plants' growth or to provide nutritional or other benefits to farmers, food and feed processors, or consumers.

Biotechnology is also one of Monsanto's two core technology research platforms.

Targeting specific opportunities with modern biotechnology

Biotechnology has become shorthand for an extensive process that begins with the discovery of a new gene, proceeds through the introduction of genes into plants and through the extensive testing and regulatory review, and culminates in the delivery of breakthrough products. Biotechnology has led to entirely new products, that have not been available in agriculture until the last decade.

Monsanto pioneered the application of biotechnology to agriculture. For a decade now, biotechnology traits have been used commercially around the world, establishing a record of proven benefits for farmers, consumers and the environment.

Where does biotechnology offer the most value?

With biotechnology, we're able to identify a particular trait that accomplishes something that may not be as efficiently possible by breeding or other means. For instance, scientists can identify and target genes that occur in nature that work against a particular insect. While those genes may not exist in the crop of interest, we can use the tools of modern biotechnology to refine and introduce that gene into a crop so that crop can also reap the advantage of insect protection.

That same targeted approach allows us to develop healthier oils for consumers, higher-value food and feed for processors, and even more traits that help make farmers more productive and profitable.

What makes breeding and biotechnology complementary?

The dual platforms of breeding and biotechnology offer us a choice as we approach a product concept. Breeding is largely oriented toward improving the overall package of genetic base of a crop. Biotechnology is uniquely focused on identifying a particular trait that produces a desired result more efficiently than would be possible just by combining the existing genetics in a crop type.

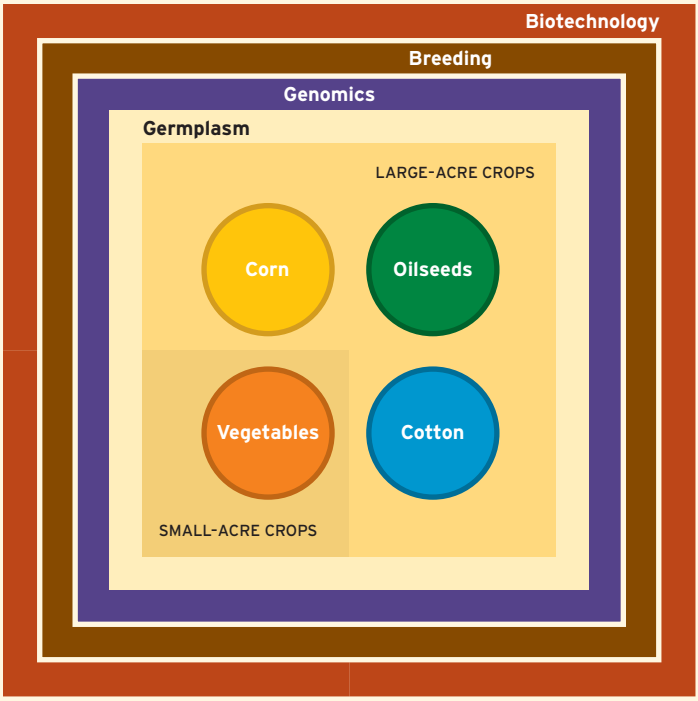
Often we can investigate a potential target through both biotechnology and breeding. Then, depending on what we're hoping to accomplish and which particular research pathway shows more promise, we may chose one platform to pursue. We may also choose to use both – combining specialized germplasm developed through breeding with a biotechnology trait. So, the advantage in having both platforms is that we're perfectly positioned to match the right approach with the right opportunity.

The value we bring to farmers

We built our business on a seeds-and-traits strategy. Using the tools of modern biology, chiefly breeding and biotechnology, we look for ways to help our farmer customers do more with less. We have pioneered in this industry a new commercial model that emphasizes the application of technology to improve germplasm and to introduce new traits. Our research investment and commitment to innovation come together in the fields, where we have created new options and opportunities for farmers.

Applying our tools to benefit farmers

Part of the benefit in pioneering the technology tools is that we can apply each tool individually or in combination to target an ultimate commercial product. By applying one or more of these tools, we've developed crop varieties that benefit our farmer customers. As you unfold this document, we have highlighted various Monsanto crops, the tools we used to develop each product and the benefits our farmer customers derive from these products.



