**Populus breeding and hybrid poplar development in Minnesota:** 16-year update

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**ABSTRACT:**
An applied Populus breeding program based at the Natural Resources Research Institute in Duluth, MN has been producing and testing intra- and inter-specific hybrid poplar germplasm for the past 16 years (1996 – 2011). The primary focus of interest for breeding and testing in Minnesota include P. deltoides, P. nigra, P. maximowiczii and P. trichocarpa. The initial base breeding population consisted of eastern cottonwood selections from an earlier University of Minnesota collection and from other regional Populus improvement programs. Genetic diversity within the base population has been supplemented with periodic open-pollinated seed collections from native stands and from selected trees in managed field trials. For the purpose of long-term parent population improvement and clone development, seed collections and parent materials have been exchanged with cooperators working in the United States, Canada, Europe and Asia. Clone selections have been identified in pedigreed field-test populations and many parent candidates have been archived in breeding orchards. Annual breeding among first and second generation materials generates new genotypes for the various stages of evaluation (i.e.: nursery progeny tests; field-level family genetic trials; advanced clone testing; and preliminary yield block plantings). Fast growth, disease resistance and ease of establishment are key selection criteria for new clones for advanced evaluation and recommendation. All field testing consist of replicated trials imbedded in commercial fiber farm operations and are maintained with current management practices. Operational logistics of each evaluation phase - from breeding hall and nursery testing through an anticipated fiber plantation rotation period (10 to 12 years) - will be presented. General results regarding relative growth, disease incidence and clone development will be summarized on adaptation and performance under climate conditions in Minnesota and the upper Midwest.

**Keywords:** Populus genetics, hybrid poplar, tree breeding, clone development, population improvement

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**Populus breeding materials: NRRI base-population components and source agencies**

- **Populus deltoides** – UMD-NRRI and U. of Minnesota; state-wide and regional collections
- **Populus nigra** – U. of Toronto; Boise Cascade; EU FORGEN Populus Nigra Network (PPN)
- **Populus maximowiczii** – U. of Toronto; Oji Paper Company (Japan); GreenWood Resources
- **DxM hybrids** – U. of Minnesota; USFS-Forest Science Laboratory, Rhinelander, WI
- **TxD hybrids** – Potlatch Corp.; Boise Cascade; GreenWood Resources, Inc.
- **Populus trichocarpa** – Potlatch Corp.; GreenWood Resources, Inc.; British Columbia & Idaho
- **Asian Populus** species – Oji Paper Co.(Japan) and PRI, Liaoning Province (China)

**Populus breeding time-line: NRRI testing stages and duration of each evaluation phase**

- **CP:** Control-pollinations (CP) – NRRI and UM NCROC greenhouses (1st year)
- **PNT:** Progeny nursery trial phase of evaluation - two locations (2+ years), removed 3rd+ year
- **FFT:** Family field trial phase of evaluation - (minimum 3 years); maintained for 10-12 years
- **CT:** Advance clonal field testing - (minimum 3 years); maintained for 10-12 years
- **YB:** Preliminary yield block testing – (minimum 3years); maintained for 10-12 years

**Final stage: Clonal scale up and recommendation for commercialization**

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**Hybrid Poplar Research Site Locations**

Field test network on 43 sites includes large-scale replicated tests of the products of the breeding program deployed in replicated clone tests of select genotypes and yield blocks to estimate absolute biomass yield in closed-canopy fiber plantation conditions.

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**Results of a series of replicated family field trials continue to indicate that significant yield gains over current commercial standard clones are possible. Average family means of top-ranked CP pedigrees equal, or approximate the mean of the standard clone, “NM6”. Top-ranked clone means within these highly-ranked pedigrees nearly double that of the standard clone. Yield testing (Yield Blocks) of promising clones continues under operational, or industrial plantation conditions to verify actual yield gains in west central Minnesota and at other cooperative research locations within the region.**

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In a coordinated effort with our research cooperators, the UMD - NRRI Populus program's forestry research team has worked out the large-scale logistics of moving newly generated CP progeny lots from the initial nursery evaluation phase of testing through the various levels of replicated field testing (i.e: family field tests; advanced clone tests; preliminary yield block tests). The NRRI Populus program works closely with Verso Paper Company and other industrial partners in the USA. Efforts for parent population improvement at the species level will expand and future intra- and inter-specific F1 breeding will utilize adapted parent stock selections from archive plantings, existing family trials and exchanges with cooperators. Clonal scale up and recommendations for commercialization continue.