Agriculture and Agri-Food Canada Agriculture et Agroalimentaire Canada

Biomass Inventory Mapping and Analysis Tool & Related Activities

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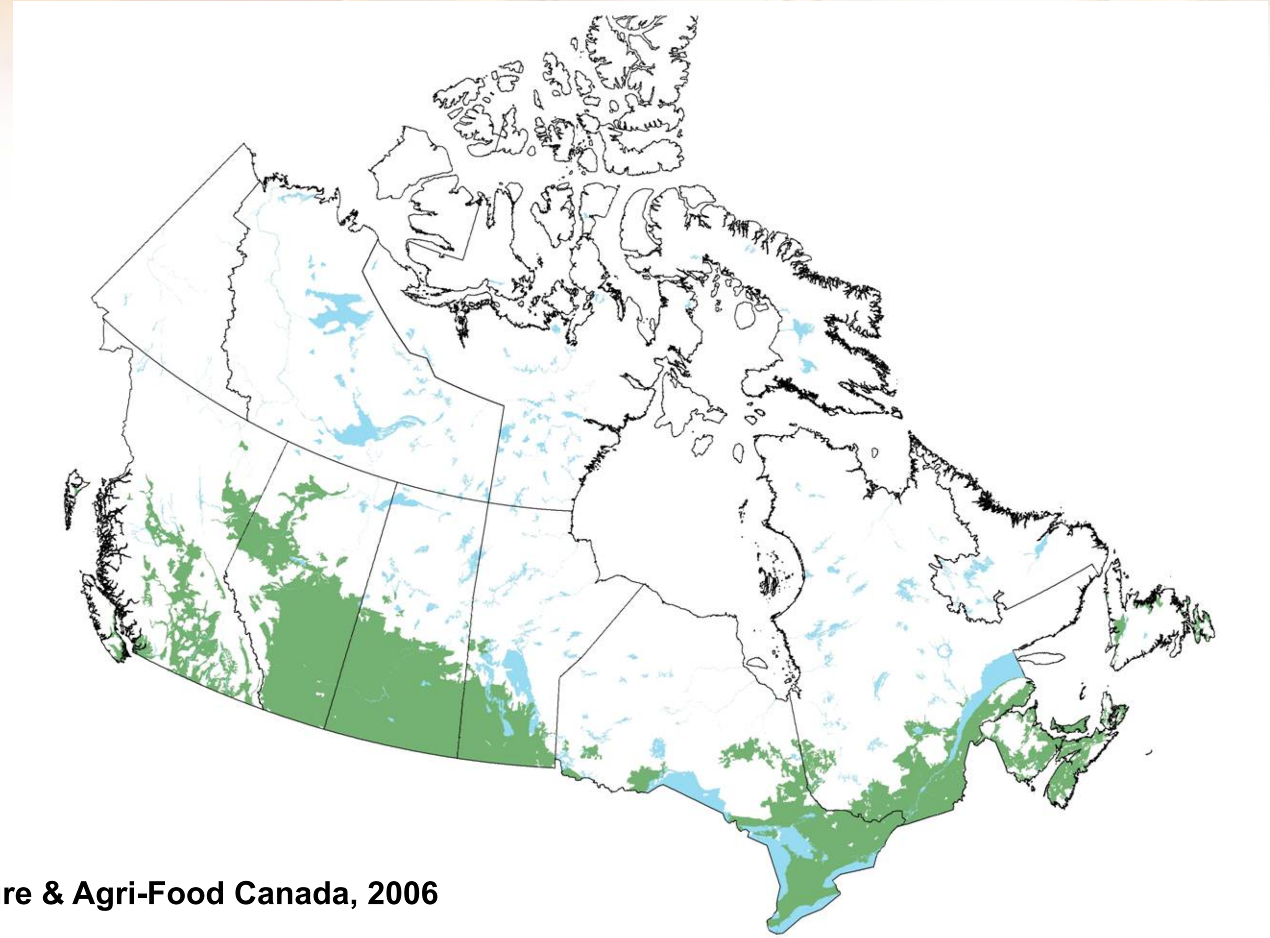
Bioeconomy Definition

Economy where:

1. raw materials for energy, materials, and chemicals are derived from animal/plant/crop-based (biomass) sources;
2. renewable biomass is sustainably produced; and
3. sustainability is defined in economic, environmental and social terms that must all be coordinated and addressed to ensure the long term viability of our community and the planet.

