Fostering and Promoting Innovation and Entrepreneurship in the Canadian Agri-Food System

University of Alberta as a solution Provider

John J. Kennelly, PhD.
GCHERA World Dialogue
OCTOBER, 20 2013
NANJING, CHINA
“Personally, I am astonished when I contemplate the simple fact that since I was born in 1920, the world’s population has more than quadrupled and in less than four decades it will grow by half, to 9 billion”

Donald McQueen Shaver, O.C

Source, The Gene Scene, Summer 2012
Agriculture and food research in Canada

University of Alberta

Internationalizing the curriculum – “global” students

Emerging research innovation model

Challenges and opportunities associated with moving from a public model to a public-private partnership
providing solutions
to
global challenges

Alberta
Rocky Mountains
Alberta
Abundant Natural Resources
Agri-Food Sector is a Major Contributor to Canadian Economy

- 2009 – exports valued at 35.2 billion, 4th largest exporter
- Agri-food system employed 2 million people
- Accounted for 8.2% of total GDP

Source: AAFC An overview of Canadian Agriculture and Food System, 2011
Challenges and Opportunities for Canadian Agriculture

- Productivity gains are slowing – decreased investment in R&D
- Higher income in developing countries - increase global demand for animal protein
- Financial sustainability of production sector
- Social License to operate
- Impact of climate change and biofuels
“…Canadian patents related to ICT, Chemicals, and AgriFood have a greater impact than the world average”

“…Canadian research in Agriculture, Fisheries, and Forestry ranked second in the world”

“…Canada’s share of the world’s scientific publications is particularly high in the fields of … Agriculture, Fisheries, and Forestry.”

“…Canada’s output in almost half of the fields grew more slowly than total world output, most notably in Agriculture, Fisheries, and Forestry…”

Source: “The State of Science and Technology in Canada, 2012”, Adapted from Douglas Hedley ED ACFAVM
AGRICULTURE AND FOOD RESEARCH IN CANADA
UNIVERSITIES ARE THE MAJOR PLAYERS

Percent of Publications
2003-2010

- Universities: 80.1%
- AAFC: 11.8%
- Other Federal: 6.8%
- Other: 1.2%

Source: Douglas Hedley ED ACFAVM
COLLABORATION NETWORK OF CFAVM MEMBERS (2003–2010)

Source: Assessment of the Scientific Output of CFAVM Members, Science Metrix
• Founded 1908
• 18 Faculties on five campuses
• 39,000+ students; ~17% intl
• Comprehensive university
• One of Canada’s largest research universities
• Annual research income of ~$500 million
• Over $2B in new/recent construction on campus
2011 NTU World University Ranking – UAlberta Ranked 73th

UofA “Agriculture” ranked 25
UofA “Environment” 33

Forestry Program consistently ranks among the best in North America.
Individual and Community Well-being:

Research Themes

Bioresource Innovation

Environmental Sustainability

Food and Nutritional Security

Evolution from traditional agricultural faculty
Faculty of ALES- A SNAPSHOT

OUR FACULTY

- 120 professors
- Recruited 70% of faculty over past 10 years
- 6.5 Canada Research Chairs
- 2 NSERC Industrial Research Chairs
- 350 support staff
- 90 PDF and Research Associates
STATE OF THE ART INFRASTRUCTURE
FACILITIES SPANNING FOOD PRODUCTION TO HUMAN HEALTH

- Agriculture/Forestry Building
- Agricultural Genomics and Proteomics Unit
- Agri-Food Material Science Unit
- Food Science facilities
- Human Nutrition Research Unit
- Nutrition & Metabolism facilities
- Plant Growth facilities
- AgriFood Discovery Place

UNIVERSITY OF ALBERTA
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providing solutions for a better world
Close relationship to Alberta Health Services and other Organizations

- Alberta Diabetes Institute
- Human Nutrition Centre
- Alberta Palliative Care Research Initiative
- Alberta Prion Research Institute
- Alberta Veterinary Research Institute (AVRI)
- Edmonton Clinic Health Academy
- Centre for Health Promotion Studies
- Coordinated Dietetics Program
Agri-Food Discovery Place

Driving Innovation in Alberta Agriculture

www.afdp.afns.ualberta.ca

A partnership between the University of Alberta, Government of Alberta and Olds College
Agri-Food Discovery Place is home to two unique, state-of-the-art research facilities, specializing in crops utilization and meat safety.