We apply our seeds-and-traits strategy to two categories of core crops. In the diagram at right, our large-acre crops – corn, cotton and oilseeds (primarily soybeans and canola) – are highlighted in yellow, blue and green, respectively. Small-acre crops, which constitute our vegetable seed business, are shown in orange.

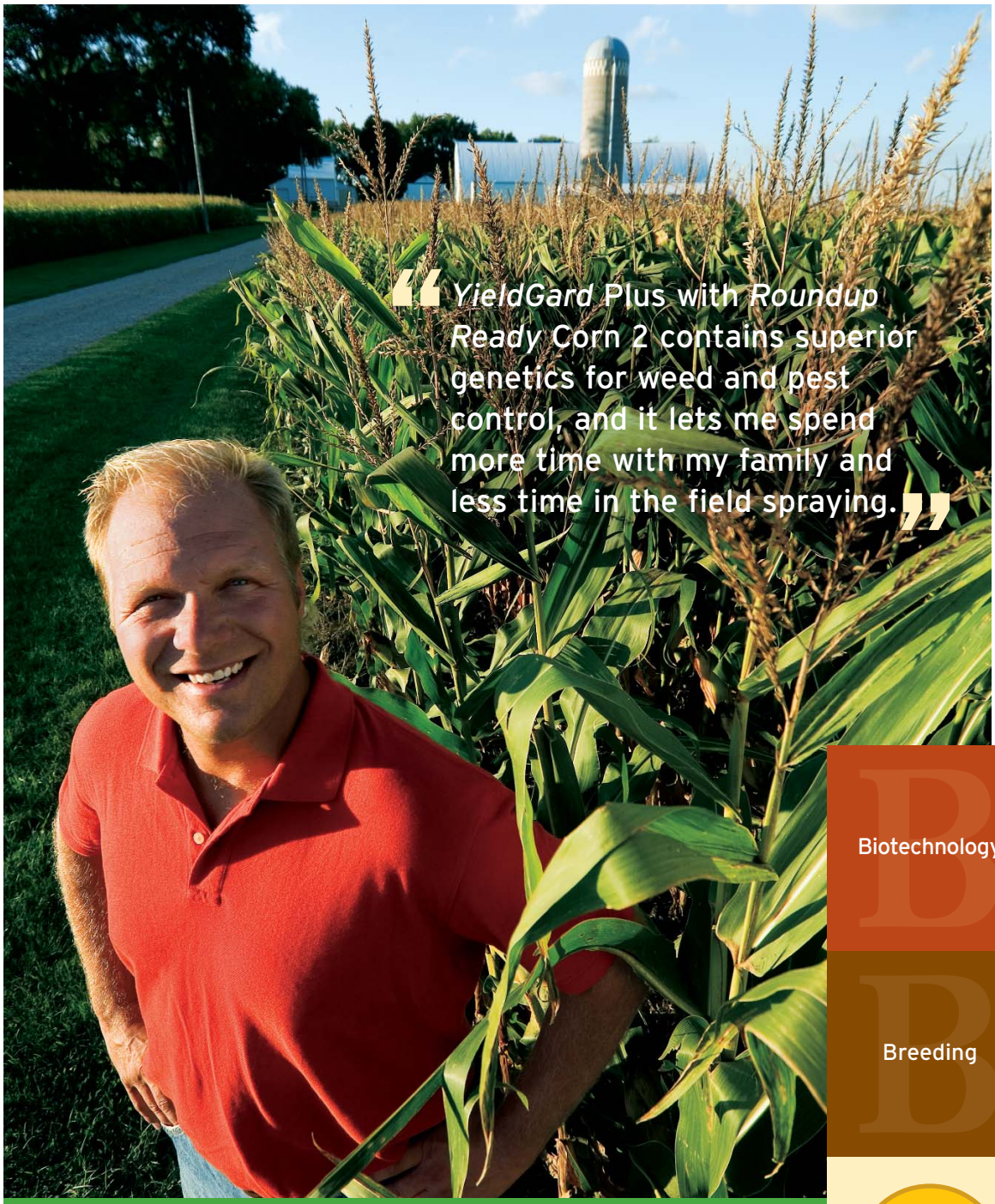
The diagram shows the product development from the inside out. Germplasm, the starting point, is shown as the innermost square and includes each of the four colored circles representing the respective crops. Germplasm is the basic genetic material for any plant. Our industry-leading genetics give us a competitive advantage in creating opportunities for innovation in the seeds-and-traits category.

