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WORLD INTELLECTUAL
PROPERTY ORGANIZATION



INTERNATIONAL UNION
FOR THE PROTECTION OF
NEW VARIETIES OF PLANTS

**WIPO-UPOV SYMPOSIUM ON
INTELLECTUAL PROPERTY RIGHTS
IN PLANT BIOTECHNOLOGY**


organized by
the World Intellectual Property Organization (WIPO)
and
the International Union for the Protection of
New Varieties of Plants (UPOV)

Geneva, October 24, 2003

DISSEMINATION OF BIOTECHNOLOGY
INTO AGRICULTURE

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Dissemination of Biotechnology into Agriculture

WIPO-UPOV Symposium on
Intellectual Property Rights in Plant Biotechnology
Geneva, Switzerland
October 24, 2003
Stephen Smith
Pioneer Hi-Bred International, Inc.
DuPont Agriculture and Nutrition

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Dissemination of Biotechnology into Agriculture: Outline


- Introduction
- Global use of transgenics on farms
- Looking ahead
- Crops, Countries, Traits
- Intellectual Property Protection
- Conclusions



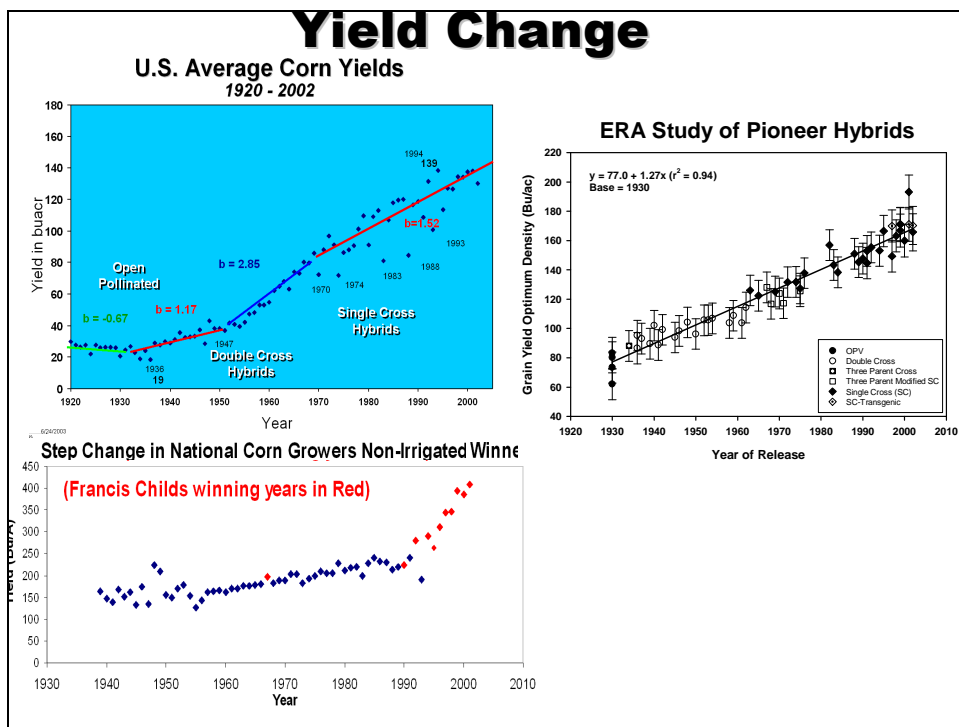
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Introduction