Crops research allows pilot-scale processing of agri-food and agri-industrial products and development of novel technologies through separation, conversion and application technologies all under one roof.

Meat research focuses on the different approaches to control pathogens during the processing, packaging and storage of meat products and is unique in its ability to work with pathogens in a small scale pilot processing environment.

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### CROPS

- **Integrated Bio-refining**
  - Biomass
  - Separation processes
    - (dry and wet)
    - Supercritical carbon dioxide;
    - Sub/super critical water
  - Conversion processes
    - Thermal, chemical and biological
  - Applications development
    - Functional foods, nutraceuticals, biofuels and bioproducts for industrial applications

### MEAT

- Process validation at all stages of food production systems
- Ensuring food safety for food service operations and consumers
- Development and validation of new technologies to improve food safety

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FUNDING REFLECTS SOCIETAL PRIORITIES

$47 million
Average external funding
2009-2012

$467,000
Average per continuing Faculty member
2009-2012
DIVERSE UNDERGRAD PROGRAMS

1,629 undergraduate students - 17% international

9 programs (8 BSc – 1 BA)

• Nutrition and Food Science
• Environmental & Conservation Sciences
• Agriculture
• Animal Health
• Human Ecology/HECOL-Bed
• Ag/Food Business Management
• BA, Environmental Studies
• Forestry
• Forest Business Management
• Dietetic internship
• Human Ecology Practicum
• Work Placement
• Capstone courses
• Field Schools
• Community Service Learning
• International Experience
• Excellent career prospects
550 graduate students

- 51% international
- 22 specializations

Degree

- 55% Masters
- 45% Doctoral
Graduate Students
Top Five Countries

- CHINA 28%
- MEXICO 8%
- IRAN 7%
- INDIA 6%
- USA 5%
1. Student Mobility
   • Undergraduate
   • Graduate
2. Academic Exchange
3. Research Collaboration
International Undergraduate Recruitment

- University Transfer Programs (2+2)
- Reciprocal Exchange
- Foreign Governments’ Education Abroad Scholarships
- Overseas Recruitment
- Web - Media Presentations
- Marketing Communications
- Relationship Building & Promotion
ALES - MOUs and Agreements

- 12 multilateral agreements with international partners
- 9 bilateral agreements with universities and partners in Africa, Asia, Europe and South America
- 10 bilateral agreements with Chinese universities
Universities play a central role in educating future leaders in food security area

Domestic students gaining international experience

Graduate students participating in international development and capacity building

Foreign students an important growth industry
International projects

IDRC-sponsored projects:
  India
  Tanzania
  South Africa

International field schools:
  Africa
  Mexico
  Cuba
To be a world-leading science-based faculty, drawing from the natural and social sciences, providing solutions to some of today’s key global challenges.
Providing Solutions

Science

Policy

Practice
Leading royalty generation at the U of A from 2007-2011

- 64 Reports of Invention
- 31 Applications for Patents
- 18 Patents approved
- 10 License Agreements
- $1.16M in royalties
INNOVATION AND ENTREPRENEURSHIP MODEL

- Not-for-profit organization
- Commercialization service provider for the Greater Edmonton region
- Technology transfer agent for the University of Alberta

Source: Chris Lumb TEC Edmonton
TEC EDMONTON MISSION

TEC Edmonton develops a stronger Edmonton economy by:

– Accelerating success of emerging innovation-based companies
– Commercializing technology from private, university, and public sources
– Fostering and promoting innovation and new enterprise development

*University and City: visionary decision to create joint venture to create innovation-based commerce for regional benefit.*

Source: Chris Lumb TEC Edmonton
TEC SOURCES OF REVENUE
IN DECREASING CONTRIBUTION ORDER

• Commercial Revenue
• University of Alberta
• Alberta Innovates Technology Futures
• City of Edmonton
• License Revenue
• Western Diversification
• Alberta Innovates Health Solutions
• Industrial Research Assistance Program
• Corporate Sponsors
• Total: ~$7.5M

Source: Chris Lumb TEC Edmonton
## Stages of Maturity

<table>
<thead>
<tr>
<th>Idea Generation</th>
<th>Concept</th>
<th>Development</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Academic, Industry, Entrepreneurs)</td>
<td>Investigation</td>
<td>Feasibility</td>
<td>Market Intro</td>
</tr>
<tr>
<td></td>
<td>Development</td>
<td>Growth</td>
<td>Maturity</td>
</tr>
</tbody>
</table>

