

**COMPARATIVE STUDY OF ANATOMICAL CHARACTERISTICS
OF EARLYWOOD AND LATEWOOD OF BLUE PINE
(*PINUS WALLICHIANA*, A.B. JACKSON)**

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Abstract

The anatomical characteristics of earlywood and latewood in three mature trees of Blue Pine were studied. Some of the features observed, do not appear to have been reported in the literature. These are:- the occurrence of crassulae or bars of Sanio on radial walls of earlywood tracheids; Pits with serrate tori on radial walls of earlywood and latewood tracheids; Biseriate arrangement of pits on the radial walls of earlywood; Occasional occurrence of vestured pits in earlywood; and Occasional occurrence of fused fusiform rays in both earlywood and latewood.

Introduciton

In conifers, the most distinct features of wood are the growth rings and within the growth rings, the zones of earlywood and latewood. The proportion of these two types of wood within a growth increment greatly affects the physical, mechanical and chemical properties of wood. These differences have their origin in anatomical features at microscopic and submicroscopic levels.

Though the general anatomy of wood of Blue pine is well known (Pearson & Brown, 1932; Greguss, 1955; Mahmood, 1983), but comparative study of anatomical characteristics of its earlywood and latewood are not known from literature. This aspect of anatomy of Blue pine is discussed in this paper.

Material and Methods

Wood samples were obtained from three mature Blue pine trees. They were 55-70 years old growing under natural conditions at Namli Marra gallis forest division, NWFP. After felling the trees, cross sectional discs, about 5 cm thick, were removed from the bole at breast height level. They were wrapped in polythene bags and transported to the laboratory. Small blocks measuring 2 x 2 x 2 cm representing 7 rings inside from the bark (sapwood) and 5 rings (near the pith) starting 8-12 rings out side the pith (heartwood), were cut from these discs. Blocks were boiled in water until fully water logged and 15 μ m to 20 μ m sections were cut from cross, radial and tangential faces on a sliding microtome. After staining in safranin and haematoxylin, sections were dehydrated in

absolute alcohol and mounted in canada balsam. Anatomical characters such as tracheid diameter, lumen diameter, cell wall thickness, ray height and ray width, number of cells per ray along ray height, number of cells per ray along ray width and number of rays per mm^2 were determined from these sections with the help of eye piece micrometer both for earlywood and latewood. More than 50 readings were taken for each character. All the measurements were recorded at random. For the determination of cell wall thickness, method described by Richardson (1964) was used.

For measurement of fiber length, 80-120 μm thick serial sections were cut from earlywood and latewood separately. These sections were macerated in 20% nitric acid with the addition of few crystals of potassium chlorate in a test tube until the tracheids were torn apart. After a thorough washing with water, tracheids were stained in a weak solution of methylene blue and mounted on glass slide by a liquid dispersal method (Echols, 1961). Tracheid length was measured from these slides by projection method. Nearly 500 readings were taken for each portion.

Table 1. Average values of anatomical characteristics of earlywood and latewood of three Blue pine trees.

Properties	Maximum		Minimum		Average		Standard deviation	
	* EW	** LW	EW	LW	EW	LW	EW	LW
Taacheid length (mm)	5.55	6.60	2.07	2.27	3.72	4.01	± 0.74	± 0.69
Tracheid tangential diameter (μm)	56.00	26.40	30.40	12.58	43.44	18.92	± 4.03	± 3.36
Tracheid tangential lumen diameter (μm)	48.77	16.48	24.47	3.77	36.30	6.34	± 5.71	± 3.16
Tracheid tangential wall thickness (μm)	4.73	7.80	1.33	4.62	2.84	5.77	± 1.01	± 0.80
Normal ray height (μm)	313.6	320.3	29.3	32.0	184.0	162.7	± 39.7	± 39.9
Normal ray width (μm)	18.1	24.6	9.6	9.0	14.3	16.4	± 2.1	± 3.0
Fusiform ray height (μm)	455.0	448.0	147.0	163.3	303.0	338.5	± 75.2	± 87.8
Fisiform ray width (μm)	56.0	49.0	35.0	32.7	46.9	40.4	± 6.2	± 6.0
No. of cells/ray along normal ray height	19	13	2	2	8	6	± 3	± 2
No. of cells/ray along fusiform ray height	36	36	13	12	24	23	± 4	± 4
No. of normal rays per mm^2	4	5	1	1	2	3	—	—
No. of resin canal per mm^2	1	1	0	0	0	1	—	—

