

# Genetic and Phenotypic Characterization of Figured Wood in Poplar

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## Abstract

When "Curly Aspen" (*Populus canescens*) was first characterized in the early 1940's<sup>[1]</sup>, it attracted the attention from the wood-products industry because "Curly Aspen" produces an attractive veneer as a result of its figured wood. Birdseye, fiddleback and quilt are other examples of figured wood that are commercially important<sup>[2]</sup>. These unusual grain patterns result from changes in cell orientation in the xylem. Although 50 years have passed since finding "Curly Aspen", there is still some question about the extent to which figure is under genetic control. The reasons researchers investigating the formation of figure have not made more progress include the: 1) long juvenile period of trees, 2) inability to identify figure without cutting open a log<sup>[3]</sup>, and 3) lack of genomic resources. This research project is focused on: 1) investigating how and when figure forms through the use of histological techniques; 2) creating a rapid and easy way to identify figure *in planta*; 3) developing genetic markers, such as microsatellites to aid in genetic fingerprinting; and 4) isolating the gene responsible for figure using marker-aided cloning. Our ultimate goal is to transform the gene responsible for eliciting figure into fine hardwood species.



Figure 5. Anegre wood, normal. Flat cut, single leaf (origin: Africa). Figure 6. "Curly Aspen". Flat cut, single leaf. Originally characterized by Grober in 1942<sup>[1]</sup>.

## Introduction

Figure in wood results from combinations of color, luster, texture, and grain (Figs. 1-4, 6). It is one of attractive qualities of wood. The desire to have high-quality figure has led to the need for research to identify the mechanism underlying its formation. It is widely assumed that the development of figure is under strong genetic control<sup>[3, 5]</sup>. Assuming this is true, it is necessary to identify the gene(s) controlling the development of figure in order to reliably impart this trait to tree species of interest. Accordingly, we will characterize a genotype of curly aspen known as "Curly Aspen", which exhibits strong figure. As a part of this project, we will evaluate the cytological basis and the phenology of figure development in this clone, and attempt to develop a high-throughput technique to reliably detect figure in progeny. In addition, the effect of various environmental factors on figure formation will be evaluated in this research.



Figure 1. Birdseye in maple. Rotary cut, three-piece book match (origin: North America). Logs with high density patterns like this that are consistent and clean will demand a premium price<sup>[4]</sup>.



Figure 2. Fiddleback in koa. Two-piece, quarter cut book match (origin: Hawaii). Very limited availability. Koa is a wood that is known for its lustrous interlocking grain in yellow to reddish brown colors with dark streaks. Highly figured logs like this are truly special.



Figure 3. Beeeswing in eucalyptus. Quarter cut, three-piece book match (origin: Australia, Europe, and North America). Also called Tasmanian oak. Highly figured logs are highly prized.



Figure 4. Quilt in kosiyo. Quarter-cut, single-leaf (origin: Africa). This sample represents a large consistent log with unique figure and grain pattern.

