



# Opening the “Model Tree” Tool-box

Plant Canada 2005

# Poplar

**Widely distributed and utilized**  
**Easily transformed**  
**Readily cloned**  
**Small genome (~485 Mb)**  
**Genome sequenced (2005)**

***Genome to Production* workshop  
sponsored by**

**Poplar Council of Canada and Genome Canada**

# **Research Priorities for Poplar/Aspen**

(from G2P Workshop – 2005)

**Screening tools are needed**

**for**

**early stage assessment**

**of operational traits**

# High through-put screening of new hybrids

We need critical information on many traits for ~20,000 new *Populus* genotypes, but traditional methods will take 5 to 20 years

*Can we do this screening in year 1 ?*

- ❖ resistance to *Melampsora* rust (1st priority in the Pacific Northwest) and *Septoria* leaf spot (1st priority in other regions)
- ❖ drought tolerance and frost tolerance.



## More generally ...

What is the **spectrum of susceptibility** of naturally occurring *Populus* hybrids to disease, pest and environmental stresses?

*Will this profile change significantly with continuing climate change?*

# Early stage assessment of operational traits

- **rootability** of cuttings  
(clones with particular genetic backgrounds)
- **gender identification** in pre-, or non-flowering trees
- tolerance for **high density** greenhouse planting  
(light use efficiency?)
- **adaptability** of clones to different sites (integrative test)
- **nutrient use** efficiency / fertilizer requirements
- **parentage identity** of 2-way or 3-way hybrids
- moose, deer and vole problems in plantations  
(*how to have **a less tasty tree?***)

# Tree form and wood quality issues

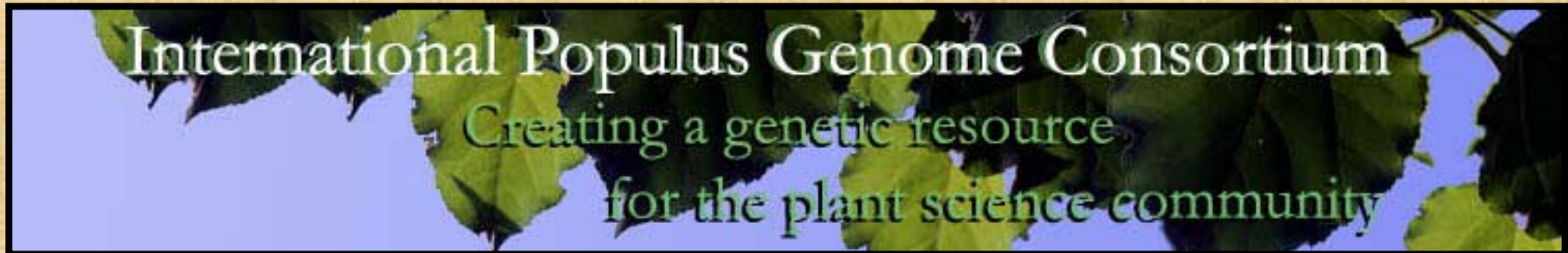
- molecular determinants of **hybrid vigour**,  
**branch angle**, **sytleptic branching**, **growth rate**
- markers for genotypes (hybrids and pure species)  
that can take advantage of **elevated CO<sub>2</sub>** impact  
(eg: root:shoot ratio changes)
- molecular determinants of **wood density** and **pulp yield**

## Other targets ...

- **transferability** of genomics tools between *Populus* species
- regulation of fall **dormancy** in *Populus*, and its relationship to **winter hardiness**
- **salt tolerance**
- susceptibility to **wood stain**
- physiological control of **sunscald**
- **flood tolerance**

## What do we have?

- ❖ extensive genomic and genetic (native and breeding) resources for *Populus*



<http://www.ornl.gov/sci/ipgc/>

>200,000 ESTs  
>4500 full-length cDNAs  
genomic DNA BAC libraries  
>5000 activation-tagged lines  
~2000 mapped genetic markers  
large-scale cDNA- and oligo-based microarrays






# Umea Plant Science Centre, Sweden

PopulusDB - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Print Mail Word Excel PowerPoint Outlook

Address <http://www.populus.db.umu.se/index.html> Go Links



Home Project Search Blast Results

## Welcome to PopulusDB


This open resource for tree genomics is the result of a collaboration between UPSC (Department of Plant Physiology, Umeå University and Department of Forest Genetics and Plant Physiology, SLU Umeå and Department of Biotechnology, KTH Stockholm, with financial contribution from Knut and Alice Wallenberg Foundation, Kempe Stiftelserna, the Foundation for Strategic Research, the Swedish Research Council and the Swedish Research Council for the Environment, Agricultural Sciences and Spatial Planning

The documentation of the database is currently being improved and annotations and gene identities are soon to be updated, with the help of the full genome sequence of Populus. Please bookmark this page and return for new updates.

There are in PopulusDB links to our Populus DNA microarray database, providing powerful search possibilities for our public microarray datasets.

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The populus genome server provided by JGI has now opened.



