Science for Consumers

Rob Rennie

Agriculture Institute of Canada

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Agenda

Forces Driving Change

Serving the Customer

Sociopolitical Trends

New Technologies

International Competition

Opportunities

The Customer

- **Better Educated Customer Base**
- **More technically literate, educated, demanding**
  - **Farmer as much a businessman as an agronomist**
  - **Supported by easy access to Information**

The echnology

Knowledge is Power

- **Problems are increasingly complex**
- **No “silver” bullet**
- **Integrating technologies is critical**
- **Computing needs extensive**

Tech Transfer

The “Face” of Science

Requires broad knowledge base

- **Return of the “GP” for triage**
- **Specialist must work in teams**

TT is science’s point of customer contact

- **Marketing is key**

Need unique skill set

- **Marketing, not science**
- **Market not science driven**

Socio-Political Trends

The Politicians Finally Get It!

Energy Conservation

Environmental Quality

Food and Water Safety

Government Regulations Remain Complex and Contradictory

New Technologies

ICT

- Precision Ag

Life Sciences

- All of the “omics”

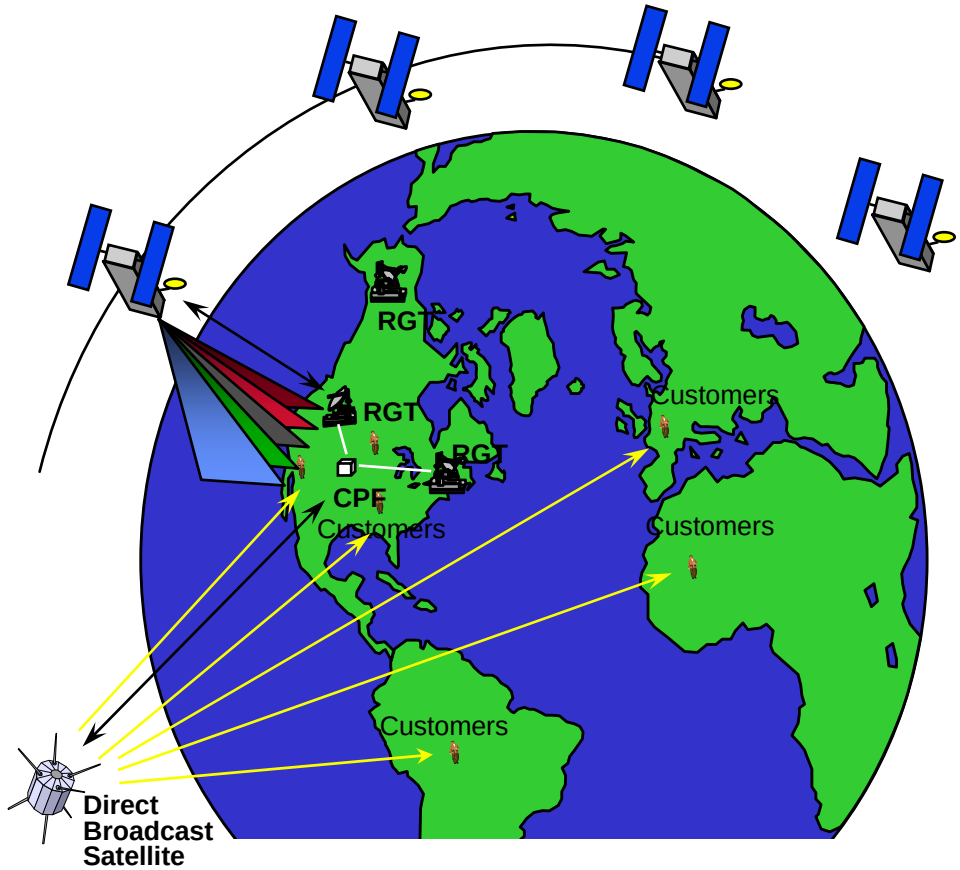
Mechanics

- Despite all of the science, we need to make it work in the field

ICT

Technology Impact

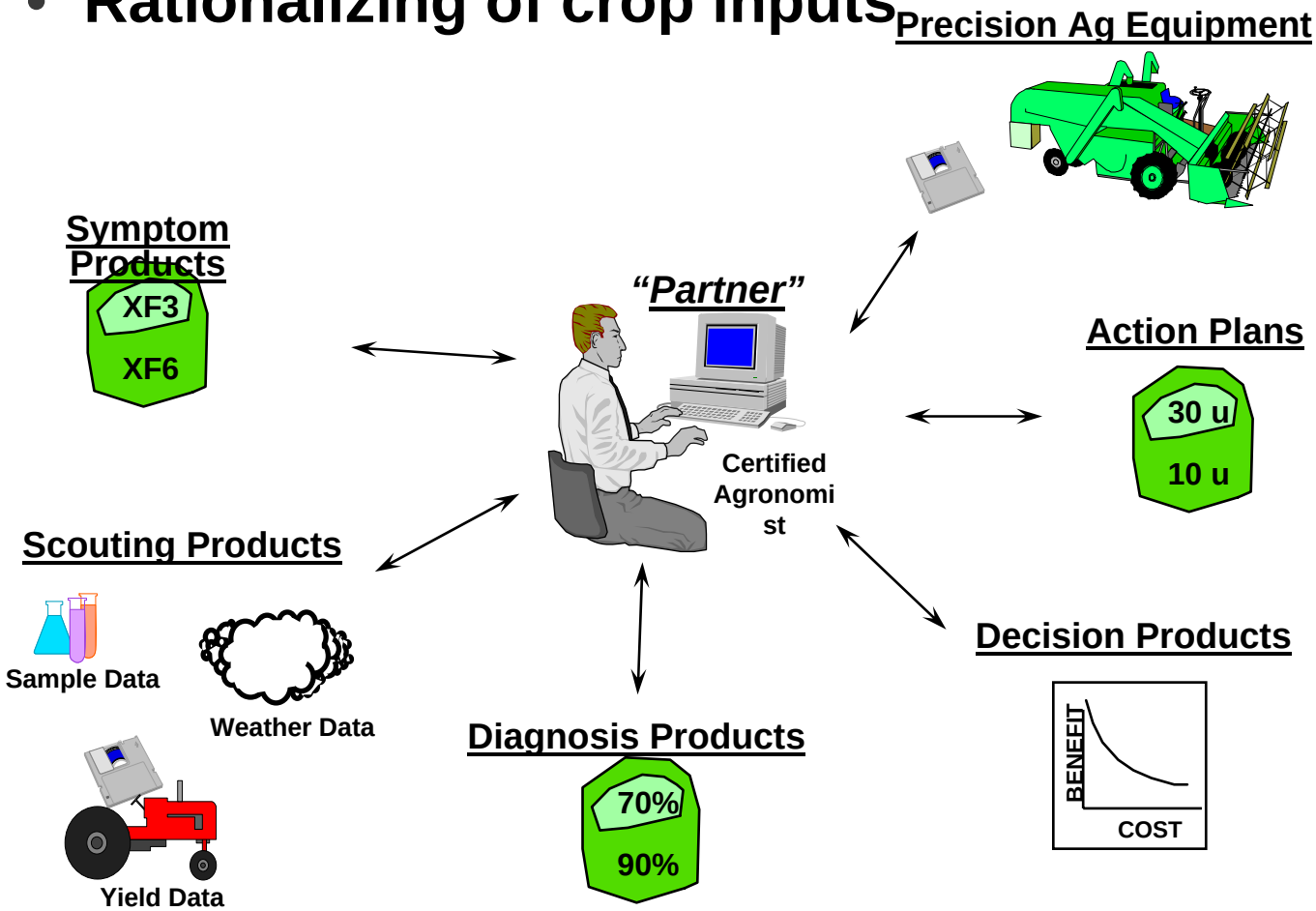
- **quantum leaps in technology anticipated**
- **giving strategic advantage**