Agricultural Land in Canada

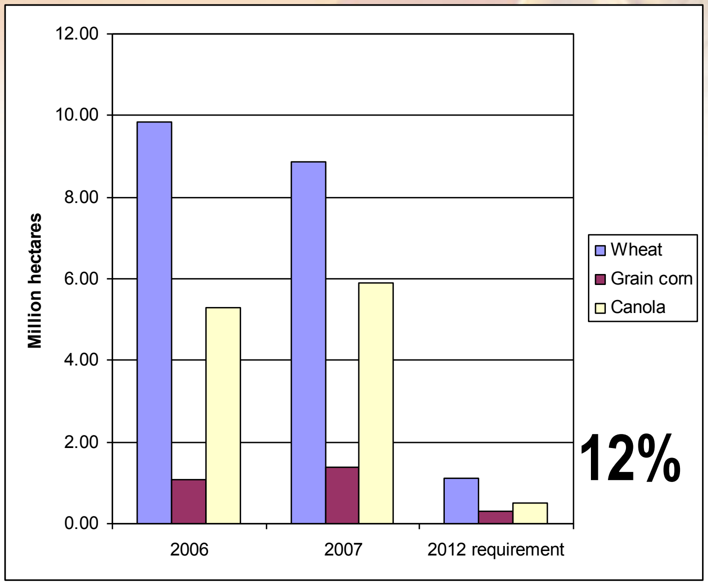
Canada has ~ 68 Million ha of Agricultural Land

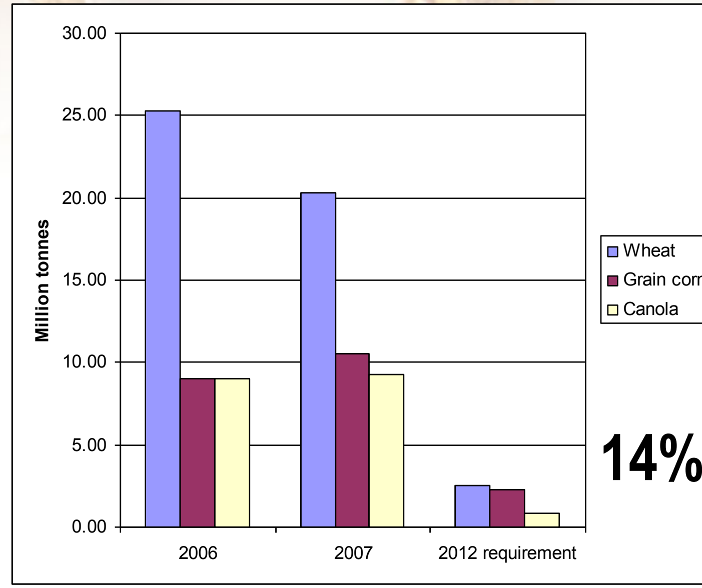


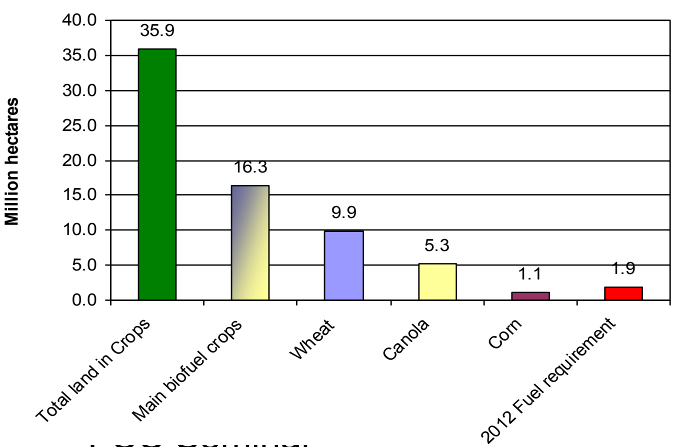
Agriculture & Agri-Food Canada, 2006

Canadian Renewable Fuels Strategy

Impact on land and production (2012 requirement vs. 2006 & 2007 production)







2012 requirement will equal 5% of total land in crops (2006). Extension beyond RFS will likely require Next Gen technologies.