*Earlywood

**Latewood

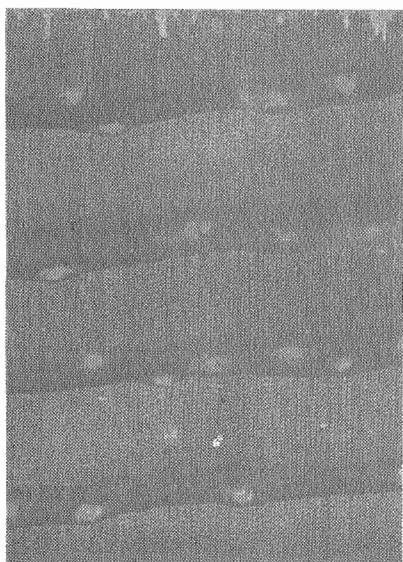


Fig. 1. Typical earlywood and latewood bands of Blue pine. x 10.

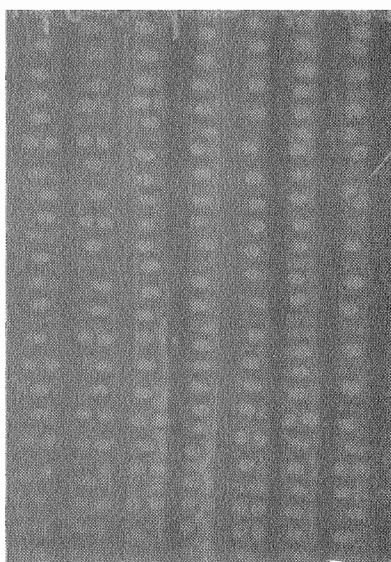


Fig. 2. Biseriate and occasional uniseriate arrangement of bordered pits on radial walls, x 150.

Results and Discussion

Data on anatomical characteristics of both earlywood and latewood is given in Table 1. Results show that earlywood zone is much broader than latewood and is more distinct (Fig. 1). It makes about 50-70% of the whole annual ring. The tracheid length of earlywood is smaller than that of latewood but the differences are not significant. The average tracheid length varies with different positions in the disc. These findings are similar with the values reported for Blue Pine (Seth & Jain, 1976). The tangential tracheid diameter and lumen diameter of latewood are significantly lower than those of earlywood (Table 1).

Cell wall thickness of latewood tracheids is significantly higher than those of earlywood tracheids. Pits are absent on tangential walls of earlywood tracheids but commonly present on walls of latewood tracheids. The inter tracheids heavy bordered pits tend to decrease from earlywood to latewood. Bordered pits on the radial walls of earlywood tracheids are numerous and arranged in definite linear rows (Fig. 2). Their arrangement is generally uniseriate as described by Pearson & Brown (1932) but biseriate arrangement is not uncommon. Pit aperture on radial walls of earlywood tracheids is distinct as compared to pit aperture on latewood tracheids. In the surface view the bordered pits on the walls of earlywood appear in the form of three concentric rings (Fig. 3). Unlike

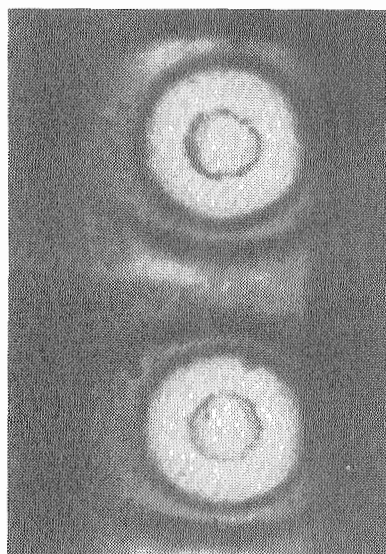


Fig. 3. Pits with serrate margins in earlywood x 1500.

