Micro Structural Changes in Juvenile and Matured Wood of *Populus tomentiglandulosa* T. Lee

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한국가구학회지 제17권 제3호(2006. 8)

Micro Structural Changes in Juvenile and Matured Wood of Populus tomentiglandulosa T. Lee[*1]

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ABSTRACT

Juvenile and matured wood of *Populus tomentiglandulosa* species of Salicaceae native grown in Korea was observed by FE-SEM and optical microscope. Species is characterized by mostly diffuse-porous, simple perforation plates, polygonal alternate non-vestured intervessel pit, medium length of vessel elements and fibres, non-septate very thin walled libriform fibres and exclusively uniseriate procumbent rays. Axial parenchyma was absent or extremely rare. Vessel and fibre length were longer in both matured and juvenile latewood than those of earlywood. Ray cell lumen diameter, ray length, number and diameter of endwall pit in ray cell, endwall pit, number and diameter of pit in lateral wall of one ray parenchyma cell, vessel ray pit number and diameter vary from juvenile early and latewood to matured wood.

Key words : wood anatomy, hardwood, wood identification

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*1 Received : 2006. 4. 20.
This Study was supported by Technology Development Program for Agriculture and Forestry, Ministry of Agriculture and Forestry, Republic of Korea

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1. Introduction

Salicaceae is a family of flowering plants. Recent genetic studies by the Angiosperm Phylogeny Group has greatly expanded the circumscription of the family to contain 57 genera. In the older Cronquist system the Salicaceae was treated in its own order Salicales, and contained only three genera (*Salix, Populus and Chosenia*), but APG includes it in the Malpighiales. The additional genera were previously treated in the Flacourtiaceae, but had a mixed history before that and have been treated in Bembiciaceae, Casearíaceae, Homaliaceae, Poliothyrsidaceae, Prockiaceae, Samydaceae, and Scyphostegiaceae.

Species from the genus *Populushave* been promoted for fast-growing plantation forestry, particularly for Northern regions. *Populus* species can have high growth rates - up to 30 m3/ha/yr and produce pulps of high natural brightness with a wide range of fibre, pulping and pulp properties (Watson and Potter, 2000). Poplars are deciduous, and turn bright gold to yellow before their leaves fall. The leaves of many poplars, including the cotton woods and aspens (but not the balsam poplars), have laterally-flattened stems, so that breezes easily cause the leaves to wobble back and forth, giving the whole tree a "twinkling" appearance in a breeze. Like willows, many poplars have very strong and invasive root systems, so they must not be planted too close to houses or water pipes as they will crack walls and pipes in their search for moisture. Fast-growing, genetically improved and vegetatively propagated clones of poplars and their hybrids have been planted extensively in the north temperate zone (Peszlen 1994). In Hungary, forest tree improvement has concentrated on these fast-growing broad leaved species, and now poplars represent nine percent of the forested area and more than twenty percent of the annual harvest (Molnar 1990). Poplars of the cottonwood section are often wetlands or riparian trees. The aspens are among the most important boreal broadleaf trees. Fast-growing hybrid poplars are grown on plantations in many areas for pulpwood and used for the manufacture of paper. Poplar is also sold as inexpensive hardwood timber, used for pallets and cheap plywood more specialized uses include matches and the boxes in which camembert cheese is sold. The wood is generally white, often with a slightly yellowish cast. Poplars and aspens are important food plants for the larvae of a large number of Lepidoptera species. This paper describes the wood micro anatomical features of *Populus Tomentiglandulosa.*