Source: Statistics Canada

The Opportunity: Integrated Sustainable Industry

Biomass Feedstocks → **Bioconversion Biorefining** →

Trees
Grasses
Agricultural Crops
Agricultural Residues
Animal Wastes
Municipal Solid Waste

Enzymatic Fermentation
Gas/liquid Fermentation
Acid Hydrolysis/Fermentation
Gasification
Combustion
Co-firing

USES

Fuels:
Ethanol
Renewable Diesel

Electricity

Heat

Chemicals
Plastics
Solvents
Pharmaceuticals
Chemical Intermediates
Phenolics
Adhesives
Furfural
Fatty acids
Acetic Acid
Carbon black
Paints
Dyes, Pigments, and Ink
Detergents

Food and Feed

Adapted from the USDA, 2003

Agricultural Feedstock Hierarchy

Conventional Grain & Oilseeds

↓

Crop Residues

↓

Perennial Crops

↓

Modified or Adapted Crops

New Land Impact Analysis Tool

BIMAT

Biomass Inventory Mapping and Analysis Tool

Why did Canada build it?

- Provide access to accurate and reliable Canadian biomass and landscape information via the Internet.
- Facilitate analysis of biomass inventory and impact of exploitation of selected agricultural, forestry, and municipal woody biomass.

Where is the BIMAT located?

Go to: www.agr.gc.ca

Use search & follow the BIMAT links to the Land Resource Viewer.

Or go to: http://atlas.agr.gc.ca/bimat

Who Did We Build BIMAT For?

BIMAT is targeted to:

1. Policy makers to assist with policy development and impact assessments;
2. Regulators to assist with impact assessment, carbon accounting, and landscape impacts;
3. Industry to improve decision-making regarding the location and operation of biomass based processing plants;
4. Industry developers by providing a tool to showcase Canadian opportunities for investment attraction; and
5. Financial interests by providing an ability to analyze and optimize economic performance.

Biomass Inventory Mapping and Analysis Tool

Current Configuration

- Modeled the quantity of forest and agriculture residual biomass.
- Modeled the quantity of urban woody waste
- Using database analysis and geographic information system (GIS) software, allow users to query biomass inventory.
    - Look for specific tonnages of specific biomass, and evaluate radius of supply.
    - Evaluate specific biomass tonnages within a given radius.
- Site now available from the AAFC Corporate web site.

Note: All estimates use best available science for sustainability requirements. These are deducted prior to providing estimates to BIMAT users.

Aspects of Sustainability

1. Environmental Outcomes
   - Air
   - Water
   - Soil
   - Non-Renewable Vs Renewable
2. Social Outcomes
   - Human Resource Development (skills, knowledge)
   - Employment
   - Capital Movement and Availability
   - Business Structure
3. Economic Outcomes
   - Local
   - Regional
   - National
   - International

Residue Export Sustainability Issues

1. Loss of Erosion Protection
2. Loss of Soil Nutrients
3. Loss of Carbon from the System
4. Economic Returns for Producers

Indian Head Long-Term Rotations 1957-1987

Rotation: Fallow - Spring Wheat - Spring Wheat
All plots - Conventional Tillage System

	Fertilizer	Straw	Total Org C (0–6") T ha^{-1}	% of A	Total Org N (0–6") kg ha^{-1}	% of A
A	Fertilized	Left	38.5	100	3243	100
B	Fertilized	Removed	38.2	99	3067	95
C	No Fertilizer	Left	36.4	95	2966	91

Indian Head Long-Term Rotations 1957-1987

Rotation: Fallow - Spring Wheat - Spring Wheat
All plots - Conventional Tillage System

	Fertilizer	Straw	Fallow Yield Bu ac^{-1}	% of A	Stubble Yield Bu ac^{-1}	% of A
A	Fertilized	Left	38	100	34	100
B	Fertilized	Removed	39	103	35	103
C	No Fertilizer	Left	34	89	13	38

Indian Head Long-Term Rotations 1990-2002

Rotation: Fallow - Spring Wheat - Spring Wheat
All plots - Zero Tillage System

	Fertilizer	Straw	Fallow Yield Bu ac^{-1}	% of A	Stubble Yield Bu ac^{-1}	% of A
A	Fertilized	Left	44	100	37	100
B	Fertilized	Removed	45	102	38	103
C	No Fertilizer	Left	24	55	11	30