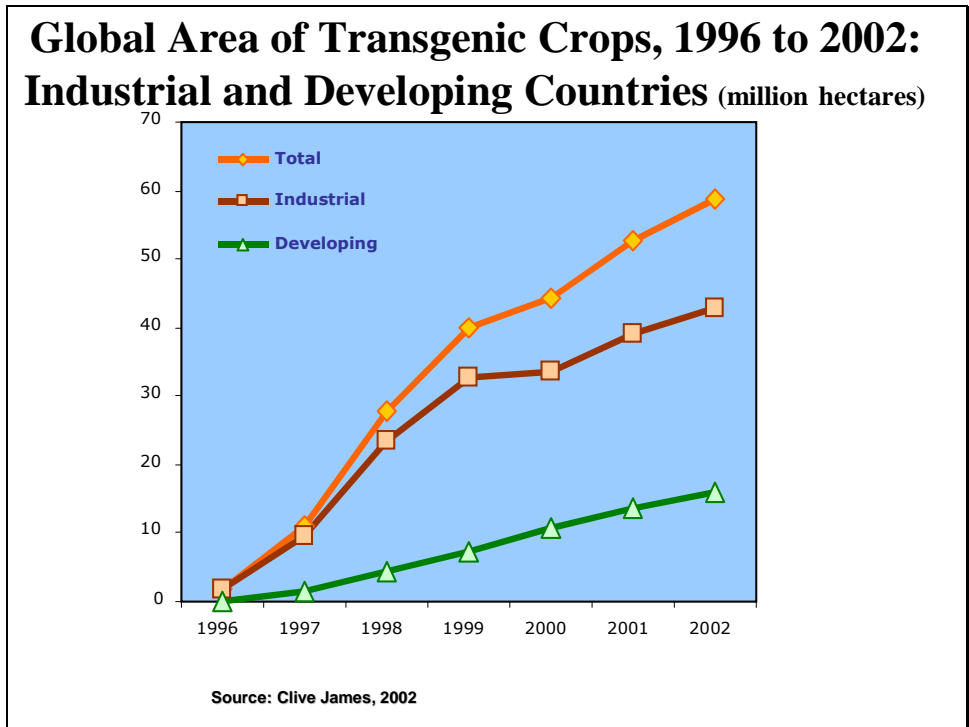
- Agriculture is the original biotechnology
- Agriculture fundamental to culture, health, quality of environment, biodiversity
- Seed: a superb vehicle for disseminating innovation and underpinning benefits
- Effective IP critical to encourage investments and promote genetic diversity
- Biotechnology: far more than transgenes
- Development of improved germplasm critical