Germplasm is the foundation to which we can add the tools of genomics, breeding and biotechnology to target an ultimate commercial product. These tools are shown in purple, brown and red, respectively, in the diagram. We apply genomics and breeding to both small- and large-acre crops, but we currently use biotechnology only for large-acre crops. Some products might need only the refinement of germplasm through breeding. Others, however, might require the full complement of our technology tools to become commercially viable.

Bringing the benefits of breeding to vegetables

Bill Johnson, Woodland, California

Small-acre crops such as vegetables are natural candidates to receive the benefits of the breeding capabilities we honed with corn, cotton and oilseeds. With the acquisition of Seminis in fiscal year 2005, Monsanto added the world’s broadest vegetable seed germplasm for its small-acre crop focus. The breeding technologies pioneered in large-acre crops such as corn and soybeans are already being applied to a variety of vegetable crops. At the Seminis seed production greenhouse in California, breeder Bill Johnson develops new varieties in the cucurbits family – squash, cucumbers and watermelon – for trial, including a commercial squash variety similar to Seminis’ Sunray Squash.



Biotechnology

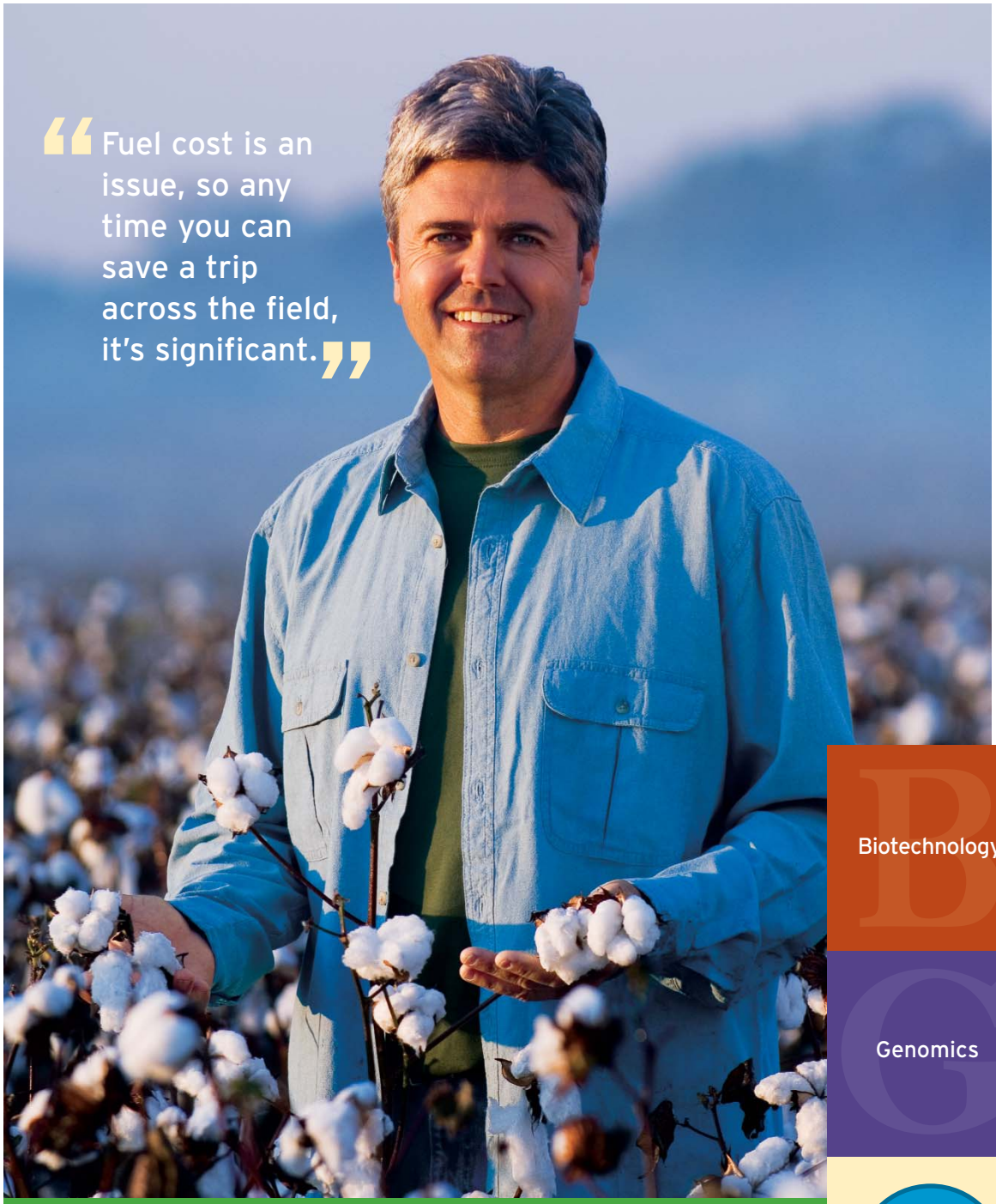
Breeding

Corn

YieldGard Plus with *Roundup Ready* Corn 2

Mark Maiers, Stewart, Minnesota

A combination of breeding and biotechnology led to the first product in the industry with three biotechnology traits: *YieldGard* Plus with *Roundup Ready* Corn 2, which has corn-borer resistance, rootworm resistance, and *Roundup* tolerance. This offering represents a growing trend toward the replacement of single biotechnology traits with stacked traits that allow farmers to do more with the same seed. Developed as the newest biotechnology product, *YieldGard* Plus with *Roundup Ready* Corn 2 is in its first year of widespread commercial planting. Farmers such as Mark Maiers from Stewart, Minnesota, use it to control insects above and below the ground while still having the ability to use *Roundup* agricultural herbicides over the top of the crop for weed control. Maiers felt confident planting 1,800 acres of *YieldGard* Plus with *Roundup Ready* Corn 2 because of his favorable experience using *Roundup Ready* technology in both corn and soybeans.



