Cottonwood

A Tree for All Reasons

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- Foundation species of riparian ecosystems
- Plantation tree for lumber, fiber, biofuels
- Clean-up tree in phytoremediation
- Model system for study of tree biology and genetic engineering
Cottonwood: A key component of riparian ecosystems
Typical fall flood of the Snoqualmie River
Erosion / deposition along river meander
Cottonwood seed dispersal (May – June)
Instant germination and rapid root growth are critical for seedling establishment. An N – fixing *Rhizobium* helps them grow on the sterile substrate  (Doty et al. 2005)
RIVER DYNAMICS AND COTTONWOOD ESTABLISHMENT

1992

spring level

seed

summer level

2000
erosion

accretion

(after Bradley & Smith 1985)
Successive cohorts of cottonwoods along a river in Alberta (S. Rood)
Silted 2-yr seedling with newly added roots
Transported, embedded branch fragment with newly developed roots: effective asexual propagation
Reproductive Events

Sexual
- Pollination
- Seed formation
- Seed dispersal
- Seedl. establ.
- Dormancy

Asexual
- Branch abscission
- Stem/br. breakage
- Root initiation

Stream discharge

Reproductive Schedule of Black Cottonwood in relation to Stream Discharge of a Typical West-Cascade River
Adaptation

Trees, as all organisms, may be viewed as systems of environmental tracking, making use of relevant ancestral experience. (after R. Levins, 1968)

This experience is encoded in their DNA. But DNA is more than a memory bank: it is the “software” that programs a tree’s growth, development, and response to biotic and abiotic cues.
Climatic adaptation of cottonwoods east and west of the Cascades, as studied in common gardens (J. Dunlap, 1991)
Ecological race formation along Yakima River near Cle Elum

Larger:
- Stem Volume
- Leaves
- Stomates
- Fewer Stomates/sq.cm.
- Rust resistant

Smaller:
- Stem Volume
- Leaves
- Stomates
- More Stomates/sq.cm.
- Rust susceptible
Hybridization can combine traits among the 30 species of *Populus* worldwide and capture hybrid vigor.
Pedigree breeding of poplars (Toby Bradshaw)
Harvest of a 7 – year old F₁ hybrid plantation for pulp near Clatskanie, Oregon (James River Corp.)
F₂ hybrid variability in leaf fall: Replicated 5-year old full-sibs in common garden near Clatskanie, Oregon
Tissue culture and genetic engineering of poplar (Toby Bradshaw)
New Molecular Tools

The complete genome sequencing of a *P. trichocarpa* tree (Tuskan et al., Science 313:1596, 2006) set the stage for:

- better understanding of basic tree biology
- tracking adaptation to climate change
- more targeted and sustainable plantation production
- more efficacious phytoremediation
Take – home Lessons

• The manifold adaptations of cottonwood to the riparian and climatic variables have a strong genetic basis

• Genetic manipulation of poplar species has opened the door to new uses of these trees and made old uses more effective

• To understand nature, we have to poke it
CREDITS

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