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AGRICULTURE AND NUTRITION BIOTECHNOLOGY

THE NEXT GENERATION OF
HEALTHY AND GREEN LIVING



CANADIAN LEADERSHIP IN AGRICULTURAL BIOTECHNOLOGY



Innovation in the agrifood sector has never been needed more than today. A growing world population demands greater amounts of food and energy; climate change has altered the way we grow crops; and concerns over food safety, health and nutrition have presented new challenges to our society. Canadian leadership in the development and adoption of agricultural biotechnology offers farmers and consumers more effective, economically sound and environmentally responsible crop production solutions.



The roots of biotechnology can be traced back to 4000 B.C. with wine and cheese production. From those humble beginnings, to the Green Revolution, to the modern production methods used today to grow more food on fewer acres using fewer resources, biotechnology makes foods safer, improves the health of our livestock and reduces the impact of agriculture on our environment.

For over a decade, farmers in Canada have planted genetically modified crops and consumers have safely enjoyed the economic and environmental benefits derived from these agricultural innovations. In 2007, global biotech acreage reached 282 million acres,¹ or 43 percent of global crop acreage—the fastest adoption of a new agricultural technology in history.

Canadian farmers have led the world in the adoption of many environmentally-friendly crops that reduce pesticide use and boost yields. Today, Canada ranks fourth in total biotechnology crop coverage with just over 17 million acres.

Canadian agricultural biotechnology continues to revolutionize global food production systems. Our scientists and entrepreneurs create new drought-resistant crops, vaccines against food-borne pathogens, healthier fruit, and advanced animal production techniques to address the most pressing issues of food supply and safety today. Likewise, Canadian consumers overwhelmingly expect to realize benefits in their lifetime to their health and the environment as a result of biotechnology innovation.²

DID YOU KNOW? CANADIAN BIOTECHNOLOGY HAS DEVELOPED A NON-BROWNING APPLE.

DID YOU KNOW? THANKS TO CANADIAN RESEARCH, A VIRUS THAT ATTACKS BACTERIA CAN NOW BE USED AS AN ALTERNATIVE TO ANTIBIOTICS FOR FARM ANIMALS.

¹ International Service for the Acquisition of Agri-biotech Applications (ISAAA).

² Pollara for BIOTECCanada, September 2007.

TIMELINE

8,000 BC HUMANS DOMESTICATE PLANT CROPS AND LIVESTOCK.

2,000 BC EGYPTIANS AND SUMERIANS LEARN BREWING AND CHEESE MAKING.

300 BC GREEKS DEVELOP GRAFTING TECHNIQUES FOR PLANT BREEDING.

1668 JEAN TALON ESTABLISHES CANADA'S FIRST BREWERY IN QUEBEC CITY, USING YEAST AND FERMENTATION, BOTH BIOTECHNOLOGY-RELATED PRACTICES.

1870–1910 BEGINNING IN 1870, LUTHER BURBANK, THE FATHER OF MODERN PLANT BREEDING, DEVELOPS MORE THAN 800 NEW STRAINS OF FRUITS, VEGETABLES AND FLOWERS, INCLUDING THE BURBANK POTATO, A BLIGHT-RESISTANT CROP THAT IS HEAVILY PLANTED IN IRELAND.

FIRST EXPERIMENTAL CORN HYBRID PRODUCED IN THE LABORATORY BY WILLIAM JAMES BEAL, A PROFESSOR OF BOTANY, AT MICHIGAN ACADEMY OF SCIENCES.

1919 FIRST USE OF THE WORD "BIOTECHNOLOGY" REFERENCED IN PRINT.

ABUNDANT, ENVIRONMENTALLY FRIENDLY CROP PRODUCTION



Agricultural biotechnology has dramatically improved the way crops are grown in Canada. Canadian crop production is now more efficient, environmentally friendly and sustainable through the introduction of safe, long-term biotechnological solutions for pest management, disease prevention, and higher quality, value-added grain, oilseed and fruit. The world needs these innovations now more than ever as growing demands on global grain and oilseed supplies require new solutions for our farmers.

Biotechnology has improved our agricultural environments through the introduction of herbicide-tolerant and insect-resistant crop varieties. Insect-resistant crops protect themselves from pests and do not require insecticide spraying. Worldwide, this has reduced chemical pesticide use by over 100 million pounds over the past 12 years. The adoption of herbicide-tolerant crops has also increased adoption of low- and no-till farming systems, saving millions of acres from soil erosion. Lowered human exposure to harmful toxins is also one of the well-documented benefits of growing insect-resistant crops.