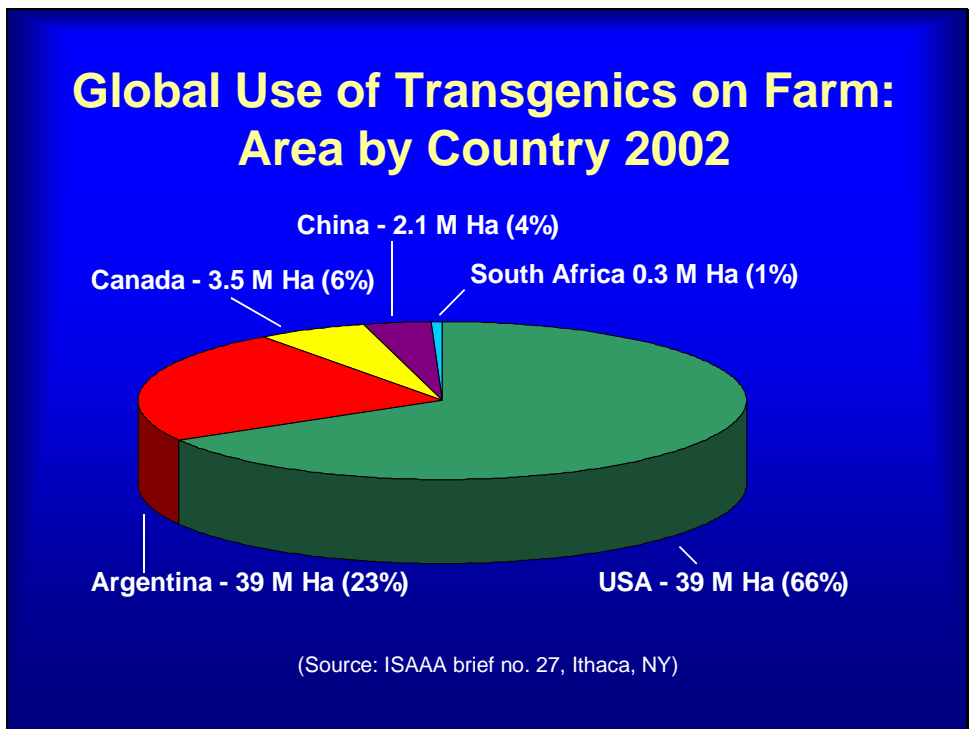
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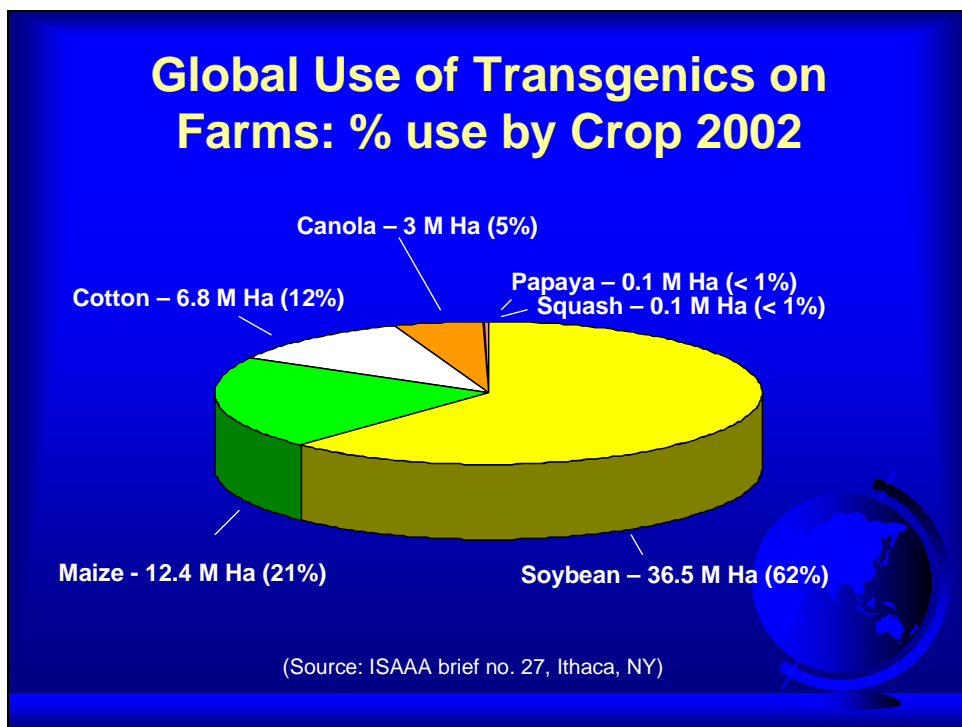
Global Use of Biotechnology: By Small and Large-scale Farmers

- 75% of GM crops cultivated in developed countries, large-scale farms-US, Canada
- Significant use in Argentina, Brazil, China,
- 6,000,000 farmers grew GM in 2002
- >75% of farmers were resource poor, small-scale cotton farmers, China, S. Africa

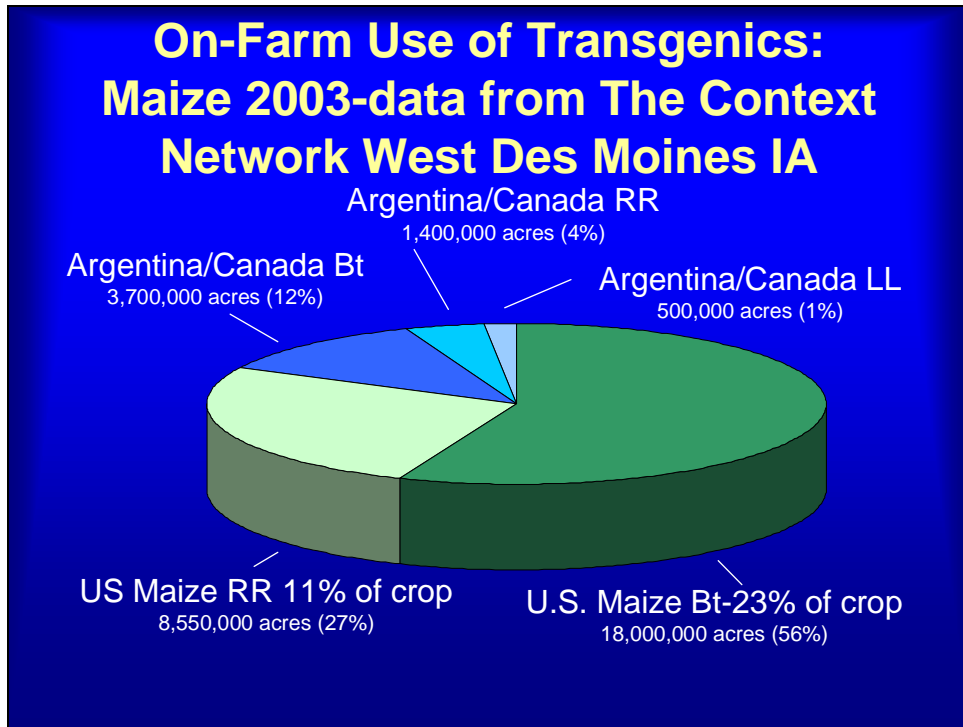
(James, C 2002 ISAAA brief no. 27 , Ithaca, NY)



