Harvesting, storage and transport of corn stover for energy

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Corn grain & residues in Canada

- Corn grain seeded on more than 1.3 million ha in 2007 (~ 800,000 ha in ON; ~ 400,000 ha in QC; some in MB)
- Yields of about 10 Mt grain/yr, 9 Mt stover/yr
- Stover protects against erosion and provides organic matter to soil
- About half the stover may be harvested safely without affecting erosion or OM

Environmental conditions before harvesting

U.S.D.A.'s Renewable Energy Assessment Program (REAP): Dr. Jane Johnson estimates that for a high yielding field of 13 t grain/ha (213 bu/ac) and 9 t stover/ha:

- **¼ of stover is needed for erosion control**
- **¼ of stover is needed to replenish soil organic matter**
- **About ½ of stover (4 t/ha) can safely be harvested on suitable land (minimum tillage, flat)**

Before harvesting corn stover, know you market: on-farm use or outside use?

Examples of on-farm use

- ✓ On-farm energy for heating buildings and drying crops
- ✓ Animal feed (after adding ammonia N)
- ✓ Animal bedding

Corn stover for off-the-farm markets

Potential off-farm uses

- ✓ **Feedstock for cellulose hydrolysis and ethanol fermentation**
- ✓ **Combustion pellets or co-firing**
- ✓ **Fibreboard (MDF, HDF) and oriented strand board (OSB)**

What form of corn stover?

- **Dry stover: for combustion, fibreboard, bedding**
- **Wet stover: for feed and hydrolysis markets**
- **Chopped stover: for industrial uses**
- **Baled stover: for on-farm use**

Traditional 4-pass system:

1) Grain combining; 2) shredding; 3) raking; 4) collecting stover

Reducing the number of passes:

1) Adjusting the combine for residue windrowing

Disactivate the straw chopper and spreader

Leave the residue fall in a windrow behind the combine

Expect to collect only 25 to 30% of residue in the windrow (mainly cobs and husk)

Reducing the number of passes:

2) Use a corn head with a chopper, followed by rake

Some corn heads have an integrated stalk cutter

The cut stover falls behind the combine; a rake then forms a windrow

Expect to collect 50 to 75% of residue, but stover will not be shredded – it will dry slowly

Different collecting systems:

