Improving Production Practices

Technology Innovations in Agriculture

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IPC, Bogor, Indonesia, May 12, 2008
Questions

- Technological innovations?
- Changes in research investments?
- Constraints to adoption?
Challenging times & changes in agriculture

Demand
- Population is increasing…
- Food demand is increasing…
- Food requirements are changing…
- Huge energy demands…
- More renewable energies
- Eradicate poverty

Supply
- Land is limited…
- Soils are eroding…
- Water is becoming scarce…
- Carbon emission need to be reduced…
- Reduce environment footprint…
- Preserve biodiversity…
- Knowledge is unequally distributed…
- Capital is equally distributed

→ Produce MORE with LESS
Addressing the challenges

- Put more land into production
- More open trade
- Climate & energy policies
- Increase productivity (good practices & technology)
- Better synergies between private & public sectors
Rice Yields: Sri Lanka

Yield (kg/ha)
Raising yields and nutrient use efficiency

Kg grain per kg N applied to maize in the United States

Updated from: Fixen and West
Data: USDA Ag Chem Use Survey & Annual Crop Production

Cereal and rapeseed production in France against fertilizer deliveries

Index 100 for Year 1980

N Fertilizer Deliveries
Cereal + Rapeseed Production
Raising yields and nutrient use efficiency

Cereals in China

Cereals in Pakistan

Sources: IFA and FAO
### Fertiliser Best Management Practices

<table>
<thead>
<tr>
<th>Right product</th>
<th>Right time</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Soil Testing</td>
<td>- Application timing</td>
</tr>
<tr>
<td>- Balanced fertilization (<em>N, P, K, secondary and micronutrients</em>)</td>
<td>- Slow- and controlled-release fertilizers</td>
</tr>
<tr>
<td>- Enhanced-efficiency fertilizers</td>
<td>- Urease and nitrification inhibitors</td>
</tr>
<tr>
<td>- Nutrient management planning</td>
<td>- Fertilizer product choice</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right place</th>
<th>Right rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Application method</td>
<td>- Soil testing</td>
</tr>
<tr>
<td>- Incorporation of fertilizer</td>
<td>- Yield goal analysis</td>
</tr>
<tr>
<td>- Buffer strips</td>
<td>- Crop removal balance</td>
</tr>
<tr>
<td>- Conservation tillage</td>
<td>- Nutrient management planning</td>
</tr>
<tr>
<td>- Cover cropping</td>
<td>- Plant tissue analysis</td>
</tr>
</tbody>
</table>

**Credit:** John Ryan

**Enhancing Agricultural Productivity:**

**Meeting the Sustainability Challenge**

CSD-16, 7 May 2008
Addressing the water challenge with plant science

Challenge
- Water contamination
- Water use efficiency

Plant science contributions
- Best practices to reduce run-off & groundwater pollution
- Drought-tolerant crops
- Reduced tillage (use of herbicides)
Plant science industry contributions

- **Innovation**
  - Food, feed & fibre
  - Protecting crop yields
  - Increasing yields
  - Improving nutritional food quality (disease-control & nutrition)

- **Stewardship**
  - Energy & new materials
  - New feedstock for energy
  - New materials (cars, paints, detergents)

- **Knowledge services**
  - Natural resource mgmt
  - Protecting & preserving soil & water resources
  - Making technologies available to developing world
The gradual conversion of two industry sectors

- Seed Industry
- (Agro)chemicals Industry
- Plant Science Industry
- Plant Biotechnology

before 1990

1990 – 21st century
Plant Science Industry: an innovative sector

R&D % of Sales by Sector

Source: UK-DTI, 2005 and Phillips McDougall 2005
The plant (life) science industry value chain

- Genomics
- Biology
- Plant breeding
- Chemistry
- Trait
- Seed
- Chemical
- Crop/Plant
- Micro-organism
- Animal
- Pharmaceuticals & diagnostics
- Food & feed
- Fibre
- Energy
- Industrial raw materials