## Innovation Requirements

- **Management**
- **Technology**
- **Licensing**
- **Product Development**
- **Regulatory Compliance**
- **Market Analysis / Business Planning**
- **Non-Dilutive Funding**
- **Customer Development / Sales**
- **Capital Financing**
- **Facilities**
- **Corporate Structure / Governance**

## TEC Services

### Technology Management
- IP Management & Advisory Services
- Technology Development
- Licensing & Legal Services

### Business Development
- Business Advisory Services
- Company Executive/Entrepreneur Coaching
- Business & Marketing Plans
- Corporate Finance
- Corporate Structure/Governance
- Incubator Facilities

### Entrepreneur Skills Development
- Entrepreneur Toolkit
- Alberta Deal Generator
- VenturePrize
- Go-To-Market
- TEC Source Advisory Panel
- HQP Training
- Mentorship
- Networks

Source: Chris Lumb TEC Edmonton
Entrepreneurs who access support networks do better – faster growth, better access to capital, higher survival rates

- 38 of 60 companies surveyed in both years (63%) created over 90% of the total new jobs
- Companies surveyed in both years grew 36% in 2013
- 80% of new jobs in companies < 20 employees
- Fastest growing companies spent the most on R&D
- Growth across many sectors

Source: Chris Lumb TEC Edmonton
A not-for-profit centre developing genomic technologies for the Livestock Industry.
Canada’s Research & Development Centre Providing Genomic Solutions That will Enable the Revitalization of the Canadian Livestock Value Chain

Global Livestock Value Chain

- Suppliers
- Farmers
- Distributors
- Processors
- Food Service
- Consumers
- Retailers

Livestock Gentec Centre

www.livestockgentec.com
• Converting DNA sequence into useful genotyping tools
• Analyzing thousands of animals to convert genotypes into predictions
• Converting genetic code into decision support tools to improve the efficiency of quality meat and milk production
• To tailor raw material to markets
IMPACT / INTELLECTUAL PROPERTY

• New tools for application of genomics
• 33 active patents and 15 exclusive licences
IP PARTNERSHIPS

• Depend on partner funding and inputs
• Can be jointly owned

• Example:
  – Partner receives rights to lead commercialization in home territory.
  – Royalties depend on inputs and share of patent costs.
  – Partners share income from 3rd territories depending upon lead party
  – University retains all rights for Canada unless partner can justify worldwide rights.
  – Partner may receive a share of 3rd party royalties and license fees in Canada depending on inputs.

www.livestockgentec.com
Making a difference in the livestock industry
DELTA GENOMICS

- A not-for-profit “spin out” company and service arm of Livestock Gentec at the University of Alberta
  - Biobanking
  - Genotyping
  - Sequencing
  - Contract research

Source: Chris Lumb TEC Edmonton
TEC EDMONTON HELPED WITH...

• Developing a Western Economic Diversification (WED) funding proposal resulting in a $3.5 million dollar grant
• Providing direction and advice on the overall corporate strategy including sitting on the Management Advisory Board and drafting a strategic business plan
• Advising on marketing and sales strategies to assist in the development and growth of Delta including undertaking market analysis for target products/services
• Providing regulatory advice including a draft quality manual with supporting SOPs

Source: Chris Lumb TEC Edmonton
U of A canola program: Partnership with industry

Industry focussed on short-term goals. The narrow genetic base in current canola is a bottleneck for improvement in this crop from a long-term perspective.

Canola germplasm enhancement by use of exotic gene pools for sustainable production from a long-term perspective

University:
Breeding-research with allied Brassica species and exotic materials

Industry:
Financial support.
Contribution to routine operation.

Govt.:
Matching industry contribution

➢ Trained breeders (Canada is facing a shortage of plant breeders)
➢ Scientific knowledge for breeding improved hybrid canola cultivars

➢ Genetically diverse elite canola lines with resistance to diseases

Hybrid canola cultivars
➢ Fundamental research results to practical application.
➢ Return of research investments.
➢ Contribution to the canola industry & Canadian economy.

