



# Bioeconomy Research at the University of Guelph

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**Professor**

**Research Program Director for the  
Bioeconomy – Industrial Uses Theme**

# Bioeconomy – Industrial Use Theme (BIU)

- Part of the **OMAFRA-University of Guelph Partnership Program**
  - Unique relationship since 1874
  - Common objective to serve agri-food sector
- Research Priorities under the BIU Theme have been set according to OMAFRA stakeholders



# Bioeconomy – Industrial Use Theme (BIU)

## BIU Priorities:

- **The Bioeconomy-Industrial Uses Theme** encompasses three major areas of focus as follows:
  - **Biomaterials**
  - **Biochemicals**
  - **Bioenergy**
- All of them involve the use of agriculturally-derived biomass to produce some type of bioproduct



# Bioeconomy – Industrial Use Theme (BIU)

## BIU Product Category: Biomaterials

- Includes: bioplastics, biobased blends, natural fibre composites, biobased nanocomposites, biofoams, biorubber, biobased paints and coatings, bioadhesives and bioinks, and natural fibres, as well as the resulting end products (e.g., textiles, carpets, mats), rigid components (e.g. tiles, panels, beams and posts, etc.), or granulated products (e.g. chips, pellets, dust).

## BIU Product Category: Biochemicals

- Includes: industrial chemicals (e.g. cleaners, lubricants, sealants, solvents, ), intermediate biochemicals, etc.
- Biotech products whereas at least part of the product is a biological organism or a component thereof (e.g., enzymes, molecular probes, microbes, yeast, etc.)
- Biopharmaceuticals and cosmetics are considered but **not** nutraceuticals and functional foods, which are part of the Food and Health Theme



# Bioeconomy – Industrial Use Theme (BIU)

## BIU Product Category: Bioenergy

- Includes: energy feedstocks (e.g., ethanol, methanol, butanol, biodiesel, bio-oil, biogas, pellets, hog fuel) as well as the end products (e.g., electricity, thermal energy)

# Bioeconomy – Industrial Use Theme (BIU)

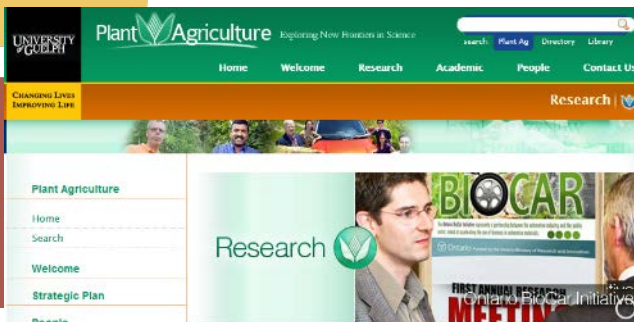
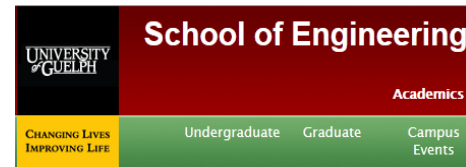
## EXAMPLES of PROJECTS FUNDED by BIU (2016):

- *“Dual cropping with camelina for the sustainable production of bioproducts and animal feeds in Ontario”* (Dr. Rene Van Acker)
- *“Utilization of food wastes in the design and engineering of value-added compostable containers”* (Dr. Manju Misra)
- *“Hybrid biocomposites from recycled polyamide and carbonaceous reinforcements for lightweight automotive applications”* (Dr. Amar Mohanty)
- *“Development of a carbon negative process for hydrogen enriched syngas, ethanol and co-products value chain from corn residues”* (Dr. Animesh Dutta)
- *“Evaluation of a Novel Sugarcorn Feedstock for Production of Organic Acids”* (Dr. Brandon Gilroyed)

# Bio-economy Research Capacity at UofG

## Expertise and Infrastructure developed over time:

- Biomaterials development
- Biochemicals
- Bioenergy
- Plant breeding and genetic improvement
- Crop management and agronomy
- Economics and life cycle analysis
- Others





# Bio-economy Research Capacity at UofG

- Research and Innovation capacity developed for Ontario
- Partnership and linkages are fostered
- HQP trained to meet market demand
- Information generated for government, industry, research community and knowledge brokers as well as general public
- Technologies developed to address environmental and economic needs

# R&D Activities of the BDDC in the Area of Bioeconomy: Ontario and beyond

CHANGING LIVES  
IMPROVING LIFE



**BDDC**  
BIOPRODUCTS DISCOVERY  
& DEVELOPMENT CENTRE  
DEPARTMENT OF PLANT AGRICULTURE

# Research Areas

- Innovation in green manufacturing from Biobased plastics
- New biocarbon-based materials
- Biocomposites and green composites
- Biobased nanostructures and electrospinning





