Innovation in Biotech Seeds: Public and Private Initiatives in India and China

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Agenda

- Agricultural biotechnology overview
  - Definition
  - Government priorities
  - Adoption
- Government policies identified as important
  - Market access
  - IPR protection
  - Regulatory environment
- Bt Cotton Case Study

AG Biotech: Definition

- Genetic engineering used for centuries; costly and time-consuming
- Modern biotech improves gene selection and transfer processes and removes obstacles to moving genes between different organisms
- Result: valuable traits not possible through conventional breeding
  - Insect and virus resistance
  - Herbicide, drought, and salinity tolerance
  - Nutrition enhancement

AG Biotech: Government Priorities

- China: “To solve the food problem, we have to rely on big science and technology measures, rely on biotechnology, rely on GM.”

  The goal is to “obtain genes with great potential commercial value whose intellectual property rights belong to China, and to develop high quality, high yield, and pest resistant genetically modified new species.”

  - Premier Wen Jiabao, 2008

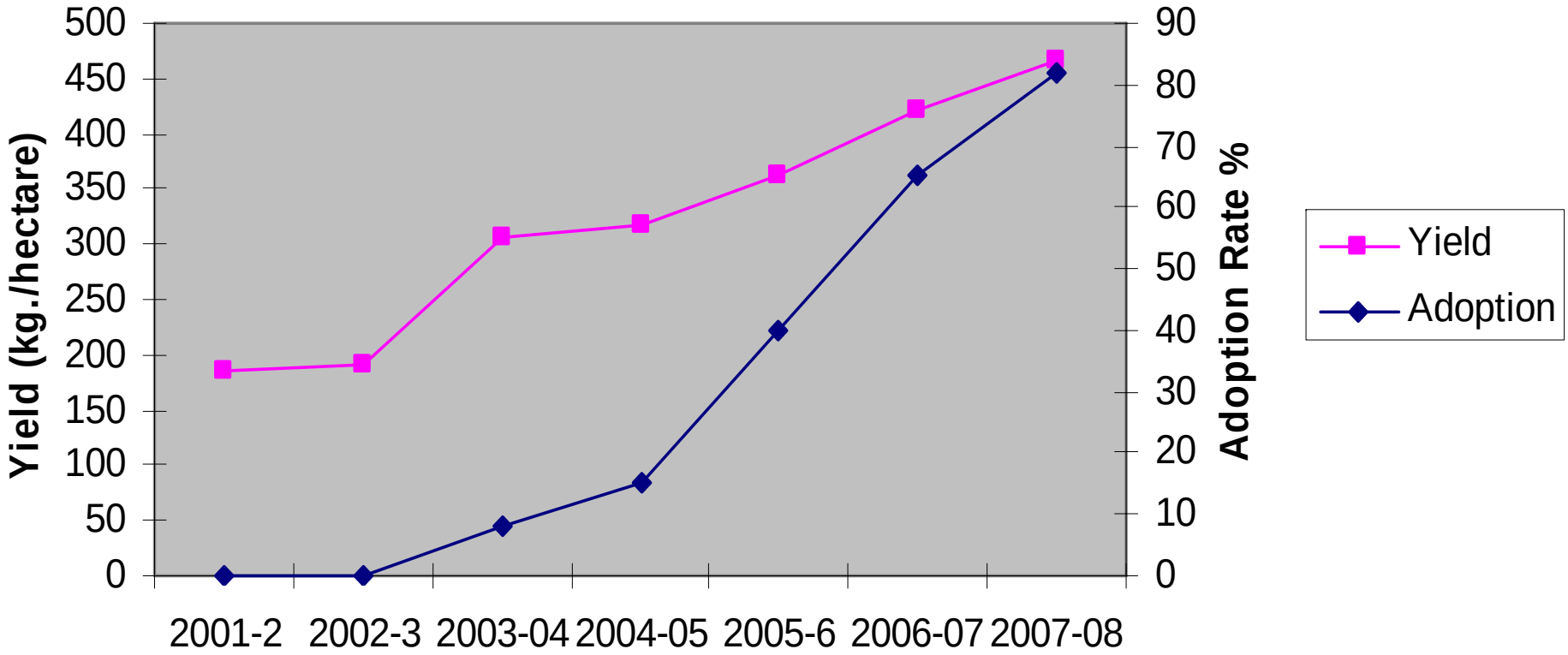
- India: “The search, characterization, isolation and utilization of new genes through the application of biotechnology are essential for the revitalization of Indian agriculture.”

