WOOD PROPERTIES OF NEW ZEALAND-GROWN *CUNNINGHAMIA LANCEOLATA*

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ABSTRACT

Cunninghamia lanceolata (Lamb.) Hook. (Chinese fir) is considered one of the most important trees in central-southern China. In China it has been cultivated as a timber species for over 1000 years; however, the species does not appear to have been planted much outside China and Taiwan. Physical, mechanical, and drying properties of three stands of New Zealand-grown *C. lanceolata* were assessed and anatomical and pulping studies were reviewed.

Results clearly showed that mechanical and physical wood properties of New Zealand-grown *C. lanceolata* are numerically lower than those of native-grown (Chinese/Taiwanese) *C. lanceolata.* The main factor is a lower basic density resulting in reduced strength; shrinkage, however, appears to be fairly constant. In comparison to *Pinus radiata* D.Don, *C. lanceolata* wood is of lower density and therefore not as strong. Shrinkage is similar for both species and there is little degrade under conventional kiln schedule or air drying. Drying rates are similar to *P. radiata.*

It appears that owing to its low basic density *C. lanceolata* would be unsuitable for heavy structural uses. However, its dimensional stability, ease of drying, and reputed durability would allow it to be used in applications such as weatherboarding, panelling, and joinery.

Keywords: wood properties; mechanical tests; timber drying; *Cunninghamia lanceolata.*

INTRODUCTION

Cunninghamia lanceolata is an evergreen conifer in the Taxodiaceae (redwood) family (Dallimore & Jackson 1931; Den Ouden & Boom 1982), occurring naturally in the sub-tropical region of central-southern China. In China it has been cultivated as a timber species for over 1000 years (FAO 1982) and its silviculture is well developed. It has been planted in Europe, Britain, and the eastern United States as an ornamental species, and has been trialled elsewhere (e.g., Brazil, South Africa, Australia, Japan) but does not appear to have been planted on a large scale (Fung 1993).

Cunninghamia lanceolata is considered one of the most important trees in China, in terms of areas of planting, timber production, and timber usage. It has desirable features such as good form, fast growth, and durable wood. It is widely distributed in central and southern China between 102° and 122°E and 22° and 34°N. It is planted in 16 out of the 21 provinces in China and constitutes over 50% of plantings in some provinces, e.g., Fujian and Hubei (China, Tree Species Editorial Committee 1978; FAO 1978, 1982).

There is little in the way of commercial plantings of the species outside China or Taiwan. In New Zealand it has been used as a specimen tree in gardens and parks and occasionally in stands, and no detailed study of the species has been undertaken