Biotechnology

Genomics

Cotton

Roundup Ready Flex cotton

Steve Bailey, Gadsden, Tennessee

By applying the tools of genomics and biotechnology, we have produced a variety of cotton that will allow farmers to spray *Roundup* herbicide over their cotton during more of the growing season. Now in the final phase of the pipeline, *Roundup Ready* Flex cotton is poised for commercial-scale plantings in the United States in 2006. Today, farmers such as Steve Bailey are growing *Roundup Ready* Flex cotton in large-scale trials, where the enhanced convenience and weed control of this second-generation biotechnology trait translates to increased value. More than 80 percent of *Roundup Ready* Flex cotton will be stacked with our second-generation *Bollgard II* trait for insect protection. Stacked with *Bollgard II*, *Roundup Ready* Flex cotton is poised for the largest-acre launch of a new biotechnology product ever. *Roundup Ready* technology has yielded savings in both time and equipment costs for Steve Bailey, who has 1,200 acres planted in cotton, 95 percent with stacked traits.

"When I found out that *Vistive* had the same genetics as the soybeans I'd been growing, I knew I could expect good yield."

Breeding

Genomics

Oilseeds

Vistive low-linolenic soybeans

Dallas Koch, Wellsburg, Iowa

For almost 20 years, scientists have been aware of the gene in soybeans that would help reduce linolenic acid content in soybean oil. But attempts to breed for the trait were largely unsuccessful. Once Monsanto was able to apply genomics and breeding technologies to soybean germplasm, however, low-linolenic soybeans became commercially viable, offering a new choice and a new opportunity to farmers. Grown for the first time this year by farmers such as Dallas Koch, *Vistive* low-linolenic soybeans went from product concept to commercial product in approximately 36 months because of the breakthrough applications of our marker-based breeding technology. With 800 acres planted in low-linolenic soybeans, Koch is among the largest growers of the new product. He plans to continue planting it because of the high yield and premium value he expects from this year's crop.