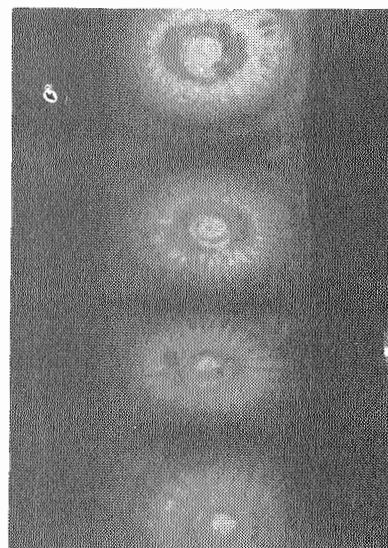


Fig. 4. Occasional occurrence of vestured pits in earlywood x 1500.

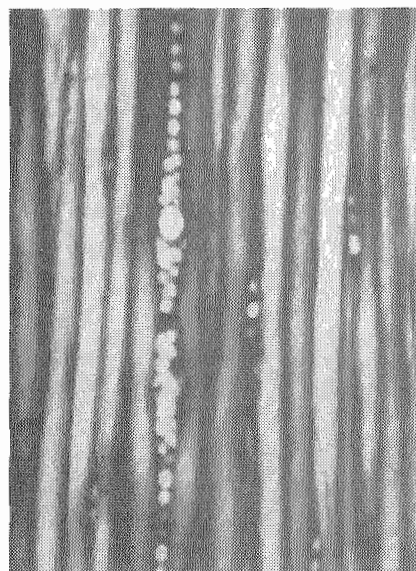


Fig. 5. Fused fusiform rays in earlywood and latewood x 125.

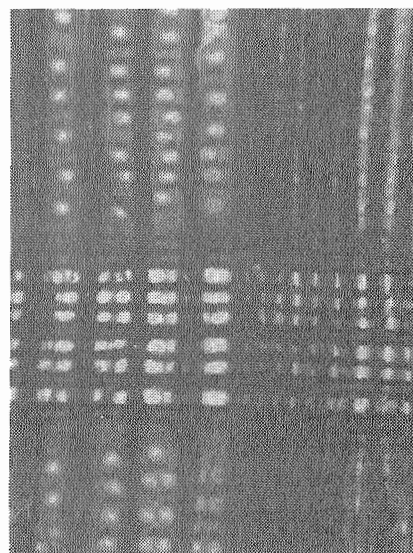


Fig. 6. Window type crossfield pits in earlywood and latewood. x 125.

the findings of Greguss (1955), pit aperture of earlywood is fairly defined as compared to latewood. Vestured pits (Fig. 4) are found occasionally in heartwood. Cross field pits in earlywood are present upto the extent of 1-2 and are generally large and window like (Fig. 6). They are exclusively one per cross field, lenticular and very narrow in the case of latewood tracheids. Crassulae or bars of Sanio occur throughout the annual ring, but are more distinct in earlywood than latewood.

Fusiform rays occasionally fuse together in both earlywood and latewood (Fig. 5). Each ray consists of two types of cells i.e., ray tracheid and procumbent cells. Ray tracheids are both marginal and interspersed.

Resin canals in cross section are more in latewood than in earlywood and canal orifices of latewood are smaller than those of earlywood. Other anatomical characters of earlywood either resemble latewood or are different from them only slightly.

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