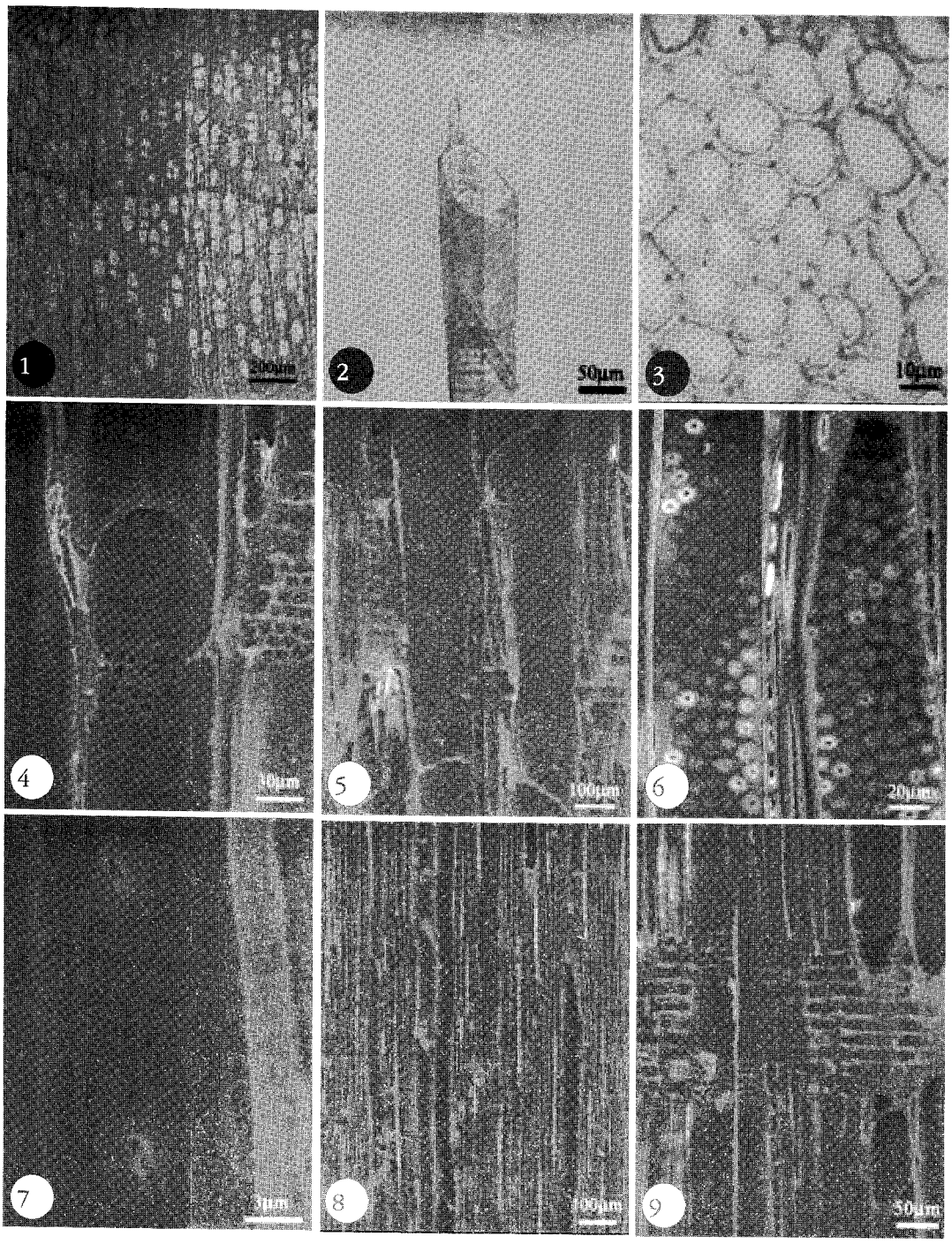
2. Materials and Methods

Wood samples of *Populus Tomentiglandulosa* T. Lee are obtained from Kangwon National University reserve forest. Microscopic slides and macerations were made according to standard techniques (Baas & Zhang 1986). Samples for FE-SEM (Field Emission

Scanning Electron Microscope) were prepared after Exley et al. (1977). Samples were dried under vacuum condition and coated with platinum and palladium by using an ion sputter apparatus. At different resolution and magnification, samples were examined at 15kV in a Field Emission Scanning Electron Microscope (FE-SEM) including macerated cells. Terminology and the method for determining quantitative features conform to recommendations from the IAWA Feature List (IAWA Committee 1989).