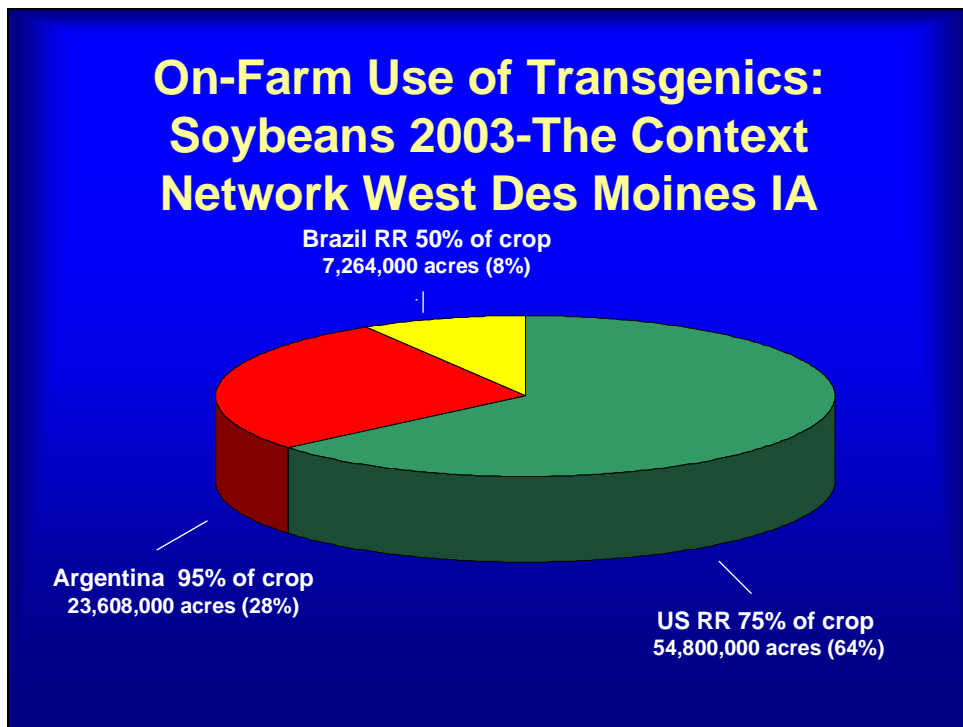
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Global Bt Cotton-The Context Network West Des Moines IA

- **US 36% cotton crop is Bt**
- **Bt cotton ranks 2nd to RR soy by global adoption**
 - Close to 5 m. acres outside US
- **China plants 90% of the total**
 - Bollgard (40%?)
 - China's own CASS Bt trait (60%)
- **Bollgard planted in 8 countries**
 - India, 2002 launch
 - ◆ Excellent prospects, hybrid cotton
 - South Africa, Mexico, Argentina and the Philippines are minor users
- **Australia launched in 1996/7**
 - Different Lep. species, less effective

Bt Cotton - International Launches
Area (1,000 acres)
Sources: Monsanto & industry comments