ICT

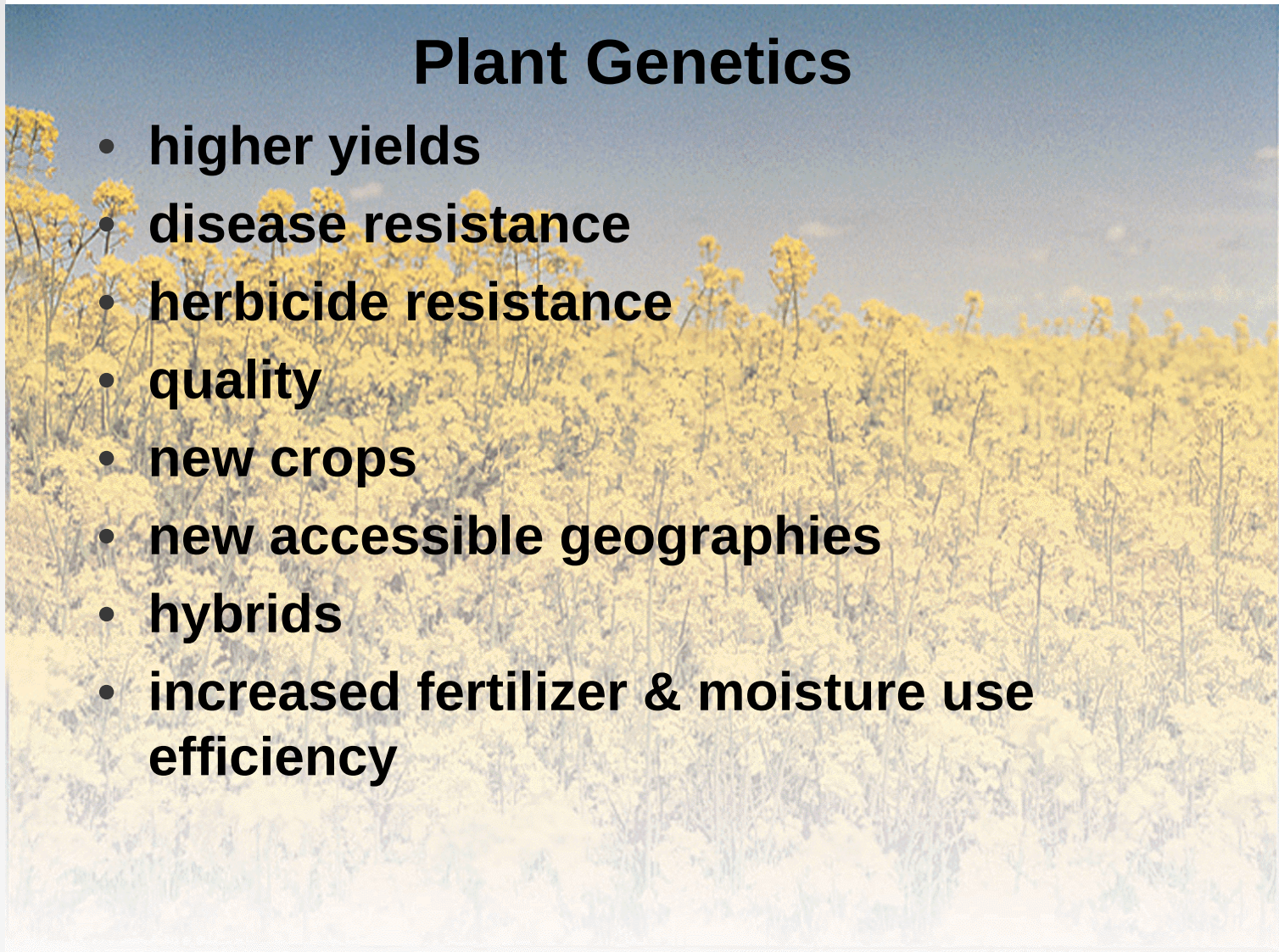
Technology Impact

- **Information systems**
- **Rationalizing of crop inputs**



Genomics
Proteomic

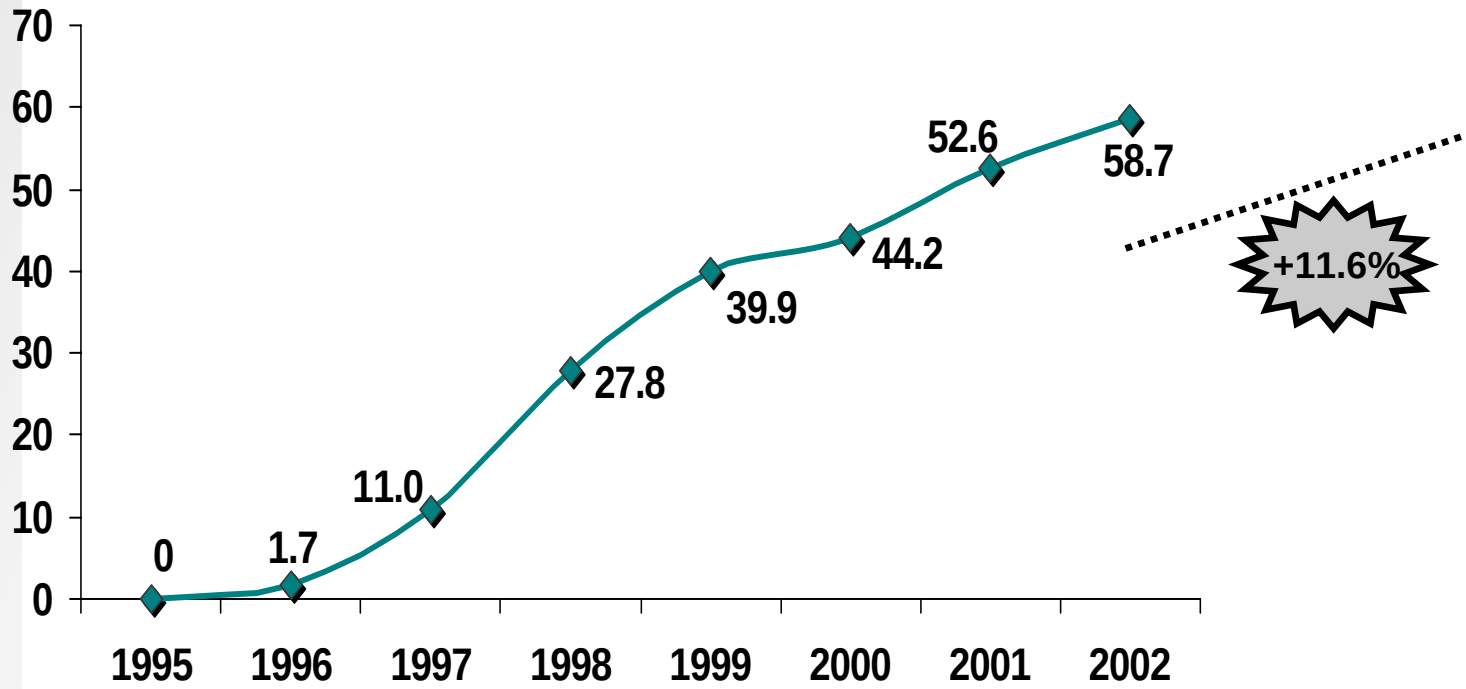
Higher yields=more not less fertilizer



Plant Genetics

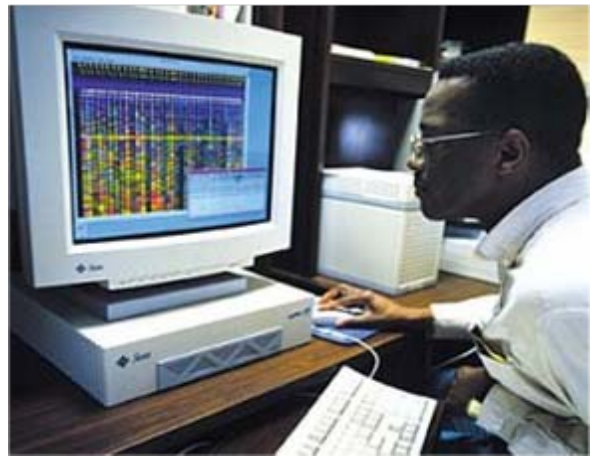
- higher yields
- disease resistance
- herbicide resistance
- quality
- new crops
- new accessible geographies
- hybrids
- increased fertilizer & moisture use efficiency