# Natural Fibres and Undervalued Co-products

[www.rtpcompany.com/products/structural/glass.htm](http://www.rtpcompany.com/products/structural/glass.htm)



**Glass  
(synthetic)**



**JUTE**



**HENEQUEN**



**COIR**



**HEMP**



**KENAF**



**WOOD**



**CORN**



**GRASS**



**Soy meal (soy  
oil industry)**



**Canola meal (Canola  
oil industry)**



**DDGS (corn  
ethanol industry)**



**Coffee chaff**



**Spent coffee  
grounds**



**Lignin (cellulosic  
ethanol industry)**



**Lignin (paper  
industry)**



**Lignin (paper  
industry)**



**Crude glycerol  
(biodiesel industry)**

Source: A. K. Mohanty et. al. in *Natural Fibers, Biopolymers and Biocomposites*, Edn.: A. K. Mohanty et al. , p. 1-36, CRC Press 2005

# Application Areas

## Products in the Marketplace or under development

Compostable rigid and flexible packaging, Automotive interior parts, Consumer products



Plastic ring for  
compostable coffee pod,  
Purpod100



Bio-bin



Flowerpot

GM / Protoplast - Oil collection tray –  
Corvette



BIOBLACKR™

USDA Certification for  
Bio-carbon:  
99% new carbon –  
world's first substitute  
for carbon black – lighter  
and price-performance-  
process competitive



Compostable  
plastic films



Console box



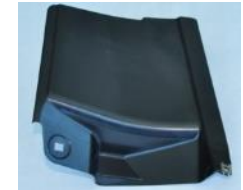
Spare tire cover



Air duct controller



Coca Cola bottle packaging tray



Fender  
cover



# HIGH LINOLEIC (18:2) PROJECT FOR INDUSTRIAL USES OF SOYBEAN

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# Soybean Oil Functionality

## Double Bonds are the Key

**Provide reaction sites**

**Foundation for chemical Intermediates**

Hydrophobic nature increase water resistance

Double bonds - Crosslinking

- Film Hardness

- Durability

- Impact resistance

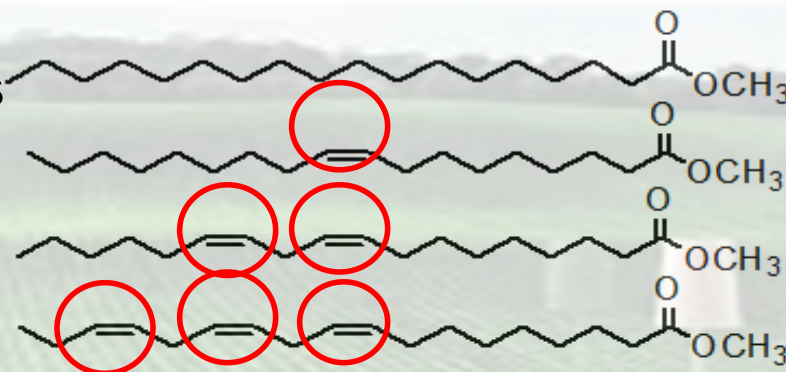
Derivatizations of the fatty acids

- Alcohol functionality

- Epoxy functionality

- Dimer Fatty Acids

- Dimer Fatty Alcohols



# Soy Foam Seats/Headrest/Acoustic Foam



Courtesy of Ford Motor & Lear Corporation



Dow Automotive Systems



# High linolenic (18:2) oil for industrial uses

**OAC 13-55C-HL** has the highest 18:2 concentration reported soybean oil at **69%**

Derived from the cross:

**OAC Wallace x RG25**

**RG25** is the high linoleic soybean parent developed by ethyl methane sulfonate (EMS) mutagenesis

**OAC Wallace** is the high yielding soybean cultivar parent

# High Linoleic Soybean Oil

Feedstock for Coatings, Resins, Polyols and Epoxies

- We are now offering samples to companies
- A number of them have received samples already and some reported good preliminary results

Comparison of FA (as % of major FA)  
Found in Commodity vs. HLO RBD  
Soybean Oil

Fatty Acids	Commodity	HLO
C16 Palmitic	11	4
C18 Stearic	4	3
C18:1n9 Oleic	24	19
C18:2 Linoleic	54	70
C18:3n3 alpha-Linolenic	7	4
Total Saturates	15	7
Total Monounsaturates	24	19
Total Polyunsaturates	61	74



# High Linoleic Soybean Oil

- Interest from industry is steady and we continue to offer samples to companies
- Soy 20/20 is securing MTA's from the companies on behalf of the U of G
- We are shipping 1 kg samples
- Soy 20/20 sponsored the Biorenewable Polymers session at AOCS annual meeting in Salt Lake City (May 1 to 4, 2016)
- Communication / information activities continue



# Acknowledgements