Canadian biotechnology continues to be at the forefront, developing new crops to supply food, fuel and industrial feedstocks. Canadian researchers have identified a gene that controls how plants minimize water loss in hot temperatures, an important step toward improving food security around the world. In the near future, Canadian-developed drought-tolerant crops will boost harvests while easing demands on precious water supplies, and plant varieties that efficiently utilize fertilizers will further enhance the sustainability of global agriculture.

CANADIAN AGRICULTURAL BIOTECH IN ACTION: TODAY AND IN THE FUTURE

By permitting more effective, economically sound and environmentally responsible crop production, innovative Canadian biotechnology companies are making food available to more people, while providing solutions to the environmental problems that increasingly face our world.

Dow AgroSciences Canada Inc. provides weed, insect and disease management for use in agriculture, as well as for forestry and industrial application. **Monsanto Canada Inc.** is an agricultural company that makes seeds easier to grow, letting farmers grow hardier plants using fewer resources. Patented weather proofing traits for plant and agricultural use from **Performance Plants Inc.** boost crop yields and improve drought tolerance—critical advantages for sustainable growth of food and biofuel crops, especially in developing countries.

Technology from **Pioneer Hi-Bred Ltd.** increases the productivity, profitability and sustainability of Canadian agriculture using plant breeding to develop innovative field crop seed solutions, and **Solanum Genomics International Inc.** has discovered genes that increase plant disease resistance. **Okanagan Specialty Fruits Inc.** uses selective breeding, genomics and genetics to revitalize the commercial tree fruit industry through products such as a non-browning apple that stays fresh longer.

Canadian bio-entrepreneurs are creating technologies that address climate change and limit the environmental impact of traditional agricultural practices: **Agrisoma Biosciences Inc.** uses leading-edge technology to create a new generation of crops engineered for bio-fuel production, while **Sylvar Technologies Inc.** produces safe and environmentally friendly biopesticide technology solutions for controlling forest pests, meaning fewer toxins are released into the forest environment.

1941 DANISH MICROBIOLOGIST A. JUSTIN COINS TERM "GENETIC ENGINEERING," A TECHNIQUE INVOLVING THE TRANSFER OF A SELECT PIECE OF GENETIC MATERIAL FROM ONE ORGANISM TO ANOTHER.

1970 NORMAN BORLAUG BECOMES FIRST PLANT BREEDER TO WIN NOBEL PRIZE FOR HIS WORK ON NEW WHEAT VARIETIES THAT INCREASED YIELD BY 70 PERCENT, MARKING THE BEGINNING OF THE GREEN REVOLUTION IN WORLD AGRICULTURE.

1974 CANADIAN SCIENTISTS DRS. BALDUR STEFANSSON AND KEITH DOWNEY DEVELOP AN EARLY FORM OF CANOLA FROM OILSEED RAPE THROUGH PLANT BREEDING TECHNIQUES. CANOLA IS LOW IN ERUCIC ACID AND GLUCOSINOLATE, WHICH MAKES OILSEED RAPE BITTER, AND WAS FORMALLY REGISTERED IN THE LATE '70S.

1982 FIRST RECOMBINANT DNA VACCINE FOR LIVESTOCK.

1983 THE PETUNIA BECOMES FIRST WHOLE PLANT GROWN FROM A BIOTECHNOLOGY PROCESS.

ECONOMIC ADVANTAGES



New technologically enhanced plants, grains and seeds can offer entire sectors significant long-term economic advantages. Herbicide-tolerant varieties allow farmers to plant earlier in the spring-time and better control weeds, resulting in greater yields. New crop varieties specially designed for use in the production of ethanol and other bio-fuels will mean more gallons of renewable fuel per acre. Canadian farmers have already realized significant economic benefits thanks to genetically modified canola. Canola growers have chosen to grow GM varieties on over 70 percent of Canada's 12 million canola acres. These varieties saved farmers an estimated 8.2 million gallons of fuel and earned, on average, \$10 more per acre, according to the Canola Council of Canada.

Many new products and technologies hold significant promise for cross-sectoral applications. **Saponin's** Prairie Carnation™ can produce foams making it a natural detergent, and contains the smallest known granule starch in the plant kingdom with unique properties that hold promise for diverse future applications for the cosmetic, food and beverage industries.