Genetically-Altered Crops Are A Fact (M ha)



“Output” Traits to Come

- Remedy to deficiencies:
  higher vitamin and iron content
- Improved nutritional profile:
  improved amino acid and fatty acid composition
- Improved processing properties:
  modified starch, higher solid content, improved fiber quality
- Reduction of post-harvest losses:
  delayed ripening, improved storage capacity



Courtesy of Syngenta

New Crop Traits with Potential Impact on Fertilizer Consumptio

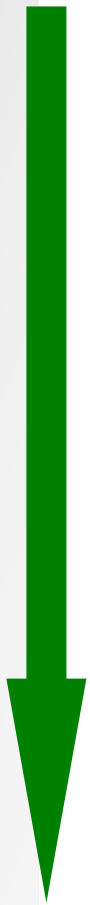
- **Enhanced potassium absorption**
- **Higher bioavailable phosphorus content**
- **Improved protein content**
- **Improved content in essential amino acids**
- **Higher iron content**
- **Other functional foods, nutraceuticals**
- **Tolerance to drought and salinity**

- Aluminium tolerance
- Phytase-excreting plants
- Improved nutrient uptake and metabolism efficiency
- Genetic control of heavy metals uptake and/or tolerance
- Improver energy efficiency of energy crops
- Low lignin
- C4 genes

Expected Positive of Biotech on Fertilizer Demand

Today -	**Essential amino acids**	S++	
	Higher protein content		N++
	Higher iron content	Fe++	
	Functional foods/nutraceuticals	K+, S+, micro+	
2008 -	**Tolerance to drought/salinity**	All +	
	Tolerance to acid soils		All++
:	**Improved energy crops**	All++	**(if policy support)**
:			
2020 -	Low lignin	**All +**	
	C4 genes	**All ++**	

Expected Negative Impacts of Biotech on Fertilizer Demand



Today -	**Herbicide tolerance**	P-	
	Higher phytase production grade)	P--	**(feed**
2008 -	**Essential amino acids**	N--	
	Tolerance to acid soils (temporary)		P--
:			
:	**Nutrient use efficiency**	N--, P---	
2020 -	Nitrogen fixation	**N---**(theoretically)	

From Potential to Likely Impact: Some to Be Answered

Example: Transfer of symbiotic ability to cereals

- **Timeframe required for transferring the gene(s)**
- **Expected problems associated with the gene expression**
- **Tentative release date**
- **Expected yield loss associated with symbiosis**
- **Intellectual property issues**
- **Economic benefit for the farmers (by farming system)**
- **Impact of fertilizers with improved use efficiency**
- **Impact of environmental regulations**

“Omics” Conclusions

- Many inventions with potential impact on crop nutrition
  - Impact: either positive or negative
- What about likely impact on fertilizer demand?
  - Probably slightly positive in 15-year timeframe; then reversal

- Shift from fertilizer to plant nutrient to crop input management management suppliers
- Lead by developing disruptive technologies before non-traditional competitors do
- Ensure more fundamental R&D and engineering base in the public sector
- Forge strong links between the seed and fertilizer industry

Life Sciences

Quantum Technical Breakthroughs

- **Potential “disruptive” technologies affecting key product lines**
  - Nitrogen
  - Potassium
  - Phosphorus
  - Sulphur

Only a fraction of the microbial flora can be cultivated

Biologicals: Harnessing the Rhizosphere

- Focus on “The Hidden Half”
  - **root health critical to nutrient, water uptake**
  - **manipulation of this “source sink” is critical**
- Plant Growth-Promoting Rhizobacteria (PGPR)
- Biological Control Agents (BCA’s)