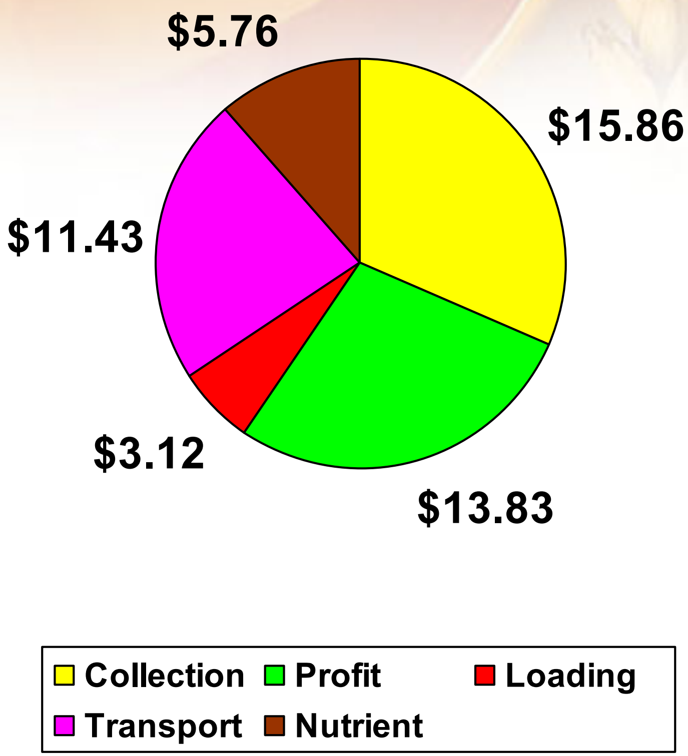
Erosion Impact of Stover Removal

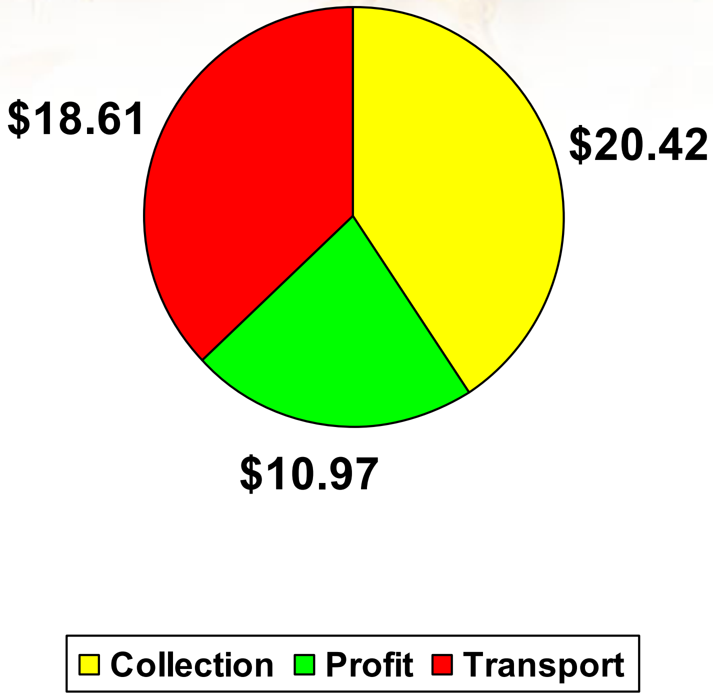
Tillage System	Residue Level kg ha^{-1}	Peak Run-Off mm hr^{-1}	Run-Off Volume mm	Sediment Yield kg ha^{-1}
No-Till	0	17.0	4.5	72.0
	750	9.0	2.6	11.0
	1500	1.0	0.2	7.0
Conv. Till	0	51.0	35.5	2812
	750	34.0	32.7	1001
	1500	26.0	18.0	513

Note: No-till @ 12% slope, Conventional Till @ 9%slope.

Mostaghimi et al. (1992).

Cost Division for Export





Based on 50 km Haul, $50 tonne^{-1} FOB Plant, & Custom Rates in Saskatchewan in 2002.

Straw is Available

1. Nutrient (N&P) loss replaced by fertilizer.
2. Reduced or 0' till management.
3. Tall standing stubble (750 kg ha^{-1}).
4. Rotational management of removal.
5. Adequate moisture for production.
6. Chaff is available every year from every area and crop.

