Biotech Canola: An Exciting History and a Great Future

September 17, 2013
ABIC 2013

Wilf Keller
President and CEO
Development of Canola – A few historical points

- During WWII (1943) – Rapeseed was successfully cultivated for uses as a marine lubricant.
- 1950 – Production dropped below 500 acres.
- Researchers recognized potential for development of a W. Canadian oilseed crop.
  - programs initiated at Agriculture and Agri-Food Canada (AAFC), National Research Council (NRC) and University of Manitoba.
- 1954 – First improved Canadian-bred rapeseed cultivar.
Development of Canola –
A few historical points (continued)

• 1950s-60s – Intensive research to identify and introduce traits for low erucic and low glucosinolate content.
• 1974 – Release of first “double low” cultivar, Tower, by University of Manitoba (a world first).
• 1978 – The term “Canola” was coined by the Rapeseed Association of Canada.
Tracing the History of Canola Varietal Development in W. Canada

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<td>AAFC</td>
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<td>MNEs: Bayer CropScience Cargill Dow AgroSciences DuPont-Pioneer Monsanto Syngenta Viterra</td>
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The 1980s was an important transitional decade in the development of Canada’s canola industry.

- growing private sector interest;
- growing capacity in new technologies (including biotechnology);
- initiation of public-private partnerships.
Canola as a Target for Biotechnology

• Canola (esp Brassica napus) is responsive in cell culture (regeneration of plants from cells and tissues)
  – e.g. pollen (microspores) → haploid plants.
• Canola was amenable to genetic transformation utilizing Agrobacterium.
• It was possible to demonstrate hybrid vigor in Brassica crops.
• Wide range of challenges
  – weed management;
  – seed yield;
  – oil quality/yield;
  – meal quality;
  – disease resistance.
Public Sector Canola Biotechnology Programs in Canada (1980s)

- AAFC (Ottawa, Saskatoon)
  - microspore culture → haploidy;
  - genetic transformation;
  - somatic hybridization.
- NRC (Saskatoon)
  - genetic transformation.
- University of Guelph
  - microspore culture, haploidy.
Establishment of Innovative Biotech Firms with Commitment to Canola R&D (early-mid 80s)

- Agrigenetics/Mycogen
- Allelix
- Biotechnica Canada
- Calgene
- InterMountain Canola
- Paladin Hybrids
- Plant Genetic Systems
Example

Development of Liberty Link Canola –
   A successful public-private partnership.
   • a Canadian success story;
   • significance of personal connections.
• Maurice Delage (Hoechst lead in Canada) visits Wilf Keller at AAFC, Ottawa (1985).

• Series of meetings between Hoechst (Germany and Saskatchewan) and AAFC representatives (1985-86).
• Michael Oelck seconded by Hoechst to work in the AAFC laboratories in Ottawa (1986).
• “Agreement” between Hoechst and AAFC.
• Experiments to introduce genes Liberty resistance into regenerable Canola cell cultures (1986-88).
• Selection of characterization of one resistant plant (1988).
• Relocation of W. Keller to NRC Plant Biotechnology Institute (1989)
• Relocation of M. Oelck Hoechst team to NRC facilities in Innovation Place (1990).
• Funding from Hoechst, NABI and NRC for expanded R&D activities (1990-94).
• Hoechst – AAFC (Saskatoon) partnership agreement for development of herbicide tolerant cultivars of *Brassica napus* canola (1990-91).
• Initiation of confined field trials (1990).
• Multi-site field trials (1991→).
- Negotiations with regulatory agencies (1990-95).
- Hoechst alliance with Schering to create AgrEvo.
Biotechnology and Hybridization Technologies have been major factors in establishing Canola as Canada’s major cash crop.
Seeded Acres – Provincial

Source: Statistics Canada, Field Crop Reporting Series, CANSIM Table 001-0017

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*2013 Preliminary estimate
Canada’s Canola Industry

- Annual contribution of >15.4B to Canada’s economy.
- 43,000 growers.
- 228,000 Canadian jobs.
- Diversification:
  - 13 crushers/refiners
  - >7 MT processed
- Provincial benefits:
  - Saskatchewan - $5.4B
  - Alberta - $5.0B
  - Manitoba - $3.3B
- >95% herbicide tolerant varieties.
- >80% hybrid varieties.
Economic and Environmental Benefits of “GM” (Biotech) Canola (2007 data)

- Average benefit to producers of $15/acre (range from $5-$25).
- Major contribution to movement to minimum and zero till systems (65% of canola grown under these systems).
- Sequestration of 1M tonnes of carbon.
- Decline in herbicide uses by up to 30% (6,000 tonnes/year).
- Reduced fuel consumption by 31.2M liters/year.
- Total economic impact
  - Average $350M/year (2005-07).
Under Development (2015 – 2025)

• Whole genome sequencing and genomic-based breeding.
• Critical new traits
  -- disease resistance (clubroot, blackleg, sclerotinia);
  -- oil quality/content;
  -- shattering tolerance;
  -- meal quality.
Taking Canola to the Next Level (continued)

**Essential Future Targets (beyond 2025)**

- Seed yield
  - heat tolerance;
  - drought tolerance;
  - apomixis.
- **Productivity/Performance**
  - enhanced photosynthetic efficiency.
- **Root System Improvements**
  - nutrient use efficiency;
  - water use efficiency;
  - plant health.
Roles of Public and Private Sectors in Crop R&D&C: A Canola Example

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<tr>
<th>Public ➔</th>
<th>Public - Private Partnerships ➔</th>
<th>Private</th>
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| • Concept  
• Discovery R&D | • Proof-of-concept  
• Pilot studies  
• Early development | • Late development  
• Commercialization |

Canola microspores/pollen culture from concept to reliability 1973 - 85

Adapt microspore culture to genetic modification and test prototype plants 1986 - 95

Cultivar development  
E.g. Innovater 1995 ➔
Comments

• Personal contacts remain critical in making deals (despite Facebook, Twitter, etc.).

• Current public policies do not place enough emphasis on concept/discovery research that must be led by public institutions (are we hoping that public-private partnerships will cover requirements for new knowledge?)

• Much remains to be done to take canola to a new level. It is not a “mature industry” and public investment in discovery research relevant to plant productivity, etc. is definitely required.

• With the strategy of controlling intellectual property, public institutions have generally lost sight of the real goals of collaborative undertakings. Institutional policies are now too restrictive and paperwork is too burdensome. This has significantly reduced opportunities for agreements that provide value to the industry as a whole as opposed to a business office embedded within an institution.
Acknowledgements

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Thank you!

www.agwest.sk.ca