The Wood Properties of an Intergeneric Hybrid — Taxodiomeria peizhongii (*Taxodium mucronatum* × *Cryptomeria fortunei*)

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Taxodiomeria peizhongii is an intergeneric hybrid between *Taxodium mucronatum* and *Cryptomeria fortunei*. By more than 30 years investigation, it is found that the hybrid is well suited for the site and climate of Shanghai area, and it will be one of the main landscape trees in near few years. So it is necessary to know its basic wood properties. In this research, we harvested 6 sample trees of *Taxodiomeria peizhongii* and studied the elementary wood properties. The results showed that its mean annual ring width was 7.0mm, mean basic density 0.32g/cm^3, and the mean percentage of latewood 24.3%. The mean treacheid length of latewood was 3.1mm, and mean treacheid width 35.1μm. Compared with other usual coniferous trees, the values of these indices were at a medium level. The period of juvenile wood was about 15 years, and the fast growing period appeared in first 10 years. The basic density, altering less in radial growth, showed a significant minus relation with annual ring width. The percentage of latewood did not related to wood density.

Keywords: *Taxodiomeria peizhongii*; Wood Property; Tracheid Length; Basic Density; Annual Ring Width

Introduction

Txodiomeria peizhongii originated in Nanjing in 1963, and was crossed between *Taxodium mucronatum* and *Cryptomeria fortunei*. By investigating the hybrid for many years, scientists are convinced that *Txodiomeria peizhongii* promises to combine the best characteristics of their parents. It is semi-evergreen. Its trunk is usually divided at a height of 5~8 m into two or more primary branches with a conical crown. It can grow in ordinary garden soil, wetlands and saline sea-shores with a soil pH ranging from 6.5 to 8.6. It can even grow in saline soil with 0.4% salt. The hybrid was introduced into Shanghai in 1975, and since then it has been propagated vegetatively. Through more than 30 years research on its characteristics, it is found that *Txodiomeria peizhongii* is well suitable for the ecological environment and site of Shanghai area. Therefore the hybrid is expected to be the main planting tree species in urban afforesting and greening, saline alkali soil planting, costal landscape planting as well as for large-scale windbreaks in coastal regions in Shanghai area(Zhang, 2003).

As its fast-growing characteristics, the *Txodiomeria peizhongii* can reach 30 ~ 40cm in diameter in breast height during 20 to 30 years growth period (Zhang, 2003). So we have to consider in advance after it comes into matured period, whether its timber can be effectively used.

In China, studies on basic wood properties is mainly focused on some of common timber species, for conifer tree species such as fir, larch, cedar, and for broad-leaved species, such as poplar, paulownia, eucalyptus and so on(Bao, 1998). Up to now, *Txodiomeria peizhongii* is not the tree specie planted commonly, and its wood properties has not been studied. Before the large-scale popularization of the hybrid, it is necessary to understand the nature of its timber.

Materials and Methods

Materials

Six sample trees of *Txodiomeria peizhongii* were harvested. One of them was from the ground of Shanghai Academy of Agricultural Sciences, and the other five trees were from Chuan Sha Forest Farm located in suburb of Shanghai. The details of sample trees were illustrated in Table1. All trees harvested were straight and uniform crowns, and free of lean and visible defects. After felling, 10-cm-thick disks at breast height were cut from each tree for test.

All disks were placed in indoor to reach the air-dried state, and then the surface of disks were planed, and a radial line through the pith was drawn for the determination of the annual ring width and latewood width. Then along the radial line, about 2 × 2cm blocks were cut along the tangential direction of annual rings by slicing knife used for measuring basic density and tracheid length and width.

Measurement

The annual ring width and latewood width were measured with a 10×50mm magnifying glass in two reverse directions with the precision of 0.01mm. The basic density was determined by release water method in two reverse directions.

For tracheid length and width measurement, the latewood of each annual ring was macerated in Schulze solution for 2~3 days and the tracheid lengths and width were measured with the Olympus SZX7 optical microscope. The number of tracheid length measured per annual ring was about 100 with the amplification ratio of 50, and the number of tracheid width measured per annual ring was 50 with the amplification ratio of 100. Then the average tracheid length and width were calculated for further analysis.

Result and Discussion

The basic indices of wood properties

The basic indices of wood properties for six sample trees were presented in Table1. As expected, it showed that between sample trees, there were differences in mean values of basic indices.