DID YOU KNOW? A CANADIAN FIRM HAS INVENTED A WAY TO MAKE INSULIN FROM SAFFLOWER.

ANIMAL HEALTH



Canadian biotech companies are meeting the demands of Canadians for safer, more nutritious food, and for healthier livestock through animal health technologies such as protein-based vaccines and metabolic modifiers.

Elanco Animal Health produces a range of products, from parasite control to feed ingredients that enhance animal health, wellness and performance, to help produce an abundant supply of safe and affordable food. **ViaGen** enables owners of cattle, horses and pigs to preserve and multiply their best genetics and protect their livestock through genomic services.



There is also a demand for Canadian innovations in animal health worldwide. For example, **Stirling Products Limited** develops and commercializes bioactive products with metabolic modifiers for a range of uses in the international animal healthcare market, and **Bioniche Life Sciences Inc.** is developing a range of biopharmaceutical products including vaccines and cancer therapies for both humans and animals.

DID YOU KNOW? AFRICA HARVEST BIOTECH FOUNDATION INTERNATIONAL USES DROUGHT-RESISTANT MAIZE DEVELOPED IN CANADA TO FIGHT POVERTY, HUNGER AND MALNUTRITION IN AFRICA.

1990 THE FIRST FOOD PRODUCT MODIFIED BY BIOTECHNOLOGY, CHYMOSIN, IS APPROVED IN CANADA AS A SUBSTITUTE FOR RENNET, THE ENZYME USED IN CHEESE MANUFACTURING TO CURDLE MILK.

2001 CANADA BECOMES ONE OF MORE THAN 130 COUNTRIES TO SIGN THE CARTAGENA PROTOCOL ON BIOSAFETY, PROVIDING AN INTERNATIONAL FRAMEWORK FOR SCIENCE-BASED RULES AND PROCEDURES ON THE ACCEPTANCE OF GENETICALLY ENHANCED CROPS.

1989 NATURALLY OCCURRING BACTERIA ARE USED TO HELP CLEAN UP THE EXXON VALDEZ OIL SPILL OFF THE COAST OF ALASKA.

1995 THE FIRST GENETICALLY ENGINEERED POTATO, RESISTANT TO THE COLORADO POTATO BEETLE, IS SOLD IN CANADA. CANADA IS THE FIRST COUNTRY IN THE WORLD TO GROW BIOTECH CROPS.

NUTRITION AND HUMAN HEALTH

Through innovative biotechnology, Canadian companies lead in the development of solutions to some of the most pressing human health concerns. Canadian innovators have developed new plant-based platforms for the production of human pharmaceuticals. These plants can be used to produce treatments such as insulin, cardiovascular medications and vaccines against pandemic flu.

Human nutrition will also benefit from the adoption of biotech plants. Currently available varieties of soybean and canola produce oils with lower saturated fats. New varieties of fruit able to stay fresh longer will open new markets for Canadian fruit growers and improve the health of Canadians through fresh fruit consumption.

Medicago Inc. genetically engineers plants to produce protein-based vaccines and biopharmaceuticals that address both pandemic and seasonal vaccine supply challenges. **PBR Laboratories Inc.** applies developments in genetic and environmental toxicology, microbiology and biotechnology providing services to protect human health and the environment.

Technologie Biolactis specializes in nutraceuticals and functional foods that combat obesity and diabetes, and tackle many global nutritional deficiencies. **Chemaphor Inc.** unlocks the nutriscience potential of carotenoid compounds through their many oxidation products.

Ceapro Inc. has developed a line of innovative active ingredients and formulations from oats to enhance both human and animal health. **SemBioSys Genetics Inc.** use safflowers to produce U.S. pharmaceutical-grade insulin, as an alternative to traditionally derived insulin.



2006 CALGARY-BASED SEMBIOSYS GENETICS INC. PRODUCES COMMERCIAL QUANTITIES OF HUMAN INSULIN FROM GENETICALLY MODIFIED SAFFLOWER PLANTS.

2005 THE BILLIONTH AGRE OF A BIOTECH CROP WAS PLANTED BY ONE OF 8.5 MILLION FARMERS, IN ONE OF 21 COUNTRIES.

2007 CANADA RANKS FOURTH IN THE WORK FOR TOTAL BIOTECHNOLOGY CROP COVERAGE (OVER 17 MILLION ACRES). (SOURCE: ISAAA)