Courtesy of Monsanto

Improvement of Microorganism and Symbiosis

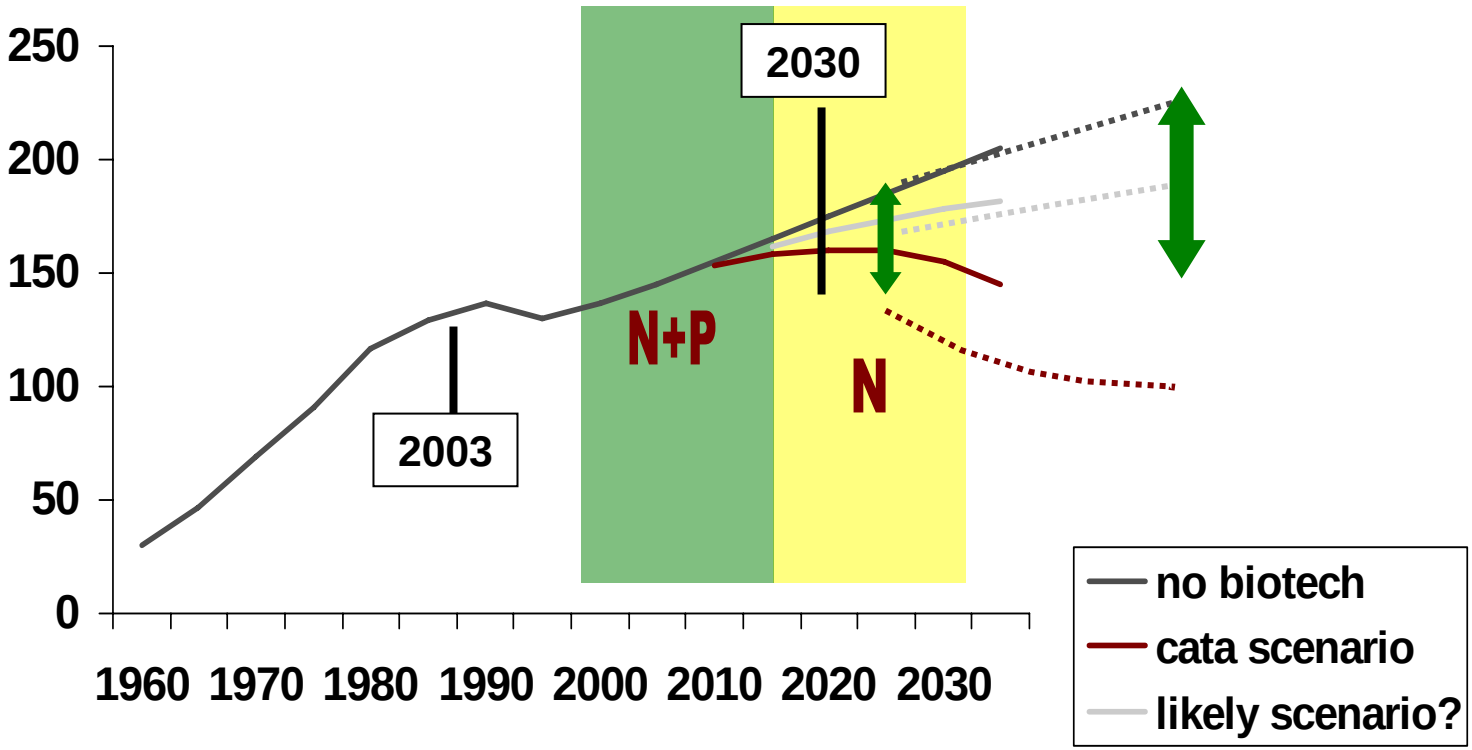
- Phosphorus solubilization
- Sulphur oxidization
- Ability to develop symbiosis with nitrogen fixing bacteria
- Improved nitrogen fixation in legumes

Some Developments in Other Technologies

- Conservation farming
- Seed coating with phosphorus
- Improved FUE:
  - polymers, inhibitors
- Improved catalysis:
  transition metal chemistry
- Solar-powered urea plants in LDC's

Courtesy of Monsanto

Fertilizer Demand Forecasts (Mt) The Senarios



What Does Ag Chem| Mean?

Competitive environment changing

- **Consolidation in seed and ag chem**
- **But not in fertilizers (most gov’t owned)**
- **more R&D in industry**

Polymer Chemistry

Types of Fertilizer

- Controlled release fertilizer
  - less need for post-emergence fertilization
  - increased fall fertilization opportunities
- Higher analysis fertilizers
  - new chemical technologies
    (high S, higher solution N, etc.)

Mechanics

Machinery

- Minimum or zero tillage
- Planting precision
- Precision Farming

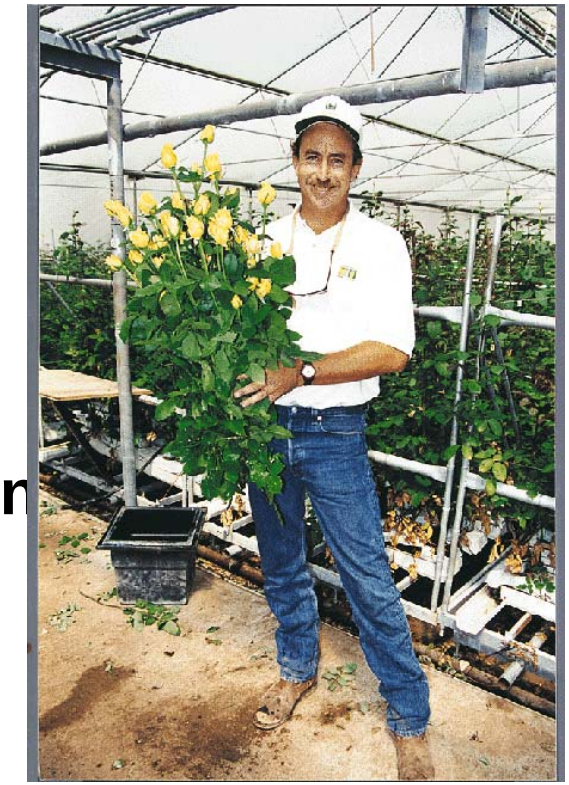
Don’t Forget the Basics

Agronomic Practices

- Right Product
- Right Place
- Right Time

Results

- Reduced losses
- Increased nutrient uptake
- Moisture conservation
- Uniform seedling emergence
- Better ROI



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ompetition

BRIC
(Brazil, Russia, India, China)

Common themes

- Vast amounts of rich, low cost land (Brazilian cerrado)
- Low labour costs
  - I repeat : Low Labour Costs
- Less need for mechanization