Use by the industry partner in breeding
- Develop genetically diverse canola lines for use as hybrid parents
- Developed clubroot and blackleg disease resistant canola
  - by use of allied Brassica species and exotic germplasm, e.g. cauliflower, cabbage, broccoli, turnip, rutabaga, etc.
Hybrid seeds are produced by growing side-by-side two genetically different parents: A male-sterile (does not produce pollen) and a male-fertile (produces pollen). Seeds harvested from the male-sterile plants (female block) are hybrids.

- Currently, canola is grown on about 8 mill. hectares.
- Most cultivars are hybrids (15 years ago, cultivars were mostly open-pollinated).
- Contribution of canola to the Canadian economy is about $15 billion/year.
OTHER LICENSING STORIES

- Novel technology for supercritical fluid drying of high molecular weight biopolymers
- Exclusive license agreement with an Edmonton company being finalized

Drs. Temelli and Seifried: Inventors of the new technology
2002: Spin-off company formed to commercialize the patented grain fractionation technology to concentrate beta-glucan in oat/barley

2003-2007: Scale up and production of Viscofiber®

2007: Investors sold Cevena assets to a multinational company

Co-founders: Drs. Temelli and Vasanthan
HEALTHY COWS - DR. AMETAJ’S PATENTED TECHNOLOGIES

– A vaccine technology for metabolic disorders
– An probiotic product for uterine infections
– grain processing technology to prevent SARA and increase milk fat content and mineral bioavailability
LIPID CHEMISTRY GROUP

Lipid-based Chemicals

Vegetable oils

Polyols** “Liprol™”

Resins with 100% renewable content*

Adhesives, biocomposites

Polyurethane resin and foams

Adhesives, coatings

* Patent applied

Polyols** “Liprol™”
Collaboration between Ozga/Reinecke lab and Syngenta

Overall objective of collaboration: Development of methods to reduce or prevent plant yield losses from abiotic stress.

Involves both basic and applied research initiatives

Funded at the Provincial, Federal and Industrial level for 1.9 million dollars over 3 years
PROVIDING SOLUTIONS

Environmental Sustainability

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• Diamond mines - can we build substrates for tundra plants from on-site materials (processed kimberlite, lake sediment, crushed rock, salvaged soil, sewage) and commercial products (peat, hydrogel, fertilizer, organic matter pellets, erosion blankets)?
• Mature fine tailings - is it suitable alone or capped as a reclamation substrate? What capping depths and materials are appropriate?
• Microsites - what is their role in plant community development?

• Land Reclamation International Graduate School (LRIGS)
• Anthroposols, a new Canadian soils order
• New technology for environmental assessment
• Soil temperature changes due to large pipelines led to revegetation research
• Importance of mycorrhizae for soil and plant development led to increased consideration in research

• Identification and salvage of new on-site materials for reclamation
• Testing operational feasibility of research results
  • Demonstrations to show science in operational practice
  • Technical reports for greater industry to benefit
    • Balancing environmental and economic output
    • Stakeholder involvement

• Mandatory salvage and use of LFH (forest floor) in oil sands reclamation
• Salvage and use of woody debris in reclamation
• Use of native species in reclamation
• Two lifts instead of three during pipeline construction in solonetzic soil
• Salvage all topsoil for use in reclamation
• Offset distances from pipelines to reduce impact on rare plants
Dr. David Bressler
Almost 10 years in the making, **Forge Hydrocarbons** is commercializing a patented conversion process that takes agricultural feed stocks like animal fat, such as beef tallow, crop seed oil and even restaurant grease, and converts them into ‘drop in’ fuels.

ALES researcher David Bressler, left, accepts **TEC Edmonton’s Spinoff Achievement Award** from Western Economic Diversification Minister Michelle Rempel during the company’s launch at Agri-Food Discovery Place. They are joined by Tim Haig, President and CEO of Forge Hydrocarbons.
CENTERS AND INSTITUTES — HELP DRIVE INNOVATION

- Centre for Nutrition and Health
- Livestock Gentec & Delta Genomics
- Alberta Prion Research Institute
- Phytola
- Alberta Lipid Utilization Program
- Value-Added Meat Network
- Alberta Diabetes Institute
- Biorefining Conversions Network
- Consumer and Market Demand Network
- EmbryoGENE Network
DEVONIAN BOTANIC GARDEN

1915-2015
YEARS

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LIFE & ENVIRONMENTAL SCIENCES