

The evolution and contribution of plant breeding to global agriculture



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2nd World Seed Conference, Sept. 8-10, 2009, Rome

Plant Breeding

Changing genetic make-up of plants
for the benefit of humankind

Developing new varieties

→ through creation of new genetic diversity

→ by reassembling existing diversity

→ aid of special techniques & technologies

Precursor:

9.000-11.000 yrs ago
(domestication)



Teosinte Primitive maize Modern maize

The Seed Industry - a Time Line (1)

- 1740 – 1850: First companies specialising in horticultural crops established
- 1850 – 1900: Modern Plant Breeding begins
 - Public sector involvement in plant breeding and protection of farmer & consumer interests
 - New companies established for numerous crops
 - First National Seed Associations established
- 1900-1970s: Transition and Modernization
 - Growth of the seed sector, private and public
 - Forerunners of ISF established (FIS: 1924 / Assinset: 1938)
 - International regulations affecting seed in force



The Seed Industry – a Time Line (2)

- 1970s - First wave of consolidation
 - Chemical & oil industry acquire seed companies
- 1980s - Biotechnology in plant breeding
 - DNA marker assisted selection, genetic engineering
- 1990s - Second wave of consolidation
 - Birth of 'life-science' companies
- International Treaties and Conventions with impact on the seed industry
(UPOV, CBD, CPB, IT-PGRFA)



The Seed Industry Today

1. Increasing global seed market
2. Growing use of hybrid seed with several technological components (e.g. seed coatings)
3. Growing international seed trade
4. Increasing number of regulations
5. Increasing number of multinational companies



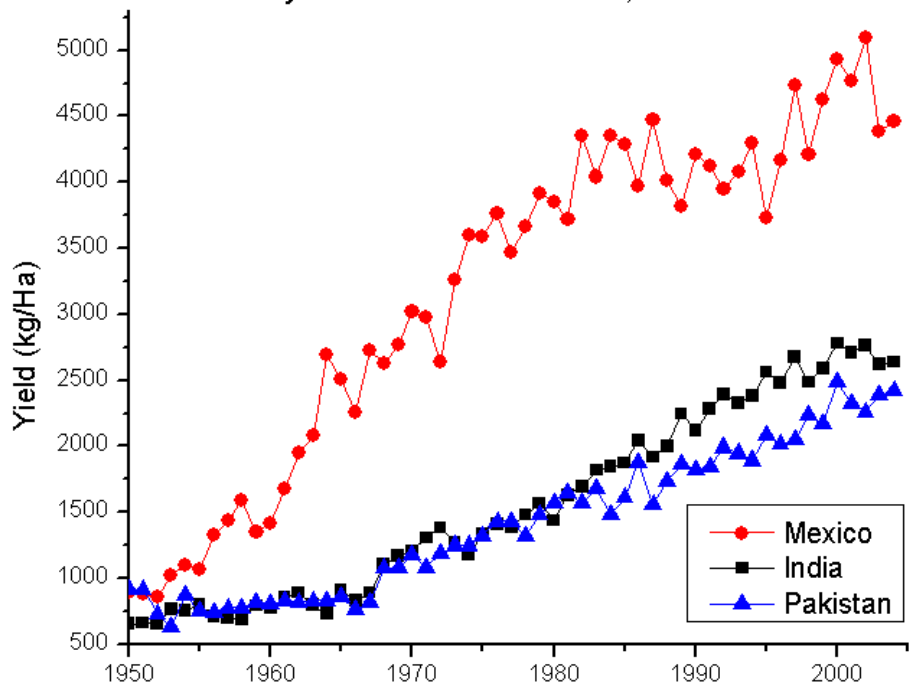
Contributions of Plant Breeding

- Yield
- Resistance to biotic stress
- Tolerance to abiotic stress
- Earliness
- Taste
- Size
- Quality
- Firmness
- Shelf-Life
- Plant type
- Labour cost
- Harvestability
- Dwarfness

