Outline

- Scope of Poplar Program
- Hybrid Poplars
- Growth & Yield Protocols
- Growth & Yield Equations
- Growth & Yield Expectations and Challenges
- New Model Development
• Boreal Mixedwood
• 58,000 km²
  or 5.8 million ha
Forest Management Agreement area

• Al-Pac’s annual allowable cut
  – 2.2 million m³ deciduous
  – 370,000 m³ coniferous
Private Wood Supply Shortage

Mill Requires
- 2.7 Million m³ / yr AAC
- 2.2 Million m³ / yr (FMA area)
- Approximately 350,000 m³ private wood purchases
- Remainder chip purchases

In 20 years it is estimated 400,000 m³ needed from plantations to meet projected short fall from private wood and mill efficiencies.
• New timber supply analysis deletes 31,679 ha for anticipated oil sands mines (10-year horizon)

Anticipate conservatively 5,000 ha annually to be cleared over next 20-years.

550 annually from seismic alone.
Edmonton

White Area of Alberta = Private ownership

Green Area of Alberta = Crown land

Al-Pac’s FMA area is within the Boreal Forest

Al-Pac’s Poplar Farm Management Area (PFMA) 200 km radius from Mill Site

Aspen Parkland/Converted to Agriculture
Al-Pac Poplar Farm Land Distribution

<table>
<thead>
<tr>
<th>Radius From Dispatch</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 50 km</td>
<td>1299.78</td>
</tr>
<tr>
<td>51 - 100 km</td>
<td>1636.49</td>
</tr>
<tr>
<td>101 - 150 km</td>
<td>585.48</td>
</tr>
<tr>
<td>151 - 200 km</td>
<td>1575.66</td>
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Scope of Project

- Plant 1200 hectares per year for 20 year rotation
- Final project size 24,800 hectares
  - 24,000 ha leased, 800ha Al–Pac owned land
- Lease terms 20 years (can extend)
- Expected growth rate 14-16 m$^3$ MAI
  - ~ 400,000 m$^3$/yr at harvest
- Current planting stock = hybrid poplar
  - 5 clones currently recommended for planting
- Comprehensive R&D breeding & testing program
Why Hybrids?

• Hybrid vigour & reduced rotation length - clonal off-spring that exhibit superior growth compared to either parent species.
Current State of the Poplar Farm Program

- Implementing best practices & investigating new herbicide options
- 4,006 ha planted (16% of target)
  - Typical annual plant of 1,200 ha
- Anticipate introduction of new operational clones by 2010.
20% of crop conversions is agricultural cropland

80% of crop conversions from as hay or pasture land
Intensive poplar farms
~17% of future fibre
to come from farms
Operational Data Collection & Sampling Protocols for Poplar Farm Operations

Compiled by:
Barb Thomas, Ph.D.

Updated
October 2003
September 2004
August 2005
Protocol

Determination of a ‘stand’ delineated by:

- Age
- Spacing
- Clone
- Same culture (eg: stock-type, biosolid application)

For a given field or portion of a field
Protocol

Two Types of Sampling:

• 1. Permanent sample plots
  – Established in yrs 1-3
  – 12-tree plots
  – Soil sampling also conducted for: soil type & pH
  – Survival, DBH, height measured at yrs: 4, 7, 11, 16 & ~20
  – If req’d, winter dieback, browse, insect attack etc. also recorded
  – # of PSP’s per stand
    • Stands < 5ha, no PSP
    • Stands < 10 ha, 2 plots
    • Remaining stands require 4 plots per 20 ha’s
1. Permanent sample plots
Protocol

2. Temporary sample plots

- Initiated in year 3 (survival only prior)
- 2–trees per hectare per stand to a maximum of 30 trees
- Annual measurement, height and DBH only
- Selection of trees random

COMPARE BETWEEN METHODS
Protocol coding

- Program is divided into 7 regions

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<thead>
<tr>
<th>Data Code</th>
<th>Region included</th>
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<tbody>
<tr>
<td>1</td>
<td>Westlock, Barrhead, Lac Ste Anne counties</td>
</tr>
<tr>
<td>2</td>
<td>Athabasca area, lesser Slave Lake counties</td>
</tr>
<tr>
<td>3</td>
<td>Smoky Lake, Thorhild counties</td>
</tr>
<tr>
<td>4</td>
<td>Bonnyville, St. Paul counties</td>
</tr>
<tr>
<td>5</td>
<td>Mill-site area, Wandering River area</td>
</tr>
<tr>
<td>6</td>
<td>Lakeland county</td>
</tr>
<tr>
<td>7</td>
<td>Sturgeon, Strathcona, Lamont, Two Hills, Beaver counties</td>
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## Protocol coding

- **Stock Type**

<table>
<thead>
<tr>
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<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>OWD (Over-winter dormant)</td>
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<tr>
<td>3</td>
<td>Hot-lifted</td>
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<td>4</td>
<td>Cuttings</td>
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</table>
Menard PSP's NW 23 67 16 W4 -- 36.74 ha
Tree Measurements

