PHYSICAL PROPERTIES OF KRAFT PULP FROM FOUR-YEAR-OLD ASPEN HYBRIDS AND CROSSES

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ABSTRACT

Short-rotation forestry and species hybridization offer acceptable raw materials for pulp and paper production. Poplars (*Populus spc.*) are the most promising materials because of their fast growth rates and their suitability for pulp. The objectives of this study were to determine the kraft pulp properties of three new aspen hybrids and crosses and to compare these properties with those of other poplars. We used *Populus alba* × *Populus tremula*, *Populus alba* × *Populus alba* Bolleana, and *Populus alba* × *Populus grandidentata*. Results indicated that the *P. alba* × *P. tremula* hybrid was most suitable for pulp production. Handsheets made from the *P. alba* × *P. tremula* hybrid had greater burst and tear strengths and a comparable tensile index compared with those of the kraft pulps of other juvenile poplars. Results suggest that *P. alba* × *P. tremula* is a promising hybrid for pulp production.

Keywords: Aspen hybrids and crosses, kraft pulp, specific gravity, fiber length.

INTRODUCTION

The demand for high quality pulpwood is rising dramatically. A USDA Forest Service report (Haynes et al. 1995) has projected that consumption of pulpwood will increase about 0.7% annually over the next five decades. This increased demand for pulpwood is not likely to be met by acquiring new forest lands be-

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cause forestry is competing with other land uses due to global population growth. Pulpwood production can be increased without acquiring more land through tree improvement and intensive cultural practices. Intensive forestry practices, especially short-rotation intensive culture, are being considered as a means to provide dependable, high-quality pulpwood supplies in the future.

Poplars consist of two distinctive species groups, the cottonwoods and aspens. Cottonwoods are extremely fast growing and have low wood density. Aspens are slower growing and have denser wood than cottonwoods. The cottonwood hybrids, commonly referred to as hybrid poplars, have been widely planted throughout the world, whereas aspen hybrids have been rare.

Poplars were chosen for intensive management, biomass energy, and pulp production primarily because of their fast growth rates. In the past four decades, numerous studies have been conducted to investigate the wood and pulping characteristics of many aspen species and hybrids. Einspahr et al. (1968) compared wood properties of 5-year-old triploid aspen hybrids, triploid, and diploid plantation-grown aspen trees. They found that the triploid hybrids had faster growth rates, higher wood specific gravities, and longer fibers than the triploid and diploid trees. Zarges et al. (1980) also studied several short-rotation intensive culture cottonwood hybrids and found a wide variation in specific gravity and fiber length among them.

Juvenile poplars have shorter fibers and lower specific gravity than those of mature trees. Silvicultural management for young poplars also has been studied intensively. Holt and Murphey (1978) found that plant spacing did not affect properties of juvenile cottonwood hybrids. Snook et al. (1986) also studied some cottonwood hybrids grown under four management strategies on different sites and found little differences in biomass yield and pulp properties. They suggested that short-rotation intensive culture poplars should be grown to the highest biomass yield at the lowest possible cost. Studies have shown that chemical pulps from short-rotation intensive culture poplars have acceptable burst and tensile strengths and only slightly lower tear strengths than do pulps from mature poplar trees (Einspahr et al. 1970; Hunt and Keays 1973; Sierra-Alvarez and Tjeerdsama 1995).

The opportunity for the present study arose when a number of experimental aspen hybrids and crosses became available from the tree improvement research programs at Iowa State University. The objective of this study was to determine the kraft pulp properties of these new materials, and to compare their properties with the properties of other poplar hybrids.

MATERIALS AND METHODS

Plant material

Three trees from each of three aspen hybrids or crosses were selected for this pulping study. These materials, grown near Moingona, Iowa, were the result of the following crosses: *Populus alba* × *Populus tremula* (1XAE91), *Populus alba* × *Populus alba* Bolleana (21XAA91), and *Populus alba* × *Populus grandidentata* (9XAG91). The origin and growth characteristics of the parents of these hybrids are given in Table 1. Trees were grown from seedlings and planted at 5-m by 5-m spacing, and most trees had two or three main stems. Trees were harvested in spring, 1996, at age 4 years. Stems up to 2.5-cm diameter tops were debarked manually and cut into 2.2-cm-thick disks with a bandsaw. After air-drying, disks were cut into chips about 2.2 cm long, 1.6 cm wide, and 0.3 cm thick. Knots that could not be chipped properly were discarded.

Specific gravity and fiber length

The wood specific gravity was determined from the oven-dry weight and green volume measurements. Twenty random wood chips from each sample were immersed in distilled water and treated with a vacuum (30 min at 30 in. Hg) and pressure (30 min at 90 psi) cycle, followed by measuring the green vol-