Tabele 1 The basic indices of wood properties for sample trees

Sample trees	DBH (cm)	Annual ring number	Basic density (g/cm^3)	Mean annual ring width (mm)	Percentage of latewood (%)	Tracheid length (mm)	Tracheid width (μm)	Ratio of length to width of tracheid
1	37	26	0.35	6.9	28.2	3.2	35.6	89.9
2	27	17	0.33	7.3	26.7	3.1	33.9	91.5
3	26	16	0.34	7.0	27.4	3.2	34.1	93.8
4	26	15	0.28	7.4	17.8	3.3	36.4	90.7
5	25	15	0.30	7.3	22.3	3.0	35.2	85.2
6	19	16	0.34	5.8	23.8	2.8	33.3	84.1
Mean			**0.32**	**7.0**	**24.3**	**3.1**	**34.8**	**89.2**

These differences between sample trees may be attributed largely to the different ages or different growth of site conditions. Sample tree No.1 was harvested in the ground of Shanghai Academy of Agricultural Sciences, with the age of 30 years. The other five sample trees were from Chuan Sha Forest Farm, with the age of 20 years. The basic density ranged in 0.28~0.35 g/cm^3, and mean annual ring width ranged in 5.8~7.4mm. And it was considered that these indices basically reflected the characteristics of wood properties of *Taxodiomeria peizhongii*.

Tabele 2 Comparisons of wood property indices for some coniferous tree species*

Tree species	Mean ring width (mm)	Basic density (g/cm^3)	Percentage of latewood (%)	Tracheid length (mm)	Tracheid width (μm)
Larix kaempferi	2.7	0.53	37.7	3.8	35.5
Cryptomeria japonica	3.6	0.36	25.6	3.3	32.5
Taxodium ascendens	5.2	0.34	10.1	2.3	35.1
Taxodiomeria peizhongii.	**7.0**	**0.32**	**24.3**	**3.1**	**34.8**
Cunninghamia lanceolata	5.2	0.30	12.5	2.7	40.7
Metasequoia glyptostroboides	6.3	0.28	15.5	3.6	36.8

* data in table was from the references listed in this paper

By comparing the mean values of these indices with other coniferous trees(Shimaji, 1994; Jiang, 1994; Yu, 1997), it could be found that the values of these indices were at a medium level(Table 2), but the average annual ring width was the biggest in the coniferous species listed, showing the fast-growing property of *Taxodiomeria peizhongii*.

Radial variation of indices

The developmental trend of radial variation of indices for each individual sample tree was carefully examined, and it was found that all sample trees displayed extremely similar trend in radial direction. So we attempted to use the average value of six sample trees to illustrate the variation trend.

From Fig.1, it could be found that the tracheids were short near the pith and then increase in length rapidly and nonlinearly for about 15 years, and after that, reached an irregular variation level. These

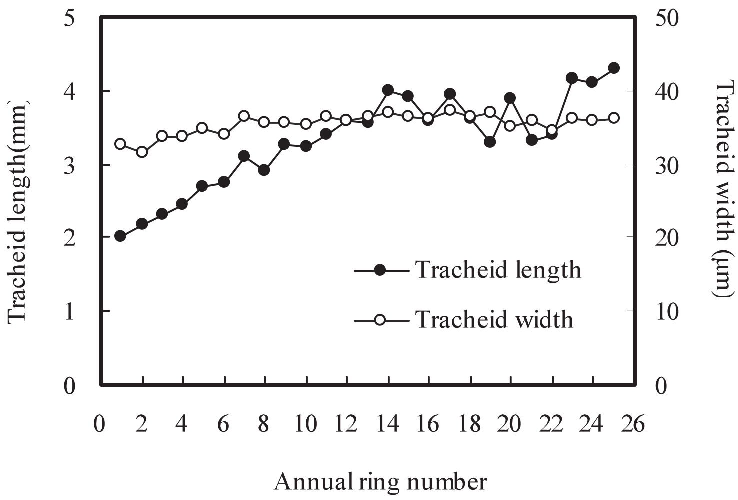

Fig.1 Radial variations of tracheid length and width

results were consistent with other coniferous wood (Shiokura, 1982), showing that the formation period of juvenile wood was about 15 years.

With the increase of annual ring number, tracheid width showed the gradually increasing trend, but the margins were small and seemed to keep a constant level, so that the variation of the ratio between tracheid length and width should be consistent with the variation of tracheid length.

As showed in Fig.2, The percentage of latewood had large fluctuations in radial direction, showing irregular changes, but it was relatively low near the pith.

The basic density had little change with increasing ages, and leveled off between 0.3-0.4 g/cm^3, keeping a relatively stable state, and after 15 years showed a slight increasing trend. The radial variation pattern was different from some other conifer species. For example, the basic density of Japanese larch was relatively low near the pith for a few years (Zhu, 2000), and then gradually increased. The Japanese cedar, on the contrary, displayed the high basic density in the first-formed rings, and had a decrease with age for some years, then remained constant (Zhu, 2003). The reason was supposed to the effect of stress wood formed near the pith.