[http://genome.jgi-psf.org/Poptr1/Poptr1\\_home.html](http://genome.jgi-psf.org/Poptr1/Poptr1_home.html)  
Links to the JGI server has been added to PopulusDB

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**By accessing PopulusDB, you agree to the following user agreement:**

- PopulusDB is protected according to the stipulations of Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases.
- All users must include the reference below in publications describing the use of PopulusDB.

Sterky F, Bhalerao RR, Unneberg P, Segerman B, Nilsson P, Brunner AM, Campaa L, Jonsson Lindvall J, Tandré K, Strauss SH, Sundberg B, Gustafsson P, Uhlen M, Bhalerao RP, Nilsson O, Sandberg G, Karlsson J, Lundeberg J, Jansson S (2004)  
*A Populus EST resource for plant functional genomics.*  
Proc Natl Acad Sci U S A. 2004 Sep 21;101(38):13951-6 [Abstract](#) [Full text](#)

-The data within PopulusDB are for research purposes only, not for clinical or commercial use. It is a non-profit service to the scientific community.

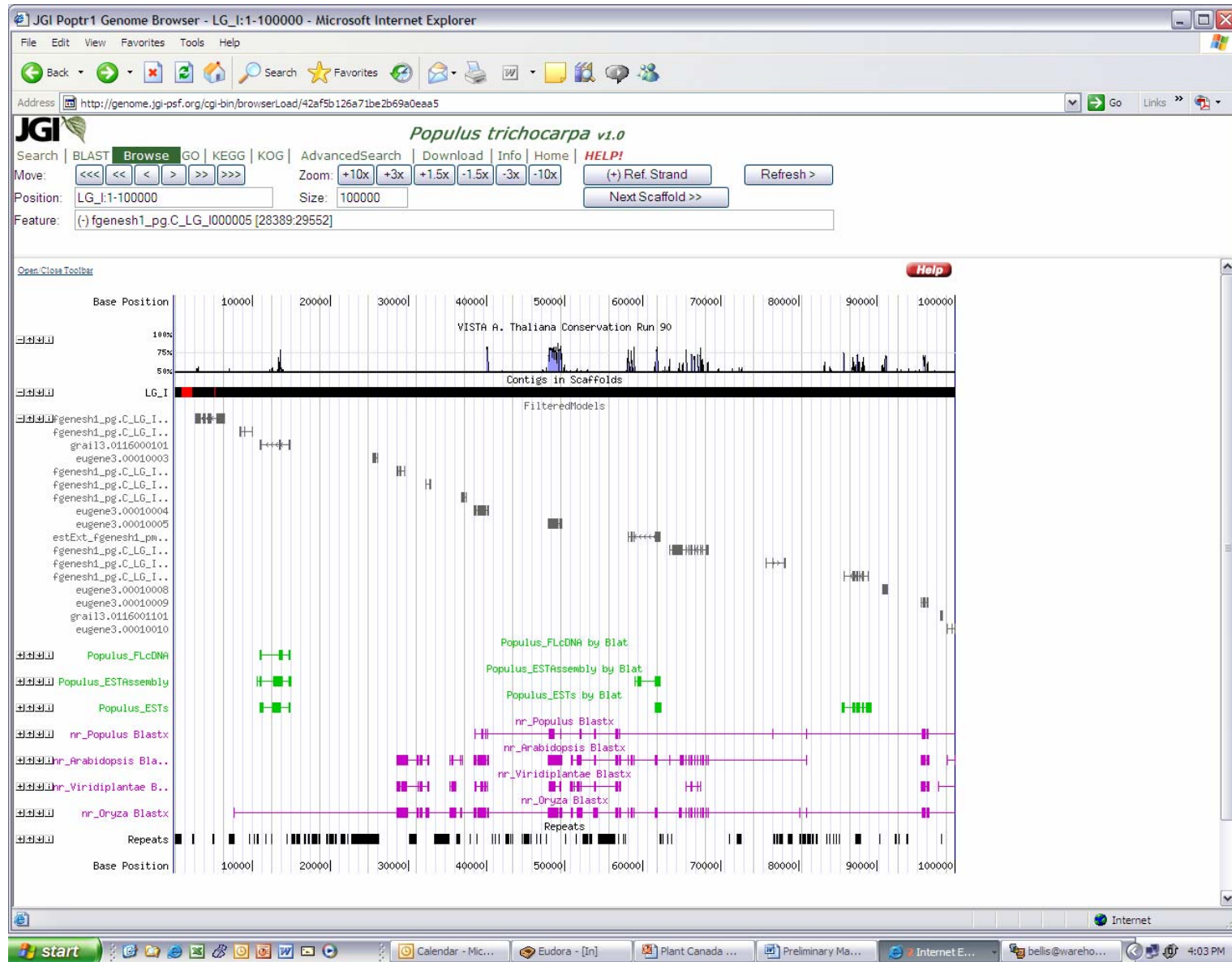
Internet

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# What do we have?