Contributions of Plant Breeding

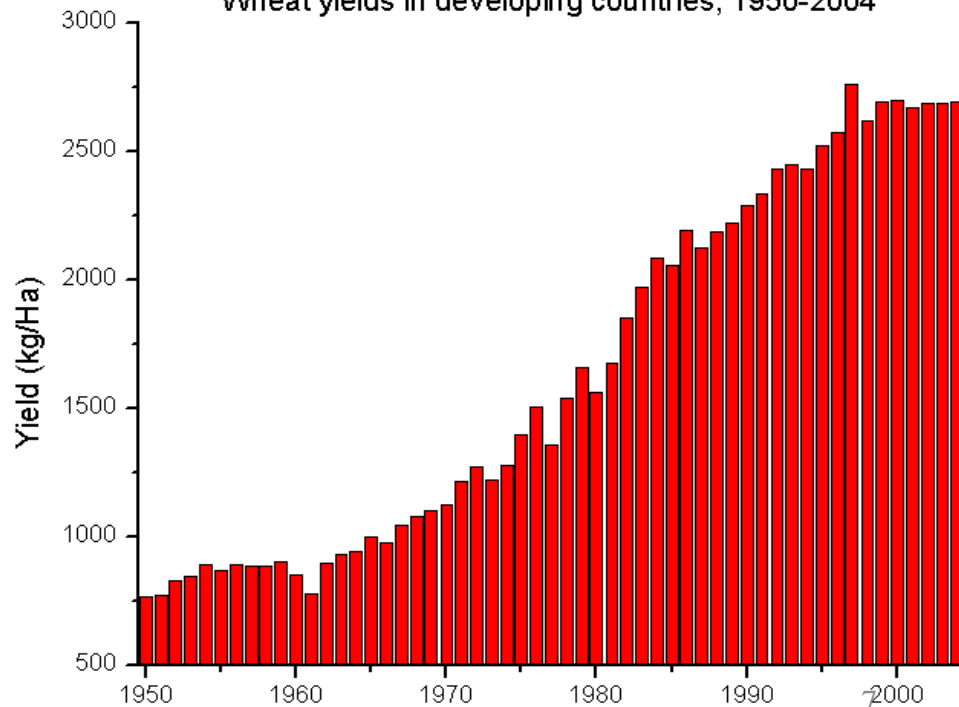
Yield

Wheat yields in selected countries, 1950-2004



Source: FAO

Wheat yields in developing countries, 1950-2004



Source: FAO

Contributions of Plant Breeding

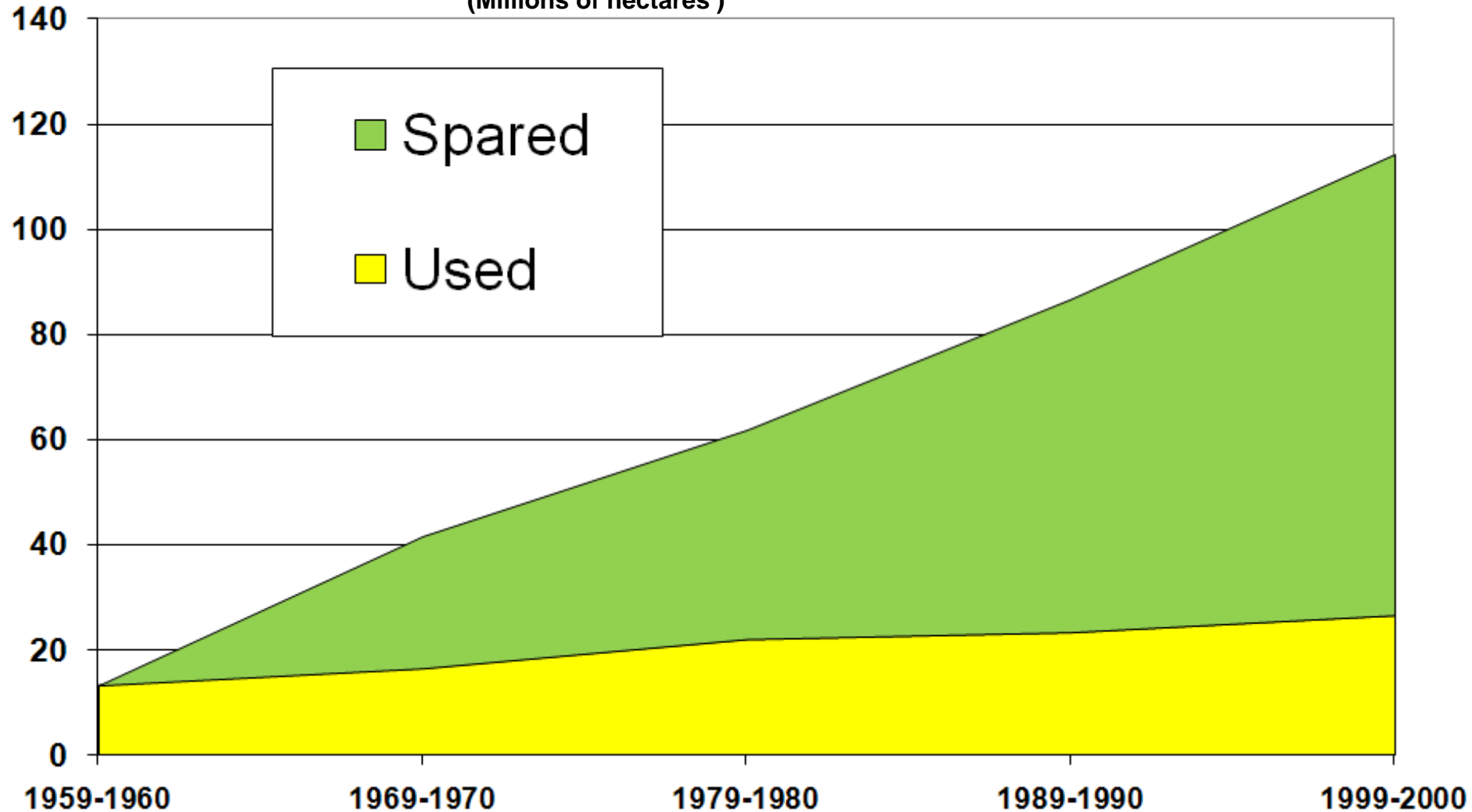
Yield

- ❑ Winter wheat yields: trebled over the past 60 years
 - 2.5 tonnes/ha (mid-1940s) to 8 tonnes/ha today.
- ❑ NIAB study 2008: wheat, barley, oats
 - 300 varieties (>3 yrs), 3600 trials, 53.000 data points
- ❑ 1947-1986: 50% of increase in yield attributed to plant breeding.
 - Rest to fertilizers, crop protection products, crop husbandry and machinery (Silvey, 1986)
- ❑ Since 1982: 90% of all yield increase due to introduction of new varieties (yield : 5t/ha =>8t/ha)

Contributions of Plant Breeding

Land spared in India through increasing wheat yield

(Millions of hectares)



Contributions of Plant Breeding

Biotic stress resistance

Plant Breeding has provided 10.000s of resistant varieties to:

- Fungi
- Insects
- Viruses
- Bacteria
- Nematodes
- Water molds



Annual global level of lost food production

\$85 billion caused by pathogens

\$46 billion caused by insects

Source: FAO, Aug. 2009

UK: disease resistance alone saves 100
million GBP/yr in crop protection products



Geminiviruses in tomato

- Tomato Yellow Leaf Curl Virus