BIMAT Demonstration

BIMAT Link: http://atlas.agr.gc.ca/bimat

BIMAT Future Plan

Improve and Expand Inventory

1. Estimates for grain production
2. Alternative crop residue harvest system modeling
3. Feedstock quality information for flax
4. Modeling of annual variability in biomass supply
5. Develop remote sensing tools and models to facilitate the within-year estimates of the biomass inventory
6. Land suitability information for the production of new forestry and forage crops for cellulosic feedstocks

Expand Biomass Reference Material

1. Add information about quality, conversion processes and life cycle evaluation

BIMAT & Sustainability Assessment

<u>Develop New Online Analytical Functions</u>

1. Logistics and carbon accounting information: full-cost accounting of biomass from ripe crop through to the plant gate.
2. Sustainability measurement framework for carbon accounting and sustainability assessment of multiple biofuel systems. Saskatchewan will be used as the case study jurisdiction.
3. Include information on the conversion systems for fuels and other biomaterials as a user selected choice based on technology information provided by the industry and science partners.

BIMAT Linkages and Activities

1. International: BIMAT demonstration and cooperation
   - APEC
   - Europe
   - US EPA, DOE, and USDA
2. Canadian Forestry Service
   - Key partner for forestry and SRF data
3. Provinces: Industrial development and implementation.
   - BC
   - Saskatchewan
   - Alberta
   - Ontario
4. Academia
   - UBC
   - ABIP networks

Harvest System Challenges

Changes to the Harvest System must improve producer economic potential:

- Maintain or improve grain quality/quantity;
- Maintain or improve straw fibre quality/quantity;
- Work in a multitude of crop types;

Alternative System Bonus Points

- Reduce time of harvest;
- Reduce the fuel requirement for harvest;
- Reduce header inventory (existing combine system);
- Reduce the cost of the combine;

Producer Returns: Quality Starts @ Harvest

1. **Low Value Uses:**
   - Example: flax pulp for paper quality enhancement.
   - Producer Net Range: $5 to $10 per tonne.
   - Savings from disposal and chopping: ~$1 per tonne.
2. **Medium Value Uses:**
   - Examples: insulation products, plastic composites, and low end textiles.
   - Producer Net Range: $30 to $100 per tonne.
3. **High Value Uses:**
   - Examples: high-end plastic composites and textile applications.
   - Producer Net Range: $60 to $150 per tonne.

Note:

Potential producer returns depend on fibre length, cleanliness, strength, & quantity. Rotary harvested straw can only meet the requirements for low value uses.

Straw Differences: 25 Bushel Flax Crop

Rotary harvester windrow with 30’ draper header

Conventional combine windrow with 20’ auger header

Goals:

