

## **Wood Anatomical Features of Stems of *Salix alba* L. from Temperate Climate of Kashmir Himalaya**

**Bilal Ahmad Wani\*<sup>1</sup>, Amina Khan<sup>2</sup> and Mudasir A. Tantry<sup>1</sup>**

<sup>1</sup>Centre of Research for Development, University of Kashmir, Srinagar - 190006, J & K, India

<sup>2</sup>Nasheman Bagat, Barzulla, Srinagar - 190006, J & K, India

\*Corresponding author: woodscience.2005@gmail.com

### **Abstract**

Willow (*Salix alba* L.) is regarded as an important natural resource almost throughout the temperate regions of the world but relatively little is known about anatomical characteristics of its wood. For this purpose sections were cut in three different planes and also maceration was done in order to know about wood anatomical features viz. fiber length, fiber diameter, fiber wall thickness, vessel element length and vessel element diameter, growth ring.

**Keywords:** *Salix alba*, fiber, wood, anatomy.

### **Introduction**

Willow belongs to the genus *Salix* and family *Salicaceae*, comprising deciduous and dioecious prostrate shrubs to large trees over 30 meters high, but most are shrubs or small trees. The word *Salix* is derived from Celtic 'Sal' meaning near and 'lis' meaning water. They are usually found on damp ground or along river and stream margins. There are about 450 species of *Salix* mainly distributed in Asia, Europe and North America (Argus 1997, 2010) but there is still disagreement among authors regarding the number of species (Fang *et al.*, 1999, Skvortsov 1999, Ohashi 2001, Heywood *et al.*, 2007). In India, there are around 33 species and most of them are categorized as shrubs except *S. tetrasperma*, *S. alba*, *S. daphnoides*, *S. fragilis* and *S. babylonica*.

Wood anatomy an important branch of wood science; which is suitable for predicting the varied utility of woods for different purposes, the present work is an attempt to elucidate wood anatomical patterns in *Salix alba*, from temperate climate of Kashmir Himalaya, as its wood is suitable for Veneer, pulp, plywood, laminated wood, reconstituted wood products, artificial limbs, fruit boxes, agriculture implements, furniture, tool handles and sports goods like cricket bat, polo balls etc.

### **Material and Methods**

#### **Source of Material**

The present study was carried out on hardwood trees *Salix alba* L. with deciduous type of habit, belonging to the family *Salicaceae* from natural provenances of Kashmir Himalaya for their anatomical characteristics.

Samples of approximately 1 cm<sup>3</sup> in size were taken at breast height (1.3 m) and were softened by boiling in water for 10-15 minutes. Cross, radial and tangential sections of 15–20 µm thick were prepared by using Reichert microtome, as well as sharp razor for studying various wood anatomical microscopical features. These features were identified as per International Association of Wood Anatomists (IAWA) list of microscopic features for hardwood identification (Wheeler *et al.*, 1989).

#### **Maceration**

Maceration was done as per Jeffery's method (Johansen, 1940) for all the sample studies. In this method, small slivers of wood were taken from the samples collected and put into the test tube and then filled with 10% chromium trioxide and 10% nitric acid and left for one to several days at room temperature and the process was

hastened by heating up to approximately 60°C for few minutes. After that, the material was thoroughly washed with distilled water till traces of the acid were removed. The mixture was teased/shaken thoroughly to separate the wood elements and stained with 1% Safranin and mounted in glycerine on microscopic slides.

#### **Staining Procedure for Sections**

Twenty micron thick; transverse, radial and tangential sections were stained in Heidenhains haematoxylin and safranin for 20 minutes. The stained sections were washed in acetone and xylene of 1:1 ratio for 10 minutes to ensure complete dehydration and subsequently in Xylene. Finally they were mounted in Diphenyl Pthalate Xylene (DPX) mountant to make the permanent slides.

#### **Photomicrography**

Photomicrography involves combination of the principles of microscopy and photography; is a technique of recording microscopic image. By this method, the object was focussed under microscope and the photographs were taken with the help of Olympus Clinical CH20I microscope model CH20 BIMF 200; on the top of which Olympus camera was fitted with photomicrographic attachments.