Year	Australia (Ingard)	China (Bollgard)	China (CASS)	India
1996	0.1	0	0	0
1997	0.1	0	0	0
1998	0.1	0	0	0
1999	0.1	0.2	0.1	0
2000	0.1	0.5	0.4	0
2001	0.1	1.5	2.6	0
2002	0.1	1.5	2.4	0.1

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Global RR Cotton-The Context Network West Des Moines IA

- **US 54% of crop is RR**
- **In Mexico**, RR cotton has been planted on a small acreage from 1997 on
 - Mexico is a very minor cotton producer
- **In South Africa**, RR cotton was launched in the 1998-9 season.
 - The country has around 150,000 acres, but by 2001/2 RR/Bollgard stacked cotton had been adopted on 28% of that total.
- **In Australia**, RR cotton was commercialized in the 2001/2 season
- **In Argentina**, RR cotton was also approved ahead of the 2001/2 planting season.

RR Cotton - International Launches
Area (1,000 acres)
Sources: Totals: Monsanto; Country Shares: Industry Comments

Year	Mexico	S. Africa	Australia	Argentina
1997	10	0	0	0
1998	15	0	0	0
1999	20	5	0	0
2000	25	15	0	0
2001	30	30	120	0
2002	35	40	200	75


Farm Labor Cost Issue

- Herbicide-tolerance traits for China, & India, Uzbekistan?

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Looking Ahead

- Climates change
- Farm cultivation/husbandry practices change
- Pests and diseases evolve
- Need more effective use of soil and water
- Need to increase productivity, including in harsh environments
- Un-ending need for better adapted varieties
- Improved germplasm and traits are needed

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Looking Ahead


- Capitalizing on scientific discovery in cultivar development—new tools facilitate access
- Adds complexities and costs to Research and Product Development
- IP is a prerequisite to support trait and germplasm development
- Encourage use of new genetic diversity rather than repeated narrowing use of old base
- Compulsory licenses (e.g. breeder exemption under patent law) undermine research investments, narrow genetic base

A small, stylized globe icon with a grid of latitude and longitude lines, positioned in the bottom right corner of the slide. The globe is rendered in a light blue color against the dark blue background.

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Future: Lepidopteran pests


- **ECB**
- France, Italy
- Romania 1.5 M ac.
- S Africa 6.5 M acres
- **Southwestern CB**
- NE Mexico
- Southern USA
- **Fall Armyworm**
- Mexico
- Argentina 4.9M ac.
- Brazil 19 M acres
- **Corn Earworm**
- **Cotton Bollworm**
- N and S America



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Future: Coleopteran pests

- **Rootworm**
insecticides on 14.5 M ac. USA
- MON 863 USDA approved
- Dow/PHI 149B1-2005
- Brazil-insecticide use on 12M ac.
- **Western rootworm**
in Serbia 1990s
- Very rapid dispersal
- 1 M ac. 1997
- By 2001 spread to Hungary, Ukrainian border, Romania, Italy, France



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The Challenge

- Population 2000 - 6 billion 2050 - 9 billion
98% of projected growth will be in the developing countries
- Malnutrition/Poverty
840 million people suffer from chronic malnutrition
1.3 billion afflicted by poverty
- Cultivable Land per capita
0.45 ha. in 1966
0.25 ha. in 1998
0.15 ha. in 2050
- World grain yields grew at 2.1 % in 1980s, but at less than 1.0 % per annum in 1990s.
- World consumption of meat tripled in last 40 years


→ **◆Must double food production sustainably on same land area (1.5 billion ha) by 2050.**

Data from World Resources Institute

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Biotechnology Potential for Developing Countries: Crops


- Banana
- Beans
- Cassava
- Cocoa
- Coffee
- Cotton
- Cucurbits
- Groundnut
- Maize
- Millet
- Papaya
- Potato
- Rice
- Sorghum
- Sweet Pepper
- Sweet Potato
- Tomato
- Wheat



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Biotechnology Potential for Developing Countries: Traits