## Materials and Methods

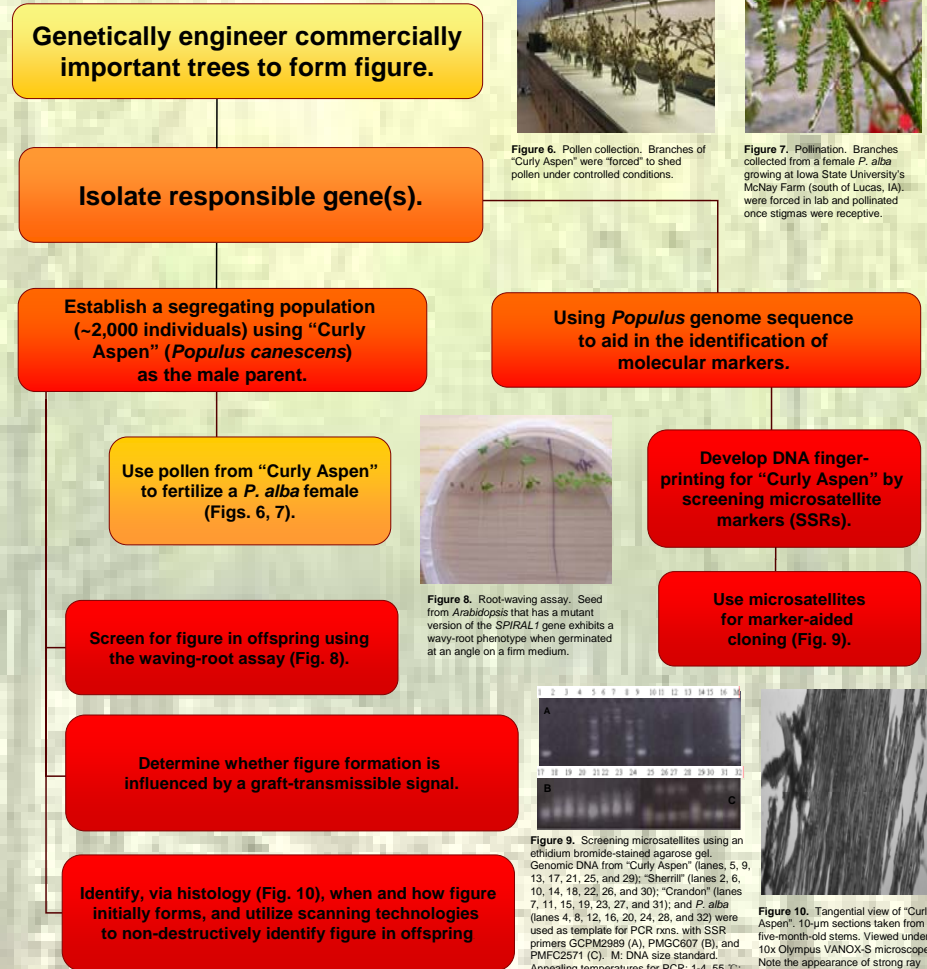


Figure 6. Pollen collection. Branches of "Curly Aspen" were "forced" to shed pollen under controlled conditions.



Figure 7. Pollination. Branches collected from a female *P. alba* growing at Iowa State University's McNay Farm (south of Lucas, IA) were forced in lab and pollinated once stigmas were receptive.



Figure 8. Root-waving assay. Seed from *Arabidopsis* that has a mutant version of the *SPIRAL1* gene exhibits a wavy-root phenotype when germinated at an angle on a firm medium.

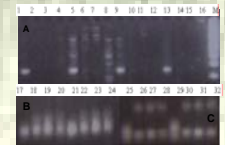


Figure 9. Screening microsatellites using an ethidium bromide-stained agarose gel. Genomic DNA from "Curly Aspen" (lanes 5, 9, 13, 17, 21, 25, and 29); "Sherrill" (lanes 2, 6, 10, 14, 18, 22, 26, and 30); "Crandon" (lanes 7, 11, 15, 19, 23, 27, and 31); and *P. alba* (lanes 4, 8, 12, 16, 20, 24, 28, and 32) were used as template for PCR runs, with SSR primers GPM2989 (A), PMSC807 (B), and PMFC2571 (C). M: DNA size standard. Annealing temperatures for PCR: 1-4, 55 °C; 5-8, 50 °C; 9-12, 52 °C; 13-16, 54 °C; 17-20, and 25-28, 56 °C; 21-24 and 29-32, 57 °C.

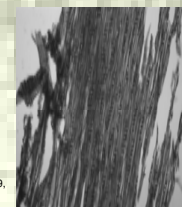


Figure 10. Tangential view of "Curly Aspen". 10-µm sections taken from five-month-old stems. Viewed under 10x Olympus VANOX-S microscope. Note the appearance of strong ray fleck.

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## Preliminary Results

- Histological sections reveal that "Curly Aspen" has strong ray flecks (Fig. 10) but this is not likely to be responsible for the figure seen.
- Of the 15 SSR primer pairs<sup>[6, 7, 8]</sup> tested, three have been shown to be polymorphic. Others are now being tested. Ultimately, our genetic fingerprinting technique will allow us to distinguish "Curly Aspen" from other genotypes.
- 17 jars of female *P. alba* branches have been pollinated (Fig. 11). Once development is complete, seed will be sown to test the occurrence of wavy roots.
- 410 "Curly Aspen" have been vegetatively propagated (Fig. 12); 364 of these individuals will be planted in the field this spring. These plants will be monitored for the occurrence of figure. The remaining plants will be used for additional propagation to establish plants for grafting studies.
- Populus* seed was germinated on the medium used for the *Arabidopsis* waving root assay (Fig. 8) to confirm that the assay can be used for the poplar.



Figure 11. Female flower catkin of *P. alba*. When female flower catkins grew up to 1/2 inch, it was fertilized with pollen from "Curly Aspen".



Figure 12. Vegetative propagation of "Curly Aspen". Each tray could contain 24-28 ramets.

## Future Work

- Screen more SSR primers to identify 20 polymorphic markers.
- Conduct waving-root assays on 2,500 germinating seeds from our segregating population.
- Ascertain the cytological basis for figure in mature trees.
- Determine the age at which figure can be reliably detected in offspring.
- Test various environmental factors for their influence on figure initiation.

## Acknowledgements

This project is partially funded by a generous donation from Dr. Samuel Grober. Additional support was provided by the USDA. We are also grateful to Drs. John Sedbrook and Patrick Masson for providing *Arabidopsis* seed. We appreciate the technical assistance provided by Jim McKenna, Carl Huetteman, Brian Beheler and Bill Skrobutt.