#### **Wood Element Measurements**

The measurements/dimensions of different wood elements viz., vessel elements and rays were made from macerated and transverse section materials, with the help of ocular-stage micrometry. Twenty-five measurements were made from unbroken fibers and vessel elements for lumen diameter, wall thickness, length and width.

#### **Colour**

The colour feature was determined when logs were cut across, showing two distinct regions of sapwood and heartwood (Chowdhury and Ghoush, 1958) and (Rao and Junjea, 1971).

Some timbers when cut on the surface have some characteristic smell or odour due to resins, oils or chemical deposits. It may be asset or a liability in its utilization for a given purpose. This feature was determined by exposing fresh wood sample or by adding moisture through breathing already cut wood sample (Wheeler *et al.*, 1989).

#### **Results**

Sapwood white or nearly so, merging into the heart wood; heart wood uniformly light red at first turning light reddish brown to light with age, frequently irregular in contour in the transverse section; rather lustrous (especially the sapwood) with a silky sheen when first exposed but becoming dull with age, without characteristic odour or taste.

Wood diffuses porous; growth rings distinct. Vessels numerous (170-340 per sq mm), mostly in short to long radial multiples of 2-4 (10) and small clusters, occasionally solitary, vessel diameter 30 (20-45) µm in tangential diameter. Vessel elements 320 (180-420) µm long, with simple perforations and alternate intervessel pits, 7-10 µm in diameter; vessel ray pits with much reduced borders and rounded to angular outline, 6-9 µm in diameter. Libriform fibers thin walled, 540 (410-650) long, with simple pits mainly restricted to radial walls, occasionally with gelatinous wall layers. Axial parenchyma in narrow and discontinuous terminal bands and very scanty paratracheal. Rays uniseriate (more rarely with biseriate portions), weakly heterocellular with square central cells, 4-40 cells or 500-1920 µm tall. Perforated ray cells restricted to upright ray cells, with perforations of about 53 x 59 µm in horizontal x vertical diameter.