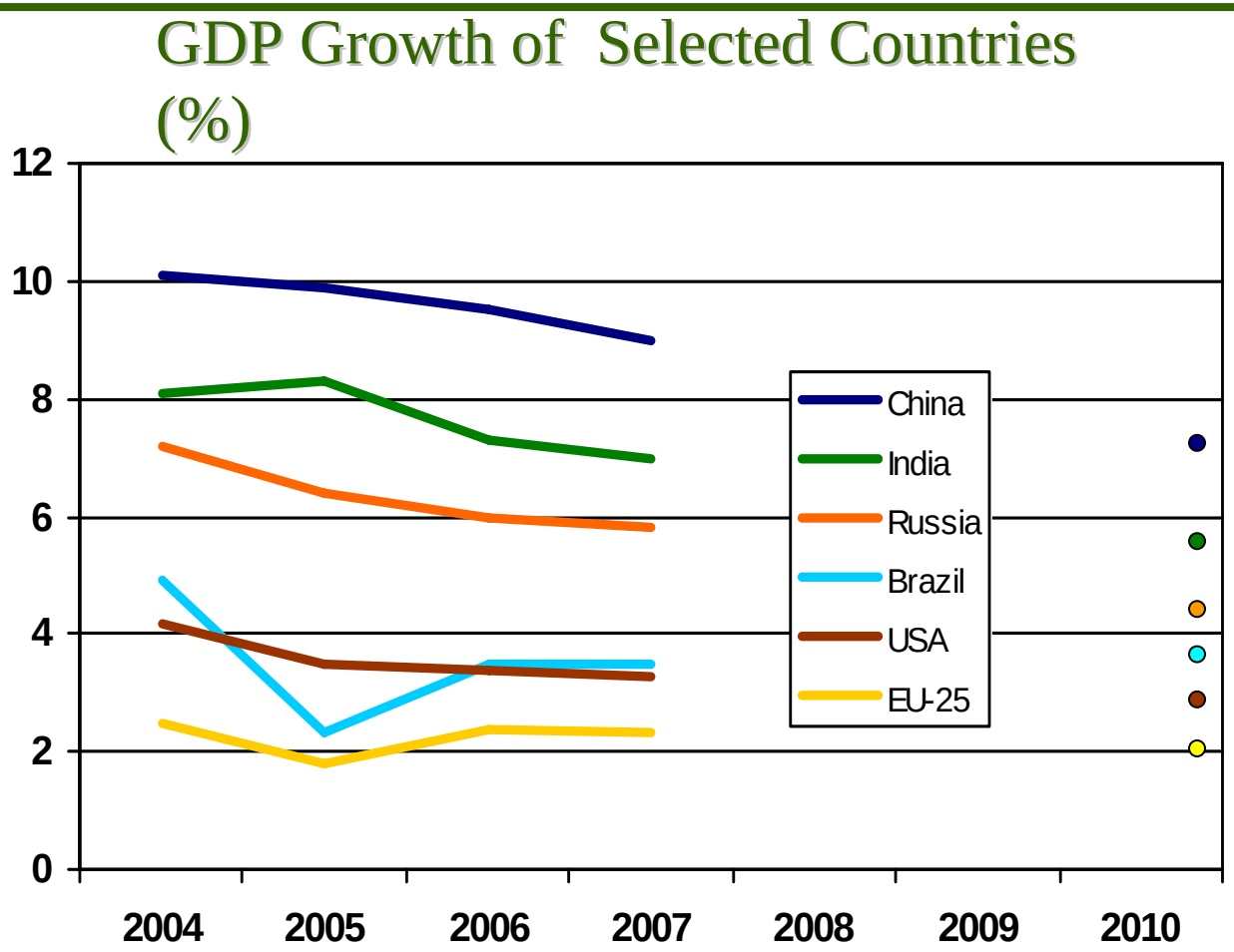
- Economic growth comes before the environment
- Rapid adoption of new technologies
- Export oriented

Population & Economic Growth

Country	Population Growth	Expected GDP 2006
China	**1.3 billion**	**8-10 %**
India	**1.1 billion**	**5-10%**
Indonesia	**241 million**	**4-5%**
Brazil	**186 million**	**4-5%**
Argentina	**40 million**	**7-8 %**

Source: Economist Intelligence Unit

GDP Growth of Selected Countries (%)