- Acid soil tolerance
- Apomixis
- Disease diagnosis kits
- Drought resistance
- Edible vaccines
- Fungal resistance
- Genetic maps
- Genomics
- High lysine
- Insect resistance
- Low soil nutrients
- Marker assisted selection
- Nematode resistance
- Starch quality
- Striga resistance
- Tissue culture
- Transformation technology
- Virus resistance
- Weed control



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Biotechnology for Developing Countries: Organizations

- **CGIAR:** (e.g.) CIAT, CIP, CIMMYT, ICRISAT, IPGRI, IRRI
- **Foundations:** African Agricultural Technology Foundation, Rockefeller, Danforth Institute, others
- **Governments:** USAID
- **NARS:** EMBRAPA, Brazil, USDA, numerous others in many countries
- **NGOs:** Harvest Biotech Foundation International, Kenya, others
- **Private sector:** Dow, Garst, Monsanto, Mycogen, Pioneer, Syngenta, others
- **Public sector:** many universities in numerous countries



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Intellectual Property Protection

- Application of biotechnology requires investments into basic and applied research hitherto not undertaken in crop improvement
- New abilities to characterize, isolate and modify genes/germplasm allow additional IP on crop genetics research and enabling technologies
- IP protection an absolute prerequisite to encourage private sector investments



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Intellectual Property Protection

- N. America – private sector investments in plant breeding increased from \$50m (1960) to \$500m (1997)
- Public sector investments in field crops level from late 70's; declined since mid 90's (\$600m)
- Globally: Private sector \$3.4 billion food and agriculture research annually; much more than public sector



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Intellectual Property Protection


- Public sector does not have all the financial, germplasm or technical resources needed to move basic research into products on farms
- No single private sector player has all the technology or germplasm needed to meet farmer needs
- Public sector can reach areas not currently commercially viable for private sector
- Key roles for public and private sectors



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Intellectual Property Protection: Bt Maize: an Example

- **Gene ownership**
 - Cry1F
 - PAT marker gene
- **Enabling technologies**
 - Microprojectile bombardment
 - Herbicide selection
 - Backcrossing
 - Production of fertile transgenic
- **Enhanced expression**
 - Chimeric genes using viral promoters
 - Enhanced expression
 - Enhanced transcription efficiency
 - Selective Gene expression
- **Elite maize inbreds and hybrids**




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From Research to the Farmer's Field: IPP Issues Bt Maize

- Recent agreements among major players allow forward movement in plant biotechnology
 - Cross-licenses
 - Dow licenses RR YG
 - Monsanto licenses Herculex 1
 - Pioneer licenses RR for corn, soybean, canola
 - Pioneer germplasm issues with Monsanto resolved
 - Matured from competing on developing basic technologies to most effective use of technologies to create improved products
 - Payment for technology/germplasm research is ultimately dependent on farmer purchases of seed
- 

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Intellectual Property Protection- Germplasm Development

- Breeders should have option of same level of IP as any other field of invention
 - Development of germplasm and traits; key
 - Patents should be available as an alternative
 - Patents should not have compulsory license or breeder exemption
 - New technologies facilitate access; recalibrate IP-access balance; Revise UPOV
 - Increase incentives to develop new germplasm versus encourage repeated use of widely used varieties
- 

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Conclusions and Future Prospects

- Increase knowledge and capabilities through research
- Increase productivity and positive environmental impacts of agriculture
- Need strong public and private sectors
- More effective IP for germplasm development
- Bridge gaps between research plots and farmers fields
- Conservation and evaluation of genetic resources for future use

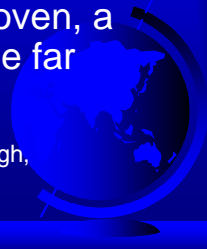
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Dissemination to Culture and the Human Spirit

- “ When I got home I heard John Barbirolli conducting Beethoven’s Seventh Symphony. What was agriculture for except that such a thing as that symphony and the playing of it should be made possible? To make bread so that it shall be possible for mankind to have more than bread; to listen to a Beethoven, a Sibelius, a Tchaikovsky, uttering some far message of paradox and joy”.

John Stewart Collis : The Worm Forgives the Plough,
Penguin Modern Classics, 1973.

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Acknowledgements

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