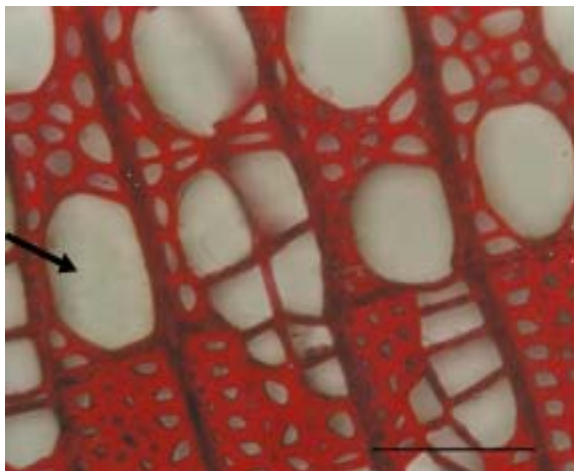


Fig. 1 . T.S. showing pores and angular shaped fibers 40X

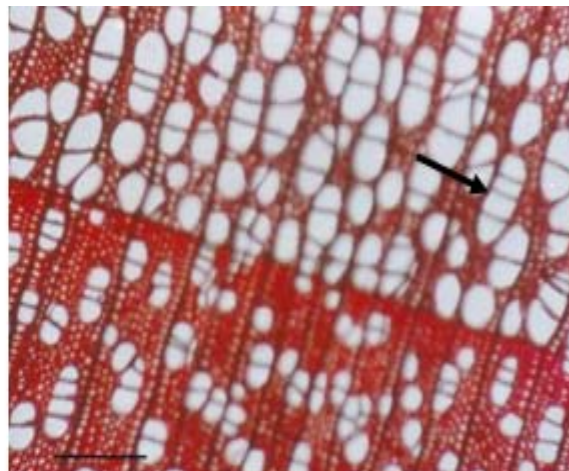


Fig. 2. T.S. showing pores in radial multiple of 2-4 10 X

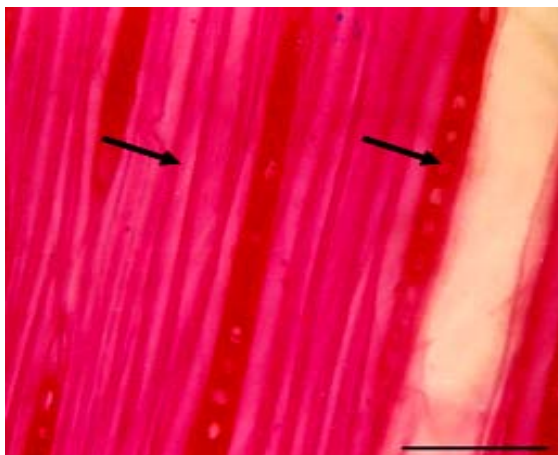


Fig. 3. T. L. S. showing exclusively uniseriate rays and cluster of fibers

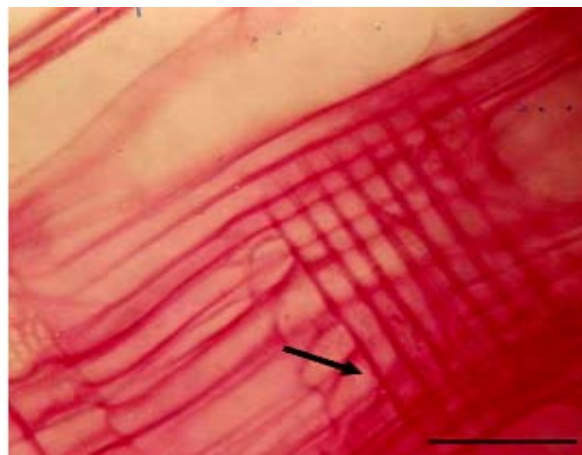


Fig. 4. R. L. S. showing weakly heterocellular rays and vessel

[Scale bar Fig. 1, 3 and 4 = 40 µm and Fig. 2 = 50 µm]

### Discussion

Wood anatomical structure of *Salix alba* L. growing in the Kashmir Valley was investigated. According to the records in the literature, there have not been any studies on the wood anatomy of willows in Kashmir except few studies by Wani and Khan (2010 a, b). Further these studies were mainly oriented towards the wood variability and cambial activity in *Salix alba*. The most detailed information on wood anatomy of *Salix* is given by Metcalfe and Chalk (1965) in *Anatomy of Dicotyledons*. Also Yazganet *et al.*, (1986) provided a cross section of *Salix alba* with schematic and anatomical illustrations. In the present study, the Sapwood of *Salix alba* was found white or nearly so which merges into the heartwood. The sap wood of a new wood provides a pipeline for the movement of water and nutrients through the trunk and into the leaves (Medhurst and Beadle, 2002). The heartwood was found uniformly light red at first and afterwards turns light reddish brown with passage of time and having irregular contour in the transverse section. Also in the present study, wood of *Salix alba* was found to be diffuse porous with distinct growth rings. Vessels were numerous mostly in short to long radial multiples of 2-4(10). Vessel

elements were found to be long with simple perforations and with alternate intervessel pits. Libriform fibres were thin walled, long with simple pits mainly restricted to radial walls. Axial parenchyma was narrow and with discontinuous terminal bands. Rays mostly uniseriate. The similar results were obtained by Metcalfe (1939), Lyr and Bergmann (1960), Sacre (1974), Sennerby-Forse (1989), Arihan and Guvenc (2011) and Isabelle *et al.*, (2013)

### **Conclusion**

Wood anatomical studies of the *Salix alba* Linn. a versatile natural resource of Kashmir Himalaya which is chiefly used for the manufacturing of high quality cricket bats have been carried out. The dimensions of cellular structures viz., vessels, fibers, rays, parenchyma present in the *Salix alba*, which have direct bearing on the properties of wood been discussed.

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