  - Leading official, Indian agricultural R&D program, 2006

AG Biotech: Adoption

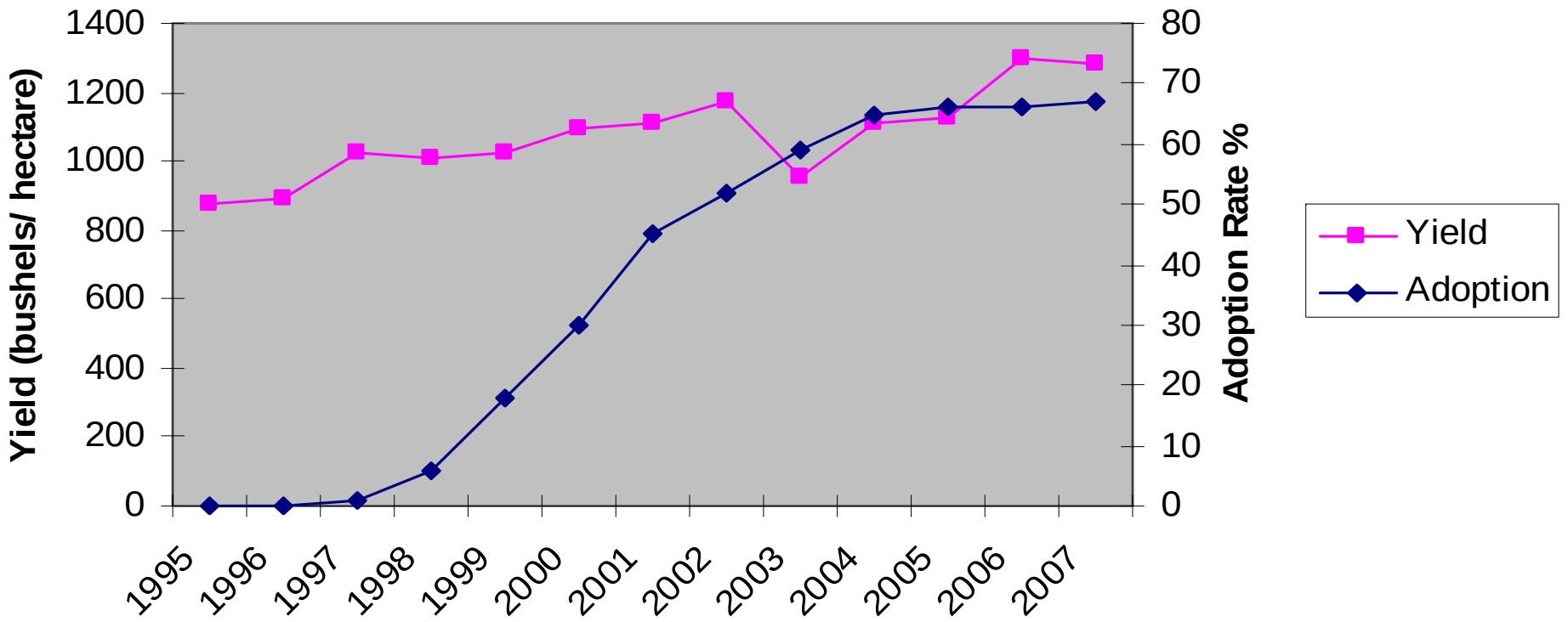
- **US leads in area planted with biotech crops**
  - **Cotton 88%; corn 85%; and soybeans 91%**
  - **Others: Canola, alfalfa, sugar beet, potato, squash, papaya**
  - **Herbicide tolerant, Insect resistant, Virus resistant, Stacked**
- **India: Bt cotton 82%**
  - **Import of biotech crops for processing**
- **China: Bt cotton 69%**
  - **Other approved products not widely commercialized**
  - **Import for processing**

India, Cotton Yield and Bt Cotton Adoption Rate, 2001-08



Source: Indiastat.com

China, Cotton Yield and Bt Cotton Adoption Rate, 1995-2007



Source: CEIC China Database

India: Market Access

- **1988: Seed law defines private sector role**
  - **Removes small scale industry restrictions**
  - **Removes restrictions on research seeds**
- **1991: Economy-wide removal of:**
  - **Industrial licensing requirements**
  - **Restrictions on FDI**
- **2002: approval of Bt cotton**
- **2006-present: State-level price caps on Bt cotton**
- **Market share (2006):**
  - **Top 10 firms includes 6 Indian firms, 4 MNCs**
  - **Control 90% of market for hybrid and biotech seeds**
  - **Price caps negatively impact Indian firms and MNCs**