1) Fine chop; 2) coarse chop; 3) round bale; 4) square bale

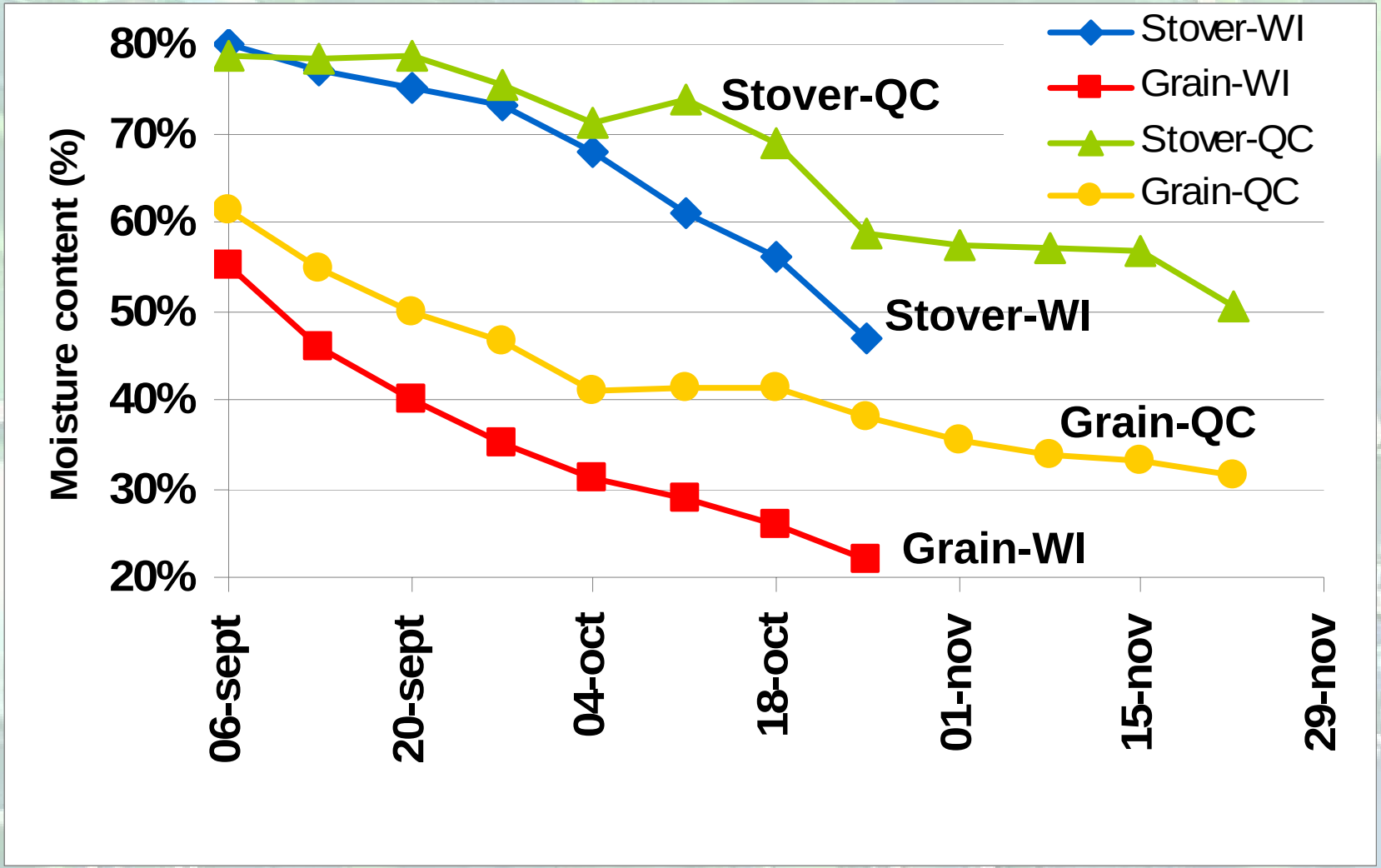
How about the one-pass system?

- Concept is not new: harvest simultaneously corn grain and stover in two flows of material
- Grain may be shelled on machine or later
- Stover will necessarily be wet – no opportunity for field drying

More recent attempts at one-pass system

- **Option 1: Separate and chop stover in front or at rear of combine (+ forage wagon)**
- **Option 2: Bale stover or straw behind the combine**
- **Expect combine to cost an extra $100,000 or more**

Moisture of corn grain and stover



Storage of stover

- **Keep it simple: stacked bales or bunker silo for chopped material**
- **Cover may be worthwhile if loss value of corn stover > cost of covering**
- **Minimize rain or snow infiltration**

Transport of stover

- For short distance, small volume: use truck
- For long distance, large volume: consider train
- Transport can be one of most important costs

Cost of harvest, storage and transport of corn stover

		$ U.S./t DM
Dry bales	Inside	$46
	Outside	$40
Wet, chopped	One-pass	$32
	Two-pass	$33
	Three-pass	$34

Source: Shinners et al. (2003); Wisconsin data

Can a farmer make money harvesting corn stover?

- Make sure you cover your costs:
  - Value of removed stover: $10 to $20/t DM
  - Cost of harvesting: $20 to $40/t DM
  - Handling & storage on farm: $10 to $20/t DM
  - Transport: $10 to $50/t DM (depending on distance)
  - Drying and pelleting: $20 to $50/tDM

- Total on-farm cost: $40 to $80/t DM
- Total out-of-farm: $50 to $130 (pellets: $70 to $180)

- Income: depends on end-use and market

Conclusion (I)

- **There is a large quantity of corn stover in eastern Canada: 4 t DM/ha harvestable on half the planted area (> 1.2 Mha)**

- **There are several ways to harvest corn stover: wet or dry, chopped or baled**

- **Know your market before you start: on-farm (heating, feed, bedding) or out-of-farm; the market will dictate many decisions**

Conclusion (II)

- **On-farm harvest and storage can cost between $40 and $80/t DM; out of farm cost will also include transport, drying and pelleting**

- **Consider local opportunities and long-term contract before investing in expensive machinery and storage facilities**

Thanks

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QUESTIONS ?

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