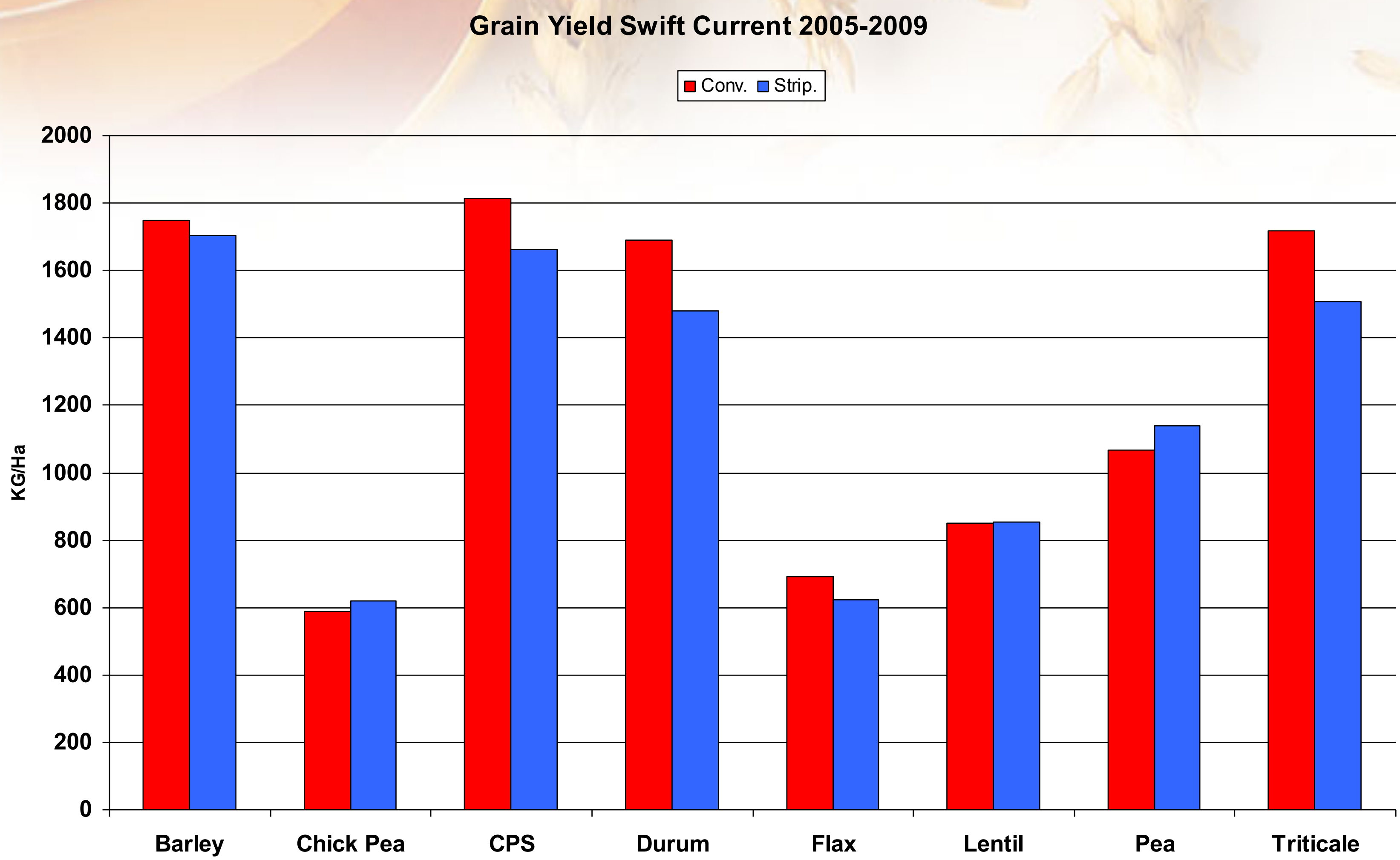
- **Develop economic harvest and biomass collection systems to supply consistent and economic qualities and quantities of straw for the provision of cellulosic feedstocks for value-added processing.**
- **Provide harvest data and materials for subsequent processing and evaluation.**

Flax straw piles awaiting burning outside Moose Jaw

Simonson Farms Demo & Plot Activity

1. Case IH 2388 with Field Data Computer and Honey Bee Draper header
2. Adapter & Shelbourne Reynolds Stripper Header
3. Comparison with Massey 550 & Conventional Auger Header
4. Materials provided to SWM.