3. Results and Discussion

Growth ring boundaries distinct (Fig. 1). Wood diffuse-porous (Fig. 1). Vessels arranged in no specific pattern. Mean tangential vessel diameter 62.69μm, with 77.43μm (sd=11.86, range 61.87-101.74μm) in matured earlywood, 55.11μm (sd=6.90, range 42.07-66.92μm) in matured latewood, 69.50μm (sd=10.71, range 39.60-87.71μm) in juvenile earlywood, 48.71μm (sd=6.65, range 39.60-62.07μm) in juvenile latewood. Vessel diameter in earlywood larger. 54-131 vessels per sq. mm, with 93 (sd=3.33, range 90-95) in matured earlywood, 105 (sd=8.06, range 93-111) in matured latewood, 66 (sd=12.79, range 54-97) in juvenile earlywood, 118 (sd=8.70, range 104-131) in juvenile latewood. Perforation plates simple (Fig. 2 and 4). Intervessel pits alternate (Fig. 5) and non-vestured. Shape of alternate pits polygonal (Fig. 5). Mean intervessel pit size large 10.57μm, with 10.55μm (sd=0.89, range 9.24-12.94μm) in matured earlywood, 10.61μm (sd=0.91, range 9.00-12.27μm) in matured latewood, 11.10μm (sd=1.22, range 8.60-13.13 μm) in juvenile earlywood, 10.02μm (sd=1.04, range 8.25-12.12μm) in juvenile latewood. Intervessel pits in matured wood and juvenile wood almost same. Vessel-ray pits with much reduced borders to apparently simple; pits rounded or angular (Fig. 6). Vessel-ray pits restricted to marginal rows (Fig. 6 and 9). Helical thickenings absent. Mean vessel element length 572.81μm, with 611.65μm (sd=129.21, range 398.59- 994.52 μm) in matured earlywood, 720.55μm (sd=160.54, range 370.17- 983.96μm) in matured latewood, 475.39μm (sd= 86.28, range 347.88-637.07μm) in juvenile earlywood, 483.66μm (sd=99.02, range 310.61-731.66μm) in juvenile latewood. Tyloses and other deposits absent. Vascular or vasicentric tracheids absent. Libriform wood fibre with simple to minutely pits (Fig. 7) and non-septate (Fig. 8). Fibre pits mainly restricted to radial walls. Mean fibre pit diameter 1.16, with 1.41μm(sd=0.27, range 0.84-2.03μm) in matured earlywood, 1.23μm (sd=0.29, range 0.87-1.93μm) in matured latewood, 1.09μm (sd=0.28, range 0.59-1.71μm) in juvenile earlywood, 0.90μm (sd=0.25, range 0.60-1.82μm) in juvenile latewood. Fibre pit in matured wood larger. Mean fibre length 1087.68μm, with 1104.71μm (sd=220.94, range 586.63-1490.00μm) in matured earlywood, 1233.19μm (sd=248.05, range 698.29-1830.00μm) in matured latewood, 910.05μm (sd=219.61, range 568.25-1470.00μm)



〈Fig 1-3〉 Observed by optical microscope. -Fig. 1. Growth ring boundaries distinct, wood diffuse-porous, vessels in short multiples. -Fig. 2. Macerated vessel with simple perforation plate. -Fig. 3. Fibre very thin walled. 〈Fig. 4-9〉 observed by FE-SEM. -Fig. 4. Simple perforation plate. -Fig. 5. Intervessel pit alternate, shape of intervessel pit polygonal. -Fig. 6. Vessel-ray pit with much reduced borders to apparently simple, pits rounded or angular, restricted to marginal rows. -Fig. 7. Fibre with simple pit. -Fig. 8. Non-septate fibres present, rays exclusively uniseriate. -Fig. 9. All ray procumbent, also vessel-ray pits restricted in marginal rows.

in juvenile earlywood, 1101.86μm (sd=229.13, 586.63- 1490.00μm) in matured earlywood, 1233.19μm (sd=248.05, range 698.29- 1830.00 μm) in matured latewood, 910.05μm (sd=219.61, range 568.25-1470.00μm) in juvenile earlywood, 1101.86μm (sd=229.13, range 661.16-1390.00μm) in juvenile latewood. Fibre length in latewood longer. Fibre very thin walled (Fig. 3). Axial parenchyma absent. Rays per millimeter 10, with 9 (sd=1.71, range 6-12) in matured earlywood, 9 (sd=1.41, range 7-11) in matured latewood, 10 (sd=2.33, range 6-15) in juvenile earlywood, 11 (sd=1.96, range 8-15) in juvenile latewood. Rays per millimeter in juvenile wood more. Rays exclusively uniseriate (Fig. 8). All rays procumbent (Fig. 9). Ray height variable from 70-470μm, mean of 250μm. Storied structure, sheath cells and tile cells absent; no perforated ray cells observed. Oil and mucilage cells absent. Intercellular canals absent. Laticifers or tanniniferous tubes absent. Included phloem absent. Other cambial variants absent. Crystals and cystoliths absent. Silica not observed.

