

Beyond Genes: Exploring the Limits of Genetic Solutions in Nematode and Disease Resistance, Fiber and Seed Quality

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Dr. Jean-Louis Belot is a cotton breeder with extensive experience in global cotton improvement programs. He holds degrees in agronomy from ENSA Montpellier and USTL in France. With a career spanning over two decades at CIRAD-France, he has contributed to cotton breeding initiatives across Africa and Latin America.

Currently leading the cotton breeding program at the Mato Grosso Cotton Institute, he focuses on developing high-performing varieties suited

to Brazil's cerrado regions. His experience ranges from breeding cotton for very smallholders in Mali, Burkina Faso, and Paraguay, to working with small farmers in Paraná, Brazil, and now catering to the needs of large-scale growers and cotton companies. His breeding efforts incorporate advanced tools and are currently centered on enhancing disease and nematode resistance to suit the humid tropical conditions of Brazil's cotton production areas.

## PRESSURE ON BREEDERS IN COMPETITIVE MARKETS

In an open and highly competitive market, breeders face significant pressure to release new commercial cotton varieties. A key lesson from recent cotton breeding history in Central Brazil is the essential need for access to a large germplasm bank and deep scientific knowledge about the genes involved in targeted traits. Networked research and international collaboration for germplasm and information exchange are crucial, especially for Brazilian breeders, to achieve genetic progress and sustain cotton production in the world's most diverse environments. IMAmt has benefited from germplasm exchanges with CIRAD, USDA, and EMBRAPA, as well as from scientific knowledge published in international journals. Collaborations are being expanded to address the new challenges of cotton production in the cerrado regions.

## **EVOLUTION OF COTTON PRODUCTION IN BRAZIL**

The landscape of Brazilian cotton production has drastically changed in recent decades. It is now concentrated in the cerrado of central western Brazil, primarily in the states of Mato Grosso and western Bahia. Here, cotton thrives under a humid tropical climate, in single or double cropping systems (cotton after short-cycle soybean), with high chemical input and total mechanization of farming operations. Consequently, Brazil has become one of the world's largest producers and exporters of cotton fiber.

# CHALLENGES AND ADAPTATIONS IN COTTON BREEDING

Cotton breeding has had to evolve rapidly to keep pace with these changes, providing growers with cultivars that have a high genetic potential for yield and fiber quality, and are adapted to environments highly favorable to pests, diseases, and nematodes. The IMAmt Cotton Breeding Program, a technological branch of the Cotton Growers Association of the State of Mato Grosso (AMPA), stands as one of the four main players in this market, alongside BASF, TMG, and Bayer. The program's history vividly illustrates the challenges that all breeding companies face.

## DIVERSE GERMPLASM AND BIOTECHNOLOGICAL ADVANCES

The availability of commercial varieties for Brazilian cotton producers has increased dramatically over the years, thanks to several biotechnological platforms like WideStrike, Bollgard, and Liberty, and to germplasm with very contrasting agronomical characteristics. Currently, there are more than 45 commercial or pre-commercial varieties available, with 85% of the production using almost 10 varieties.

#### GENETIC RESISTANCE TO PESTS AND DISEASES

Incorporating genetic resistance to diseases and nematodes in commercial germplasm was the first significant challenge faced by Brazilian breeders in the country's Midwest. Resistance to ramularia leaf spot (*Ramulariopsis pseudoglycines*) was first introduced with FMT 701, resistant to isolate 1. However, this resistance was quickly overcome by isolate 2 after 4-5 years. New sources of resistance were identified and used in IMA 5801B2RF and FM 970GLTP, resistant to isolates 1+2, which were eventually overcome after 5 years by the emergence of a new, less aggressive ramularia leaf spot species (*Ramulariopsis gossypii*), known as isolate 3, with relatively restricted diffusion in cotton crops. The introgression of ramularia leaf spot resistance reduced the need for fungicide spraying from 6-8 applications to 2-3. This re-