2003 planting

2000 planting

Data recording
Growth and Yield

22.5 cm in 18 years

Yields 6-8 times the volume/ha when compared to native stands.
Growth and Yield

Years

18 MAI
Al -Pac Data
14 MAI
Growth and Yield

Years

18 MAI
Al-Pac Data
14 MAI

M3

0 10 20 30 40 50 60 70
1 2 3 4 5 6 7 8 9 10 11
Growth and Yield

Years

18 MAI
Al -Pac Data
Best Clone + Best Practices

M3
40
30
20
10
0

1 2 3 4 5 6 7 8 9 10 11
Volume equation for hybrid poplars

- Developed in eastern Ontario
- 407 observations from a range of hybrid poplar clones (mostly \( P. \) deltoides x \( P. \) nigra clones)
Volume equation for hybrid poplars

- General individual tree stem volume equation:

\[ V = \exp(-1.064079 + 1.562891 \ln(\text{DBH in cm}) + 0.101423(\text{HT in m})) \times 1.013689/1000 \]
Volume equation for hybrid poplars

- **Mean annual increment (MAI):**

\[(\text{Individual volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival})/\text{age}\]

- **Current annual increment (CAI):**

\[\text{Yr 2 volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival} - \text{Yr 1 volume (m}^3\text{)} \times \text{stems per ha} \times \% \text{ survival}\]
## Volume equation for hybrid poplars

<table>
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<tr>
<th>Walker</th>
<th>5-year</th>
<th>10-year</th>
<th>20yrs</th>
<th>1100t/ha</th>
<th>MAI</th>
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<td>Height (m)</td>
<td>8.6</td>
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<td>27</td>
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Volume equation for hybrid poplars

Example

Mean MAI = 14
Mean CAI = 20

m3

m3/ha

MAI

CAI

Years

m3

Years

1 3 5 7 9 11 13 15 17 19 21
Volume equation for hybrid poplars

Example

Example graph showing volume over years with MAI and CAI values:
- MAI: 18.2
- CAI: 50.0
Impact of clone variation

Individual tree volumes in a block planting of 10 hybrid poplar clones

Clones
1 2 3 4 5 6 7 8 9 10
Year 4 Volume cm³
24 25 26 2393 2400 2404 2405 2408 2414 2592
Impact of spacing x clone interaction

Spacing, 1 = 1320 sph, 2 = 1090 sph, 3 = 943 sph

Volume year 4 (cm$^3$)

Spacing, 1 = 1320 sph, 2 = 1090 sph, 3 = 943 sph
Impact of spacing on individual tree volume

Individual tree volumes at three spacings for 10 hybrid poplar clones

Spacing
1 2 3
Year 4 Volume cm³
1320 sph (2.5 x 3.0 m)
1090 sph (3.0 x 3.0 m)
943 sph (3.5 x 3.0 m)

Legend:
- 1320 sph (2.5 x 3.0 m)
- 1090 sph (3.0 x 3.0 m)
- 943 sph (3.5 x 3.0 m)
Volume per hectare at three spacings

Year 4 volumes per hectare at three spacings for 10 hybrid poplar clones

spatial
1 2 3
m³ / ha
0
1
2
3
4
5

1320 sph (2.5 x 3.0 m)
1090 sph (3.0 x 3.0 m)
943 sph (3.5 x 3.0 m)
Other impacts

• Insect and disease

• Climate changes (extremes)

• Moose

• Weeds
Developing a new model?

- Different hybrid poplars grown in AB vs Ontario
- Different environmental/site factors
- Unknown what impact this might be having on our projected volume estimates
- Dr. Thompson Nunifu joined group in 2003/04
Thompson’s work

- Conducted a study with limited samples (10 clones)
- Tested Kozak’s (1988) variable-exponent taper equation
- Compared results with Ontario equation
Main stem, showing points where discs cut. 
\(d_1 = 0.3\text{m}, d_2 = 1.3\text{m},\) remaining discs taken at equal intervals 
\(x = (H_t - 1.3)/10.\)

Breast height

(1.3m)
## Comparison between Models

<table>
<thead>
<tr>
<th>Region</th>
<th>Stand Number</th>
<th>PSP Number</th>
<th>Average DBH (cm)</th>
<th>Average Height (m)</th>
<th>Tree Density (stems/ha)</th>
<th>Volume (m³/ha)</th>
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</thead>
<tbody>
<tr>
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<td>Ontario Volume tables</td>
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<td></td>
<td>35.44</td>
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</tbody>
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Outcome & Next steps

• Ontario equation appears to over-estimate volumes

• Model testing was weak wrt sample size & age of trees

• Currently measure ALL trees harvested for any study requiring whole trees (eg: wood quality, carbon, etc.)

• Will revisit modified model when sufficient data available to ensure the results are robust
Acknowledgements

• Poplar Farm Research Team
  – Dave Kamelchuk, Line Blackburn (now in QB)

• Poplar Farm Operations Team
  – In particular Chuck Kaiser,
    Al Bertschi, Joanna Ramsum

• Dr. Thompson Nunifu