China Market Access

- **1990s: Public sector dominates**
- **1996: Approval of Bt cotton (CAAS and Monsanto varieties)**
- **1997: Restrictions on joint ventures in seeds; minority ownership**
- **2000: Seed law, clearer role for private firms**
- **2002: Prohibition on FDI in GE seeds**
- **Highly fragmented market:**
  - **Top 10 firms are domestic, control less than 20% of market**
  - **Domestic firms dominant suppliers of Bt cotton**
- **Today: New MNC investments limited to research**

IPR Protections: Patents and Plant Varieties

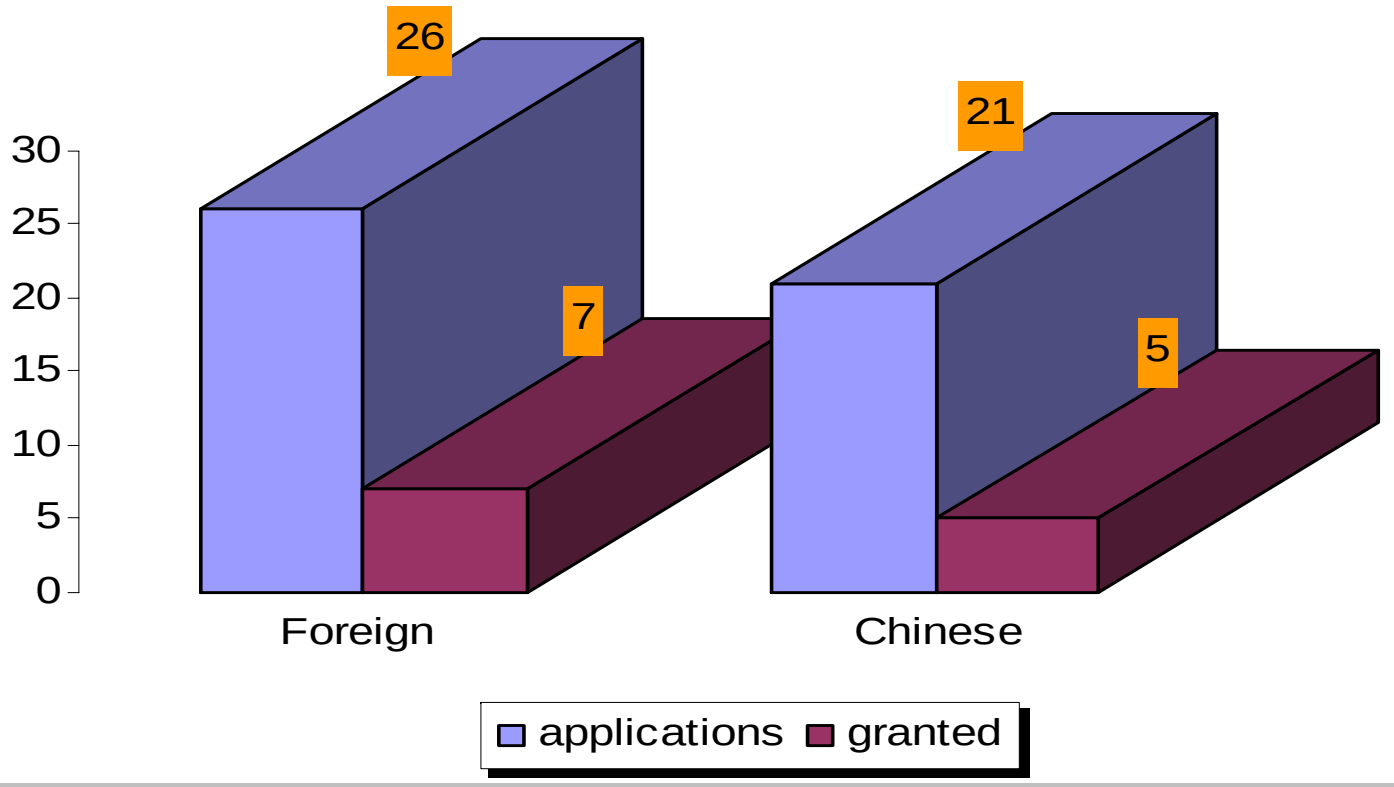
- **TRIPS requires:**
  - **Patents for plants and/or an effective alternative system**
  - **Patents for microorganism-related inventions**
- **China and India provide:**
  - **No patents for plants; alternative system instead**
  - **Patents for microorganisms**
  - **Limited experience (India esp.)**

