ANATOMICAL AND PHYSICAL PROPERTIES OF BALSAM POPLAR (*POPULUS BALSAMIFERA* L.) IN MINNESOTA[1]

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ABSTRACT

Balsam poplar (*Populus balsamifera* L.), a north temperate boreal hardwood, is spread across the continent at the United States and Canadian border and elsewhere in the interior of Western Canada. For commercial purposes, it is categorized with the cottonwoods rather than the aspens. In this study of ten straight and sound balsam poplars from Minnesota, it was determined that they had some properties permitting them to be placed in both categories. Vessel number and size were more similar to the aspens as was specific gravity at 0.36 (oven-dry weight/green volume). Characteristics similar to the cottonwoods were an average moisture content of 140% and heartwood with a much higher moisture content than sapwood.

The general patterns for angiosperms were seen in these balsam poplars. Vessel numbers increased with height in the bole, and vessel diameter decreased with height. Vessel numbers decreased from pith to bark, while vessel diameter increased. A noteworthy exception to this pattern was that the southside of the trees had significantly more vessels, higher specific gravity, higher percentage of gelatinous fiber area, and significantly higher pH. All trees had an abundance of fibers laden with gelatinous layers ranging from 22 to 63% among the ten trees.

Keywords: Balsam poplar, *Populus balsamifera* L., anatomy, gelatinous fibers.

INTRODUCTION

Balsam poplar (*Populus balsamifera* L.) also is known as balm-of-Gilead, balm, bam, tacamahac, and black poplar, the latter chiefly in Canada. Balsam poplar is a north temperate tree species found in North America across much of Canada, Alaska, the northern tier of the Lake States, the northern New England States, and some western States (Roe 1958).

In Minnesota the commercial range is the north central and north eastern portions of the state, where it is found on moist rich soils in mixture with quaking aspen (*Populus tremu-*

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loides Michx.), paper birch (*Betula papyrifera* Marsh.), black and white spruce [*Picea mariana* (Mill.) B.S.P. and *Picea glauca* (Moench.) Voss.], and balsam fir [*Abies balsamea* (L.) Mill.]. The balsam poplar growing stock in Minnesota's northern forests is approximately 18% that of aspen (Jakes 1980). While generally scattered in a typical aspen stand, the trees usually are found in small discrete clumps that may or may not be the result of regrowth from earlier cuttings, some of which would be clones.

Balsam poplar is a potential source of raw material for the manufacture of oriented strandboard (OSB), but often it does not machine well (Shen 1980; Panning and Gertjejansen 1985; Gertjejansen and Panning 1985) and therefore is not desirable for OSB as is aspen, the preferred raw material. The poor machining qualities of balsam poplar have been attributed to its high gelatinous fiber content, but this relationship has never been established (Shen 1980).

This study was undertaken to better define the anatomical and physical properties of balsam poplar, and then in future studies determine if any of the properties were related to the machining difficulties peculiar to balsam poplar.

METHODS

Raw material collection

Ten balsam poplar trees were harvested for this study from five locations or sites in northern Minnesota. The outward appearance of all trees was that they were straight, sound, and round. The areas in which the trees were harvested have prevailing winds from the north-northwest during the winter months and from the south-southeast during the summer months (Baker 1983). The trees were harvested after leaf drop, which occurs in late September to early October (Ahlgren 1957). At this time, the stems are high in moisture, and the moisture content is stable until bud-break (Sauter 1966). Site characteristics, such as location, topography, stand type and density, plant associations, and soil characteristics were observed and the same understory and surrounding flora were present at all five sites.

After individual trees were selected and felled, the height, crown width, and diameter at breast height were determined. A 183-cm (6-ft) bolt was removed from the butt portion of the tree (lower bolt) and another 183-cm bolt (upper bolt) was removed from the top portion of the tree. A 15-cm (6-in.) small end diameter (inside the bark) was chosen to be the limiting diameter for the upper bolt. After cutting, the ends of the bolts were covered immediately with polyethylene to minimize moisture loss. The bolts were stored at 1 C in a cold room until additional processing required their removal.

Raw material processing

After removal from the cold room, a 5-cm (2-in.) disk was sawn from both ends of each 183-cm bolt and discarded. The fresh-cut ends were photographed to record the color and shape of the heartwood and sapwood, and any peculiar cutting characteristics such as extensive fuzziness or roughness were noted. A 5-cm (2-in.)-thick flitch (board) with a north-south orientation was cut from the center of each bolt. The width of the flitch was the diameter of the bolt. Each center flitch was sawn into five 30-cm (12-in.) segments, and the remaining piece (approximately 20 cm) from the end of the bolt was discarded. Each segment was numbered 1 through 5, with 1 being the lowest point on the flitch with respect to the original standing position of the tree. Each 30-cm segment then was cut into four 7.6-cm (3-in.) blocks. Eight anatomical, physical, and chemical properties were determined from the four blocks. Block 1 from each segment, and therefore the lowest with respect to its original position in the tree, was used for moisture content (MC) and specific gravity (SG) determinations. The remaining three blocks were utilized for determining hydrogen ion concentration and five anatomical characteristics.

Specific gravity and moisture content determinations

Prior to SG (oven-dry weight/green volume) and MC (oven-dry weight basis) determinations, the bark was removed from each of the