Current applications
Future applications
Innovation in ag-biotechnology: outputs

Input Substitution
- Insect Resistance
- Herbicide Tolerance

First quality effects (output traits); advanced input traits
- Fungal Resistance
- Insect Resistance (2nd generation)
- Stacked genes
- Better ethanol conversion
- Better nutritional contents

Advanced quality effects
- Abiotic stresses tolerance
- Biopharmaceuticals
Innovation in crop protection: outputs

- Better chemicals with improved safety profile
- Better formulations with reduced risk
- Better packaging and improved container management
- Application technology and precision farming
Research goals for a new crop protection product

**Biologically efficient:**
- high selectivity
- fast impact
- optimal residual effect
- good plant tolerance
- low risk of resistance development

**Environmentally sound:**
- low toxicity for non-target organisms
- fast degradation in the environment
- low mobility in soil
- no relevant residues in food and fodder
- low application rate

**User friendly:**
- low acute toxicity
- low chronic toxicity
- good formulation characteristics
- safe packaging
- easy application method
- long store stability

**Economically viable:**
- good cost/profit ratio for the farmer
- broad use
- applicability in Integrated Crop + Pest Management
- innovative product characteristics
- competitive
- patentable
**Development of a crop protection product**

<table>
<thead>
<tr>
<th>Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Costs in US$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHEMISTRY</strong>&lt;br&gt;Active ingredient</td>
<td>Synthesis</td>
<td>Process development</td>
<td>Pilot plant production</td>
<td>Production</td>
<td>~ 67 million</td>
<td></td>
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<tr>
<td>Formulation</td>
<td>Synthesis optimisation</td>
<td>Formulation / Packaging</td>
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<tr>
<td><strong>BIOLOGY</strong>&lt;br&gt;Research</td>
<td>Laboratory / greenhouse</td>
<td>Pilot trials</td>
<td>Field trials for development and registration</td>
<td>Optimisation of application</td>
<td>~ 80 million</td>
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<tr>
<td>Development</td>
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<tr>
<td><strong>TOXICOLOGY</strong>&lt;br&gt;Mammals</td>
<td>Acute, sub-chronic, chronic toxicity / mutagenicity / carcinogenicity / teratogenicity / reproduction</td>
<td></td>
<td></td>
<td></td>
<td>~ 53 million</td>
<td></td>
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<tr>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
<td>Official evaluation of registration documents / registration / first sales</td>
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<tr>
<td><strong>ENVIRONMENT</strong>&lt;br&gt;Metabolism</td>
<td>Plants / animals / soil / water and air</td>
<td></td>
<td></td>
<td></td>
<td>~ 200 million</td>
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<tr>
<td>Residues</td>
<td>Plants / animals / soil / water and air</td>
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<tr>
<td><strong>Substances</strong></td>
<td>15,000</td>
<td>500</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>~ 200 million</td>
<td></td>
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</tbody>
</table>
R&D in Crop Protection Chemistry: Outputs

Average rate of new product introduction

Products introduced since 1980 by type = 286

Source: Phillips McDougall
Effective release height

No air-assistance  Air-assisted application
Critical Success Factors

- Recognition of role and benefits of technology
- Science, risk-based and workable regulations
- Protection of innovation cycle: intellectual property rights (patents, protection regulatory data, trademarks, anti-counterfeit)
- Fair and free trade rules
- Integrity standards & commitment to stewardship practices (maximise benefits, minimise risks)
- Partnerships, stakeholder engagement, corporate responsibility, and transparency
Adapt modern technologies to local conditions
(integrate local knowledge, traditional technologies)
Tech. Transfer & Training: Change in Behaviour

Lecture  | Demonstration  | Participation

Time & Cost

Training plan

Increase knowledge  | Change in behaviour

Numbers trained  | Change in Awareness

Partnership and Long-term Commitment
Is the global federation representing the plant science industry beneficial or risk public perception/understanding?
Lost sight of the value of technology and economic progress?

“Something’s just not right—our air is clean, our water is pure, we all get plenty of exercise, everything we eat is organic and free-range, and yet nobody lives past thirty.”
Thank you

www.croplife.org