India, Seed Biotech Patents Granted to MNCs, 2007-09

Firm	Granted Patents	Subject Matter
Monsanto	2009: 9 2008: 5 2007: 2	Herbicide tolerance; Bt cotton event; insect resistance in corn; elevating oil levels and improving germination rates; and seed coatings and treatments
Bayer	2009: 3 2008: 6 2007: 4	Biotech processes for corn and rice; insect resistance; stress tolerance; enhanced starch content; reduction of seed shattering
Syngenta	2008: 3 2007: 3	Seed treatments and coatings; biotech methods for insect resistance, stable transformation

Source: India Controller General of Patents, Designs, and Trademarks

Total Bt Patents and Patent Applications in China, 1988-2007



Source: China Patent Database

Major differences in plant variety protection laws: India, China, and the United States

	India (2007)	China (1999)	United States (1970)
Length of protection	18 years trees and vines; 15 years otherwise.	20 years for vines, fruits, and ornamentals; 15 years otherwise.	25 years for trees and vines, 20 years otherwise.
Coverage	18 crops eligible.	73 crops eligible.	No crops excluded.
Farmer seed saving and exchange	Seed saving, exchange, and sale by farmers broadly permitted. Farmers only prohibited from selling "branded seed."	Farmer seed saving and exchange are permitted, if noncommercial.	Seed saving and sole use by farmer to produce a crop permitted, subject to legitimate interests of breeder. Farmers cannot sell or share seed without breeder permission and royalty payment.
Breeder's exemption	Breeding activities permitted.	Breeding activities permitted.	Breeding activities permitted but benefits of "essentially derived" varieties must be shared.

Regulatory Environment

- **India**
  - **Cotton only approved biotech product**
  - **Lengthy, unpredictable, and expensive**
  - **Farmers' interests explicitly considered**
  - **Product withdrawal**
  - **Pipeline: brinjal, cabbage, castor, cauliflower, corn, groundnut, okra, potato, rice, and tomato**
  - **Closest to approval: Bt brinjal**
- **China**
  - **Biotech founder country but cotton only widely commercialized biotech product**
  - **Process lengthy and unpredictable; separate proceedings at provincial level**
  - **Pipeline: corn, rice, wheat, cotton, potato, tomato, soybean, cabbage, peanut, melon, papaya, sweet pepper, chili, rapeseed, and tobacco.**
  - **Closest to approval: phytase corn and Bt rice**

Case Study: Bt Cotton, India and China

India: Bt Cotton

- **Market access:**
  - **Monsanto genetics approved in 2002, others in 2006, 2008**
  - **Substantial price restrictions 2006 – present**
- **IPRs:**
  - **Patent protection only available for second generation product**
  - **PVP applications pending**
- **Regulatory review:**
  - **Cost: ~ $1.8 million**
  - **Delay: ~ 7 years**
  - **Substantial illegal seed market arose during review**
  - **More illegal than legal seeds from 2002-2006**
  - **Brown bagging an ongoing obstacle to safe and legal products**

China: Bt Cotton

- **Market access:**
  - **CAAS varieties approved first and across many provinces, difficulty commercializing**
  - **Rapid approval and uptake of Monsanto product in some provinces, delayed in others**
  - **FDI limits imposed**
  - **Domestic products now dominant**
- **IPR:**
  - **Patent protection not available for first generation products**
  - **PVP protection not available for cotton until 2005**
  - **Significant public sector and MNC patenting**
- **Regulatory review:**
  - **Low costs: ~ $90,000**
  - **Rapid approval**
  - **Illegitimate seeds dominant in some provinces, less effective (Hu et al. 2009)**
    - **Henan: 83% illegitimate**
    - **Shandong: 60% illegitimate**
    - **Hebei (93%) and Anhui (91%): legitimate seeds dominant**

Assessment

- **China**
  - **Biotech recognized as an important tool but FDI restrictions limit access to latest technologies**
  - **Public sector Bt cotton varieties quickly gained market share**
  - **Regulatory system problematic**
  - **IPR structures in place; public sector in particular benefiting**
  - **Illegal seeds less effective and an ongoing problem**
- **India**
  - **Biotech recognized as an important tool**
  - **FDI open but price restrictions are significant**
  - **Public sector lagged in competitive technologies**
  - **Regulatory system problematic**
  - **IPR structures only recently put in place; broad farmers' exception**
  - **Illegal seeds less effective and an ongoing problem**

Questions/Comments?

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