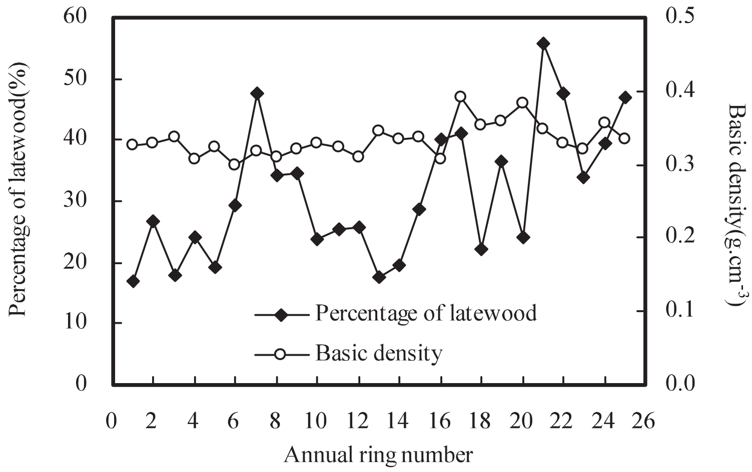

Fig.2 Radial variations of percentage of latewood and basic density

The annual ring width reflected the growth increment of different ages. Although it was subject to external factors such as climate or environment conditions, its trend could gave the growth pattern of trees. As shown in Fig. 3, annual rings in the early growth stage were wide, even up to 10mm or above in some years. After about 10 years it showed a decline and fluctuated below 6mm. So the fast-growing period of *Txodiomeria peizhongii* appeared to be in the first 10 years, which was consistent with the Japanese larch (Zhu, 2000).

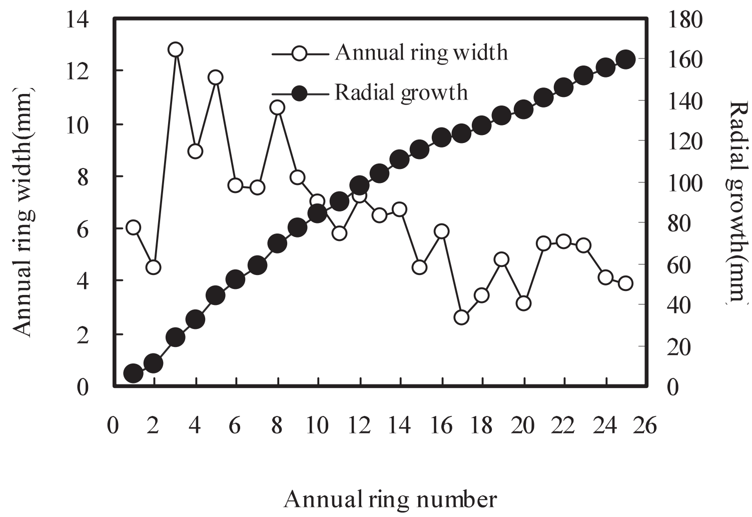

Fig.3 Radial variations of ammual ring width and radial growth

The variation of radial growth was in line with the annual rings. Although the curve of radial growth displayed a near-linear increase with annual ring number, it could clearly be divided into two stages (Fig.3): the fast-growing period, ranging from pith to about 10 years; and the mature growth period, occurring after that. The first 10 years growth rate was significantly higher than that of after 10 years.

The correlation between indices

The basic density of wood was one of important factors for evaluating the wood properties, and had a close relationship with wood strength. Usually, the greater the density of wood was, the greater the strength was. In this research, the mean basic density of *Taxodiomeria peizhongii* was 0.32g/cm^3, little larger than *Cunninghamia lanceolata* and *Metasequoia glyptostroboides*. It was generally believed that ring width and the percentage of latewood had greater effect on wood density. The results of this study indicated that the basic density had little correlation with and the percentage of latewood, but negatively correlated with the ring width significantly (Fig.4).

The negative correlation between wood density and ring width was common feature for the most of softwood, which indicated that during the formation of wood, the excessive annual growth could easily lead to lower density, so that the decrease of the wood strength. The percentage of latewood was an index reflecting the proportion of latewood during the formation of annual ring. The fact that the percentage of latewood did not related to wood density could be inferred that there were little differences in wood density between earlywood and latewood, and the wood properties were relatively homogeneous.

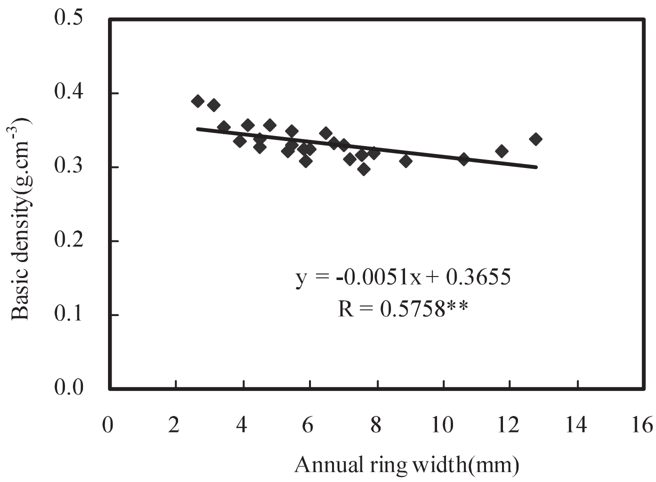

Fig.4 The relation of basic density with anuual ring width

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