Plots: Swift Current Average Grain Yield 2005 - 09



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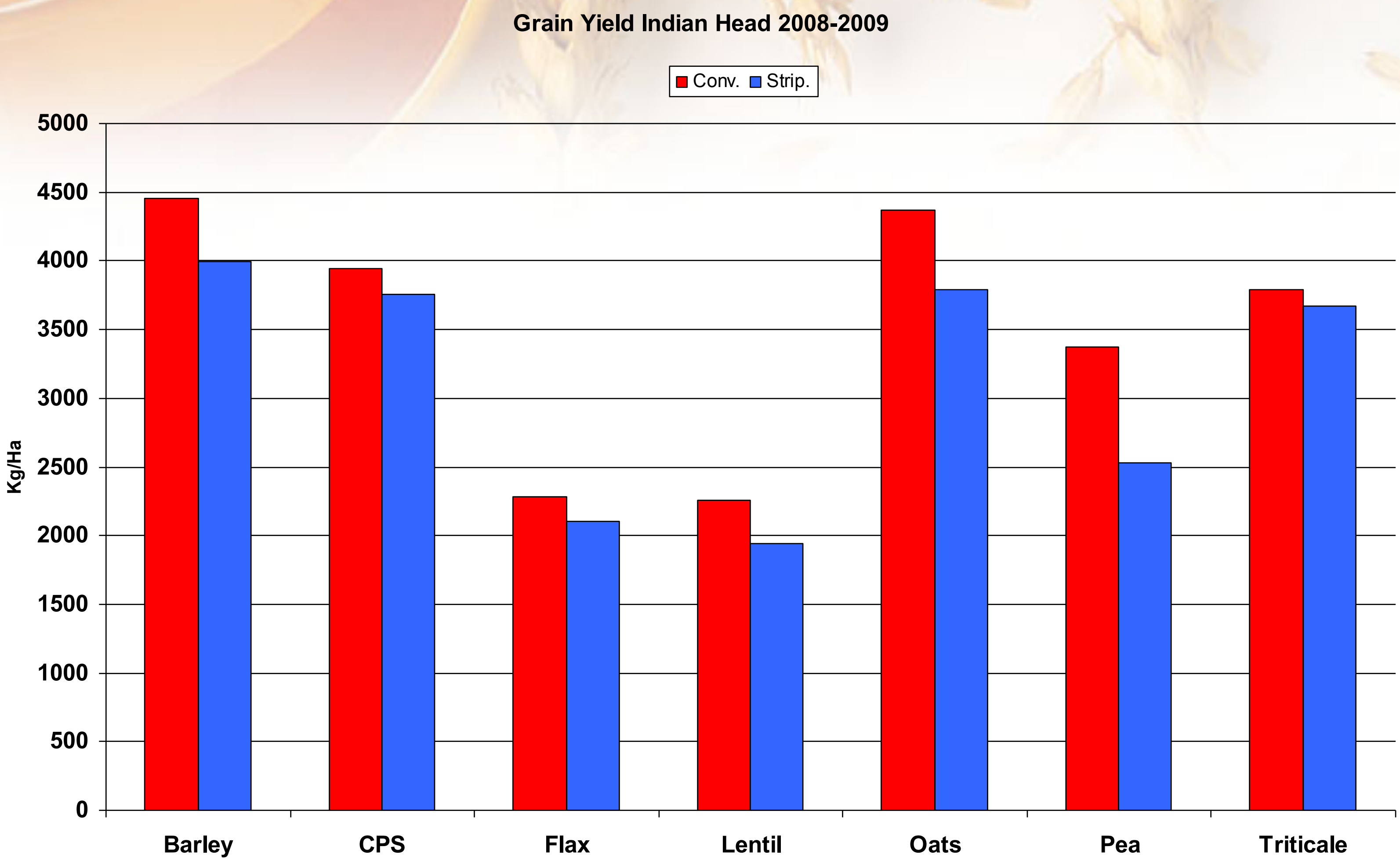
Plots: Indian Head Average Grain Yield 2008 - 09



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Demonstration Yield Comparisons: 2005 to 2008