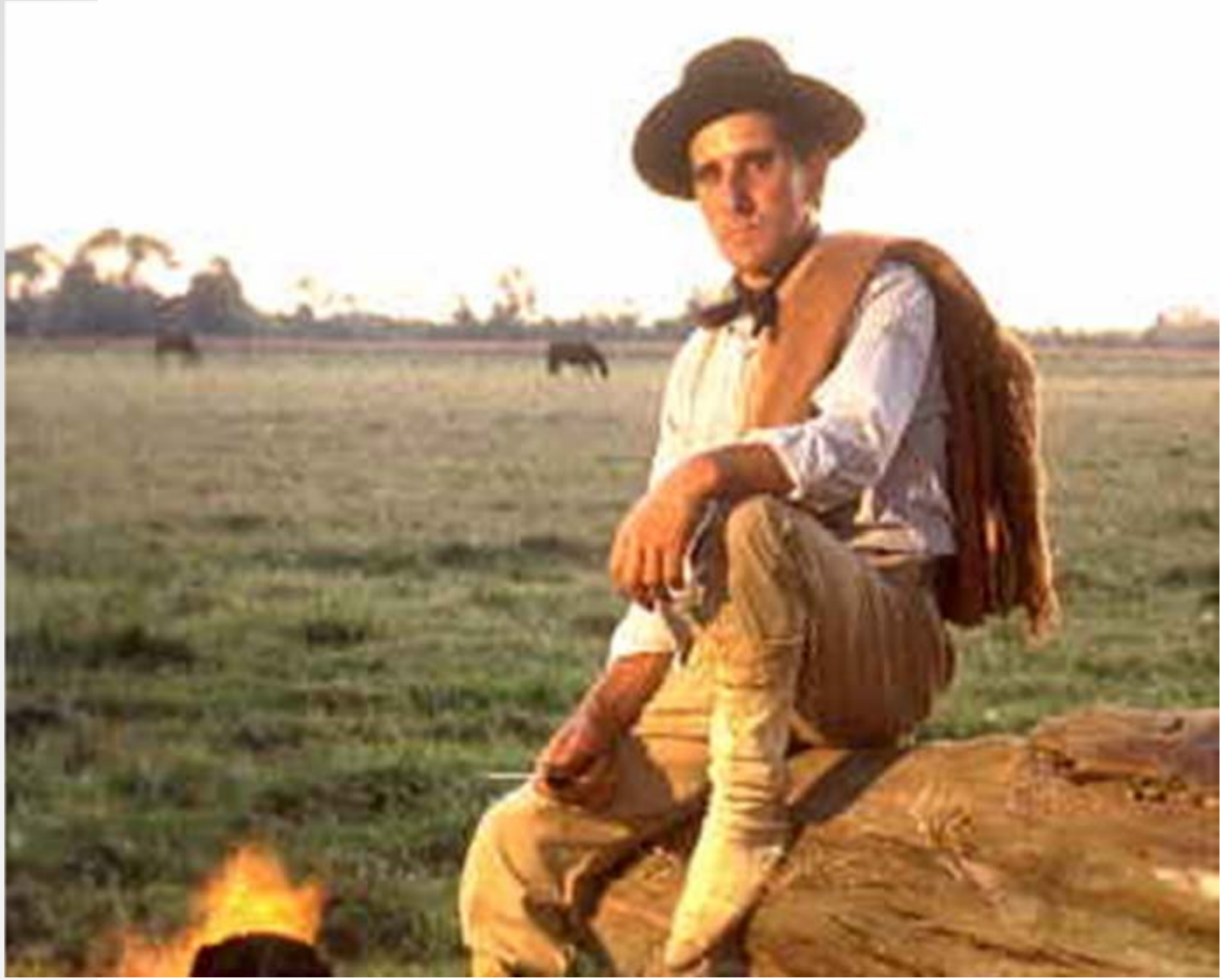


Source: IMF + FAPRI


DYN
Agencia Diarios y Noticias

TANGO 1914

TANGO 2001



Agricultural Profile of Brazil

Posição do Brasil no Ranking Mundial

Produção Agrícola

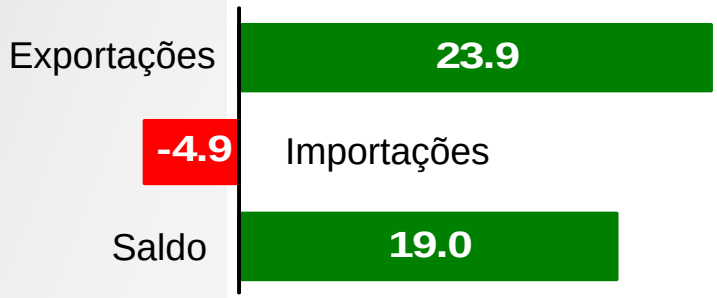
√ **1º** em Cana, Laranja e Café

√ **2º** em Soja

√ **3º** em milho

Balança Comercial do Agronegócio

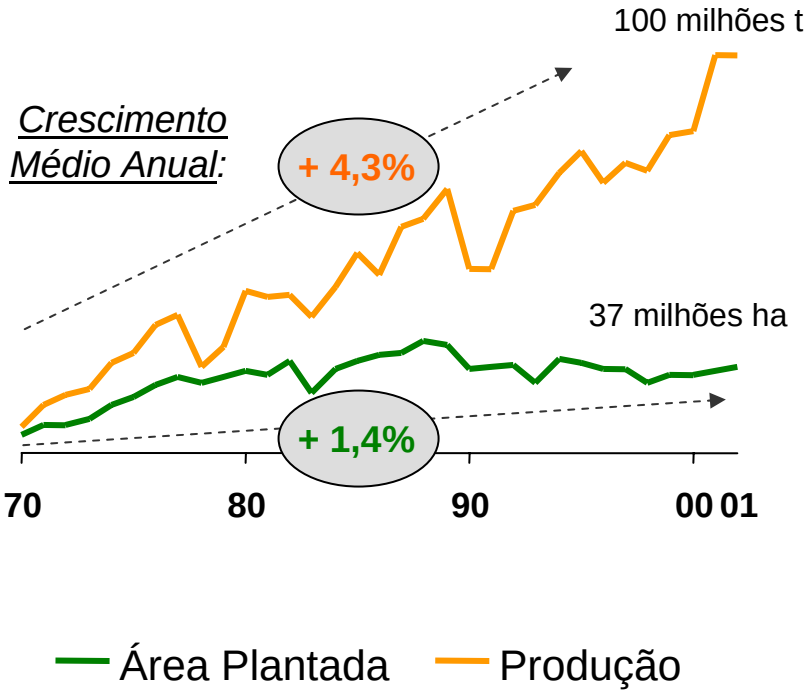
(US$ bilhões)