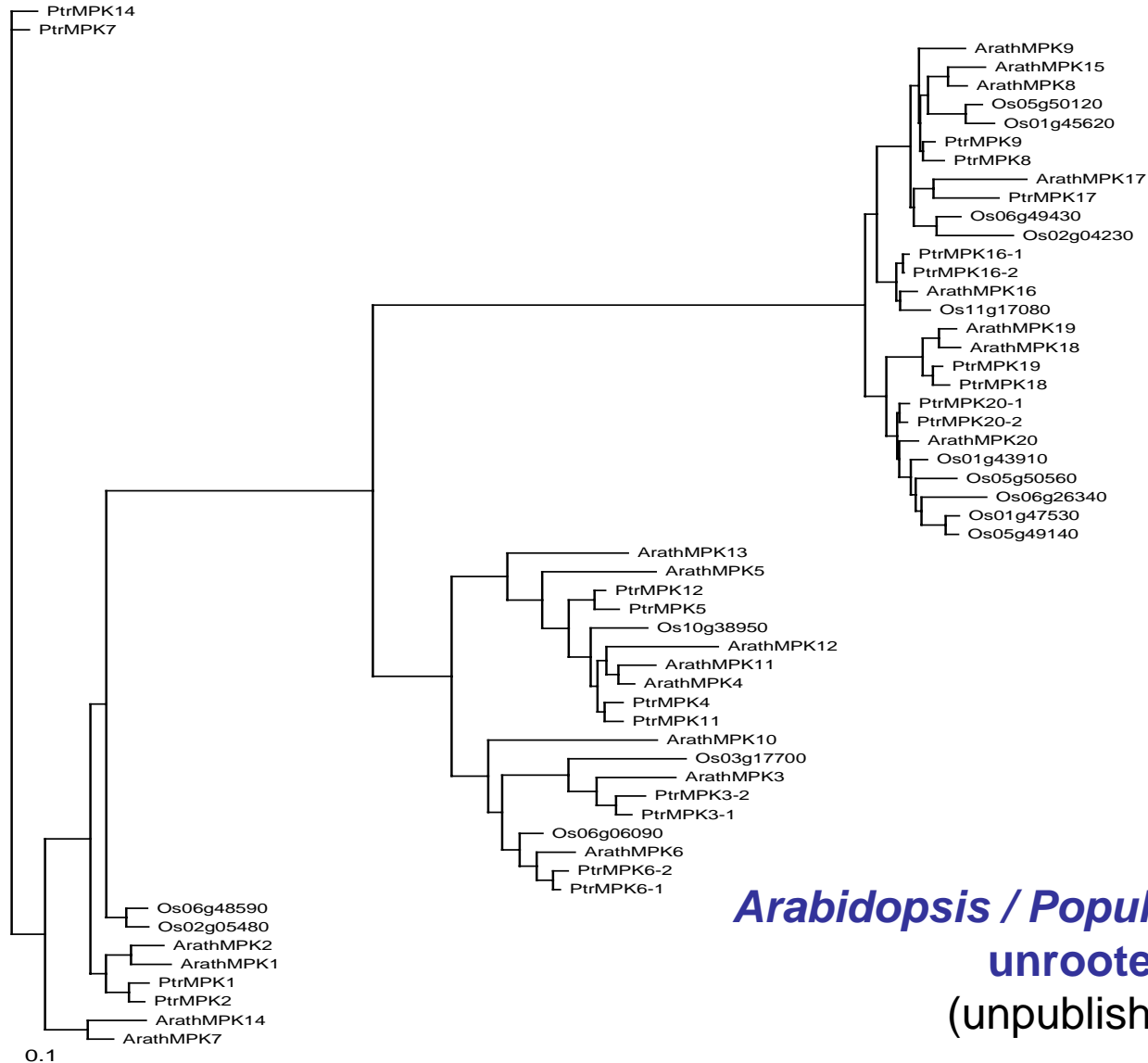
❖ sequenced genome for *Populus trichocarpa*

JGI (CA)  
US-DOE



# What do we have?

❖ high level of genetic similarity to *Arabidopsis thaliana*



# What do we have?

- ❖ increasing industry interest in poplar and aspen utilization;
- ❖ field trials across the country



# What do we need from breeders / industry / researchers?

- ❖ identification of **highly contrasting phenotypes** (e.g. resistant vs susceptible) in genetically characterized material
- ❖ **pedigreed and gender-identified** plant material
- ❖ **replicated experimental material** with similar (clonal) genetic background (e.g. 50 replicated specimens of clones with different phenotypes might be “nice to have”, but having at least 10 might be essential)

# What do we need from breeders / industry / researchers?

- ❖ growth / treatment of plant material in '**controlled environments**' (growth chambers, greenhouses, common gardens, ecological niches) in order to maximize expression of genetic differences
- ❖ an effective user / researcher **interface**
- ❖ \$\$\$ !!

# Who do we need?

- ❖ pathologists
- ❖ quantitative geneticists / tree breeders
- ❖ molecular geneticists
- ❖ ecologists
- ❖ physiologists / biochemists

## Who do we need?

- ❖ people who know the problem “on the ground”
- ❖ people who can talk to each other and are willing to commit time and energy to a communal effort
- ❖ an organizational structure? (*Poplar Council of Canada?*)