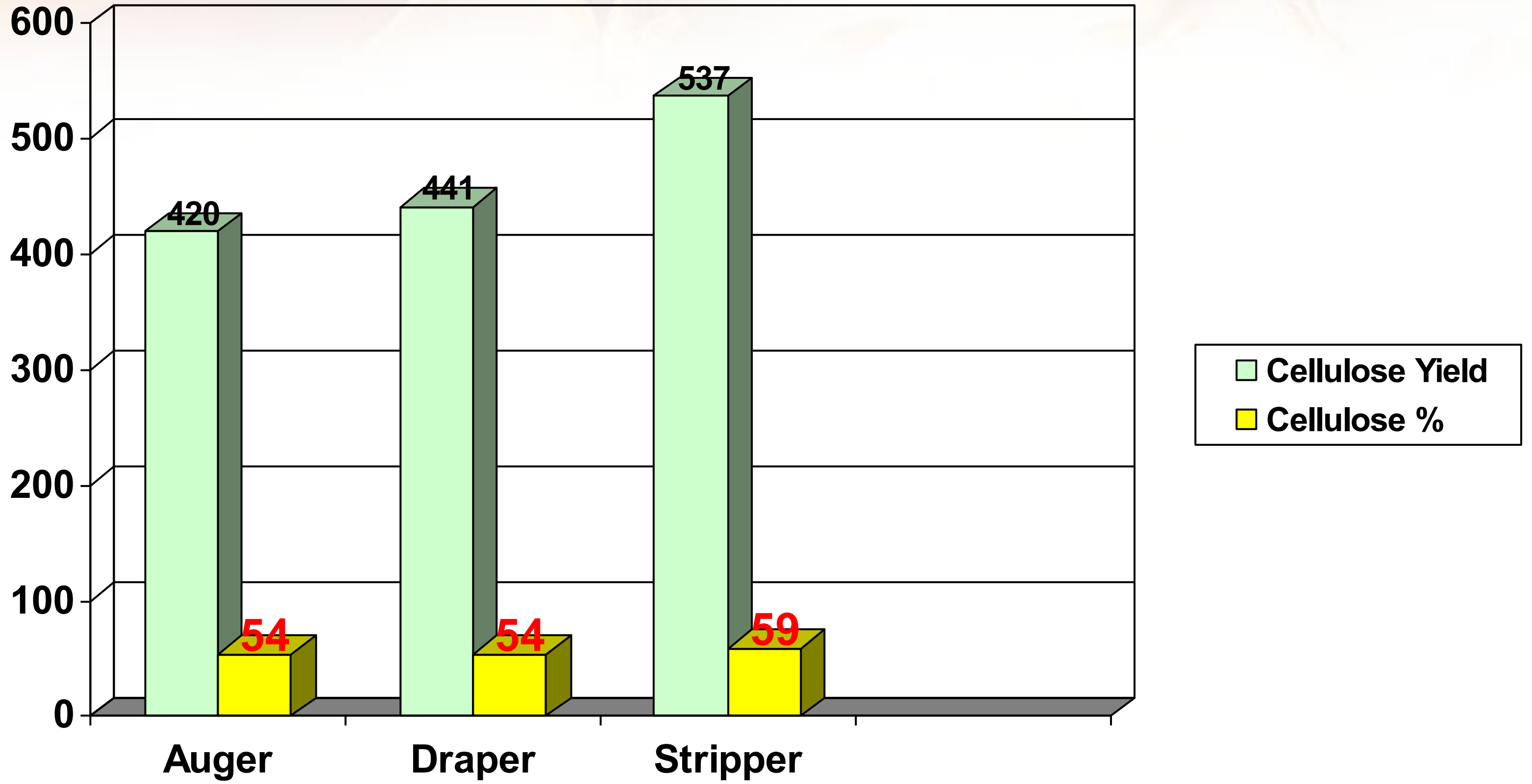
2005 - 2008

	Ave Grain Yield (Kg/ha)	% of Draper Rotary	Ave Straw Yield (Kg/ha)	Straw as % of Draper Rotary
Stripper / Conventional and Stripper Rotary	1144	98	794	132
Auger / Conventional	1253	108	783	130
Draper / Rotary	1166	100	603	100

2005 - 2007

	Ave. Grain Yield (Kg/ha)	% of Draper Rotary	Ave Straw Yield (Kg/ha)	Straw as % of Draper Rotary
Stripper/Conventional and Stripper/Rotary	1217	103	927	148
Auger/Conventional	1185	101	849	135
Draper/Rotary	1177	100	628	100

Cellulose Yield Comparisons: 2005 - 2008



Corn Cobb Harvesting

Work on corn stover and corn cob harvesting has been sponsored by US cellulosic ethanol interests.

Redekopp Manufacturing has been a Canadian participant in the study.

Cobb Harvesting Sysem

Cob / stover separation means less biomass removed from the field.

Cob windrows tend to self-store and self dry, reducing logistics costs.

Cob cart designed to match up with load requirements to match grain cart with similar unload times.

In Closing............

1. Canada will continue to pursue agricultural biomass strategies for 2nd generation feedstocks and other bioproduct opportunities.
2. Residual materials from agriculture, forestry, and sorted urban woody wastes will be the feedstocks of choice initially.
3. Greenhouse gas / CO_2, LCA, and sustainability analyses and performance will be important criteria for success.
4. Tools, such as BIMAT will be available to assist producers, development groups, financial entities, and policy authorities make sustainable decisions.

Acknowledgements

1. CBIN – Canadian Biomass Innovation Network, a Federal Interdepartmental Committee which has provided substantial funding to this project
2. PERD – Program on Energy Research and Development, has also provided long-term funding to this project.
3. ecoETI
4. FP Innovations (FERIC)
5. AAFC - AESB
6. AAFC – Research Branch
7. AAFC – NLWIS

The Future ??


Mike Keefe THE DENVER POST 11/09/07
$100 CRUDE
DON'T JUST STAND THERE- SOW SOME CORN OR SOMETHING!

Canada

Thank You !   *Questions?*