Mercado Brasileiro de Grãos

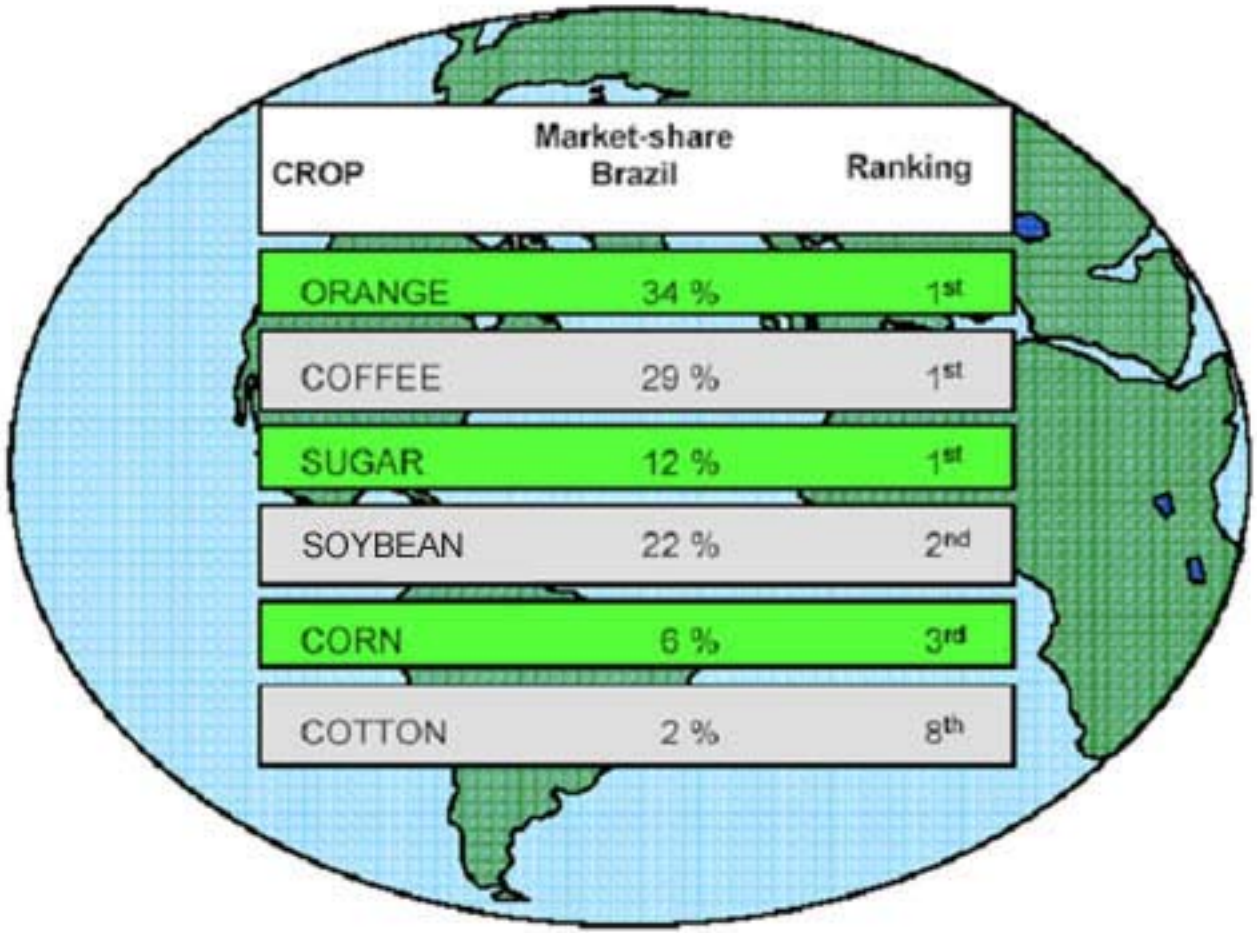
Produção x Área Plantada

(1970 a 2001)



Fontes: USDA / FAO / IBGE / SECEX

Brazilian Market-share



Source: FNPA - 2002

Posiçã

Ranking do Consumo de Fertilizantes

(1999 / 2000)

	NPK	Nitrogênio	Fósforo	Potássio
1º	China (26%)	China	China	EUA
2º	EUA (14%)	EUA	Índia	China
3º	Índia (13%)	Índia	EUA	Brasil
4º	Brasil (4%)	França	Brasil	Índia
5º	França (3%)	Paquistão	Austrália	França
		Brasil (9º)		

Total do Consumo:	**140 milhões t**	**85 milhões t**	**33 milhões t**	**22 milhões t**

Participações:

- 5 maiores	**60%**	**61%**	**62%**	**58%**
- Brasil	**4%**	**2%**	**6%**	**10%**

Fontes: ANDA / IFA

The Cerrado

Internationa Competition

Names to Watch For

Brasil

- Bunge
- CVRD

China

- Sinofert
- CNOOC

Canadian
pportunitie

Where We Cannot Compete

- × **Low labour cost**
- × **Low land cost**
- × **Low natural gas cost**
- × **Low $CDN to stimulate exports**

Canadian Opportunitie

Where Can We Still Win?

- ✓ **Economies of scale**
  - **Land area**
  - **Mechanization**
- ✓ **Transportation & Logistics Efficiencies**
  - ✓ **Rail, road, water**
- ✓ **Rich natural resources**
  - ✓ **Need to be upgraded with market focus**