Number of ray cells in axial direction 12, with 11 (sd=5.44, range 4-25) in matured earlywood, 11 (sd=4.58, range 4-23) in matured latewood, 14 (sd=5.57, range 6-30) in juvenile earlywood and 13 (sd=4.14 range 3-19) in juvenile latewood. Number of ray cells in axial direction of juvenile wood more. Ray cell lumen diameter in tangential section- mean horizontal lumen diameter 4.14μm, with 3.88μm (sd=0.42, range 3.19-4.99μm) in matured earlywood, 4.51μm (sd=1.03, range 1.98-6.10μm) in matured latewood, 3.37μm (sd=0.94, range 1.93-5.73 μm) in juvenile earlywood and 4.80μm (sd=0.94 range 3.17-7.32μm) in juvenile latewood; mean vertical lumen diameter 14.14μm, with 13.79 (sd=0.99, range 12.35-16.79μm) in matured earlywood, 15.25 μm (sd=1.76, range 12.15-19.82μm) in matured latewood, 14.10μm (sd=1.62, range 10.70-16.88μm) in juvenile earlywood and 14.19μm (sd=1.97, range 11.14-20.06μm) in juvenile latewood. Ray cell length in radial direction 63.32μm, with 64.64μm (sd=24.72, range 28.77-134.22μm) in matured earlywood, 66.95μm (sd=23.16, range 38.21-148.94μm) in matured latewood, 64.88μm (sd=26.61, range 24.43-125.14μm) in juvenile earlywood and 56.81μm (sd=23.94, range 28.30-116.64μm) in juvenile latewood. Number of endwall pit in ray cell 9, with 10 (sd=2.63, range 6-16) in matured earlywood, 10 (sd=3.83, range 4-20) in matured latewood, 9 (sd=4.39, range 2-18) in juvenile earlywood and 7 (sd=3.54, range 3-17) in juvenile latewood. Endwall pit more in matured wood. Endwall pit diameter in ray cell 1.15μm, with 1.39μm (sd=0.38, range 0.73-2.27μm) in matured earlywood, 1.19μm (sd=0.48, range 0.65-2.47 μm) in matured latewood, 1.10μm (sd=0.36, range 0.69-1.85μm) in juvenile earlywood and 0.93μm (sd=0.21, range 0.60-1.27μm) in juvenile latewood. Larger endwall pit diameter in matured wood. Number of pit in lateral wall of one parenchyma cell (ray-fibre pit number) 2, with 2 (sd=1.41, range 1-4) in matured earlywood, 2 (sd=0.71, range 1-3) in matured latewood, 2

(sd=1.41, range 1-3) in juvenile earlywood and 2 (sd=0.96, range 1-3) in juvenile latewood. Pit diameter in lateral wall of one parenchyma cell (ray-fibre pit diameter) 1.38 μm, with 1.43μm (sd=0.35, range 1.17-2.15μm) in matured earlywood, 1.60μm (sd=0.46, range 0.99-2.61μm) in matured latewood, 1.38μm (sd=0.21, range 1.23-1.53μm) in juvenile earlywood and 1.11μm (sd=0.18, range 0.93-1.38μm) in juvenile latewood. Larger ray-fibre pit diameter in matured latewood. Vessel-ray pit number in ray cell 11, with 13 (sd=2.48, range 10-20) in matured earlywood, 7 (sd=2.74, range 3-15) in matured latewood, 15 (sd=4.63, range 9-27) in juvenile earlywood and 8 (sd-3.39, range 4-18) in juvenile latewood. Vessel-ray pit diameter 8.35μm, with 8.46μm (sd=0.53, range 7.32-9.70μm) in matured earlywood, 9.62μm (sd= 1.04, range 7.70-11.44μm) in matured latewood, 9.07μm (sd=0.61, range 8.10-10.17μm) in juvenile earlywood and 6.27 μm (sd=1.48, range 3.49-10.39μm) in juvenile latewood, vessel-ray pit diameter in matured latewood larger.

Wood of this species has commercial importance. Basic specific gravity low, ≤ 0.40 Heartwood basically white to grey. It has no distinctive odor. Water extract basically yellow. Ethanol extract basically colourless. Froth test weakly positive. Chrome Azurol-S test negative. Splinter burns to a full ash, and colour of ash white.

4. Conclusion

Anatomical features of Populus tomentig-landulosa was observed as growth rings boundaries were distinct, wood diffuse-porous. Perforation plates were simple. Vessel-ray pits were with reduced borders or apparently simple, rounded or angular, restricted to marginal rows. Very thin-walled libriform fibres were nonseptate. Axial parenchyma were absent. Rays were exclusively uniseriate. Rays composed of a single cell type, homocellular ray cells were procumbent.

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