- 1990s: Destroyed 95% of tomato harvest in Dom. Rep.
- In 1991/1992: 140 million USD damage in Florida.
- Now resistant varieties

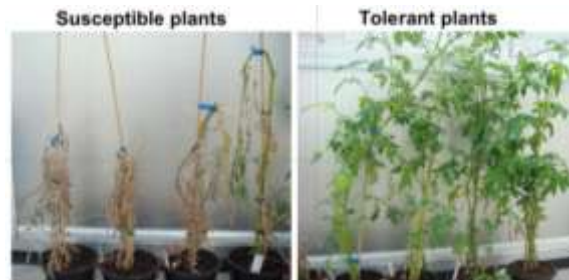
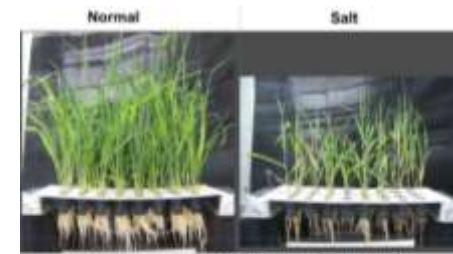


Contributions of Plant Breeding

Abiotic stress tolerance

Plant Breeders focus on tolerance for:

- Herbicides (95 billion USD / yr lost on weeds
 - 380 million tonnes of wheat)
- Drought (90 million people affected/yr)
- Flood (106 million people affected /yr)
- Salt (900 million ha affected)
- Better nutrient uptake



Source: WUR, NL

Potato plants grown without watering for 3 weeks

Nutritional quality

- 124 million people / yr in 118 countries affected by Vit. A deficiency (1-2 million deaths)
- Rice: staple crop for half of mankind
- Rice varieties developed with higher levels of carotenoids => 'Golden rice'
- Market release 2011?
- 70 IP rights from 32 companies relinquished



Contributions of Plant Breeding

Responding to the challenges

- Food security & Hunger alleviation
- Increase nutritional values
- Reduction of pesticides / fossil fuels
- Reduction GHG emissions
- Land saving / Decrease deforestation
- Conserve biodiversity
- Increase carbon sequestration

Contributions of Plant Breeding

Conclusion:

 Enormous contribution so far

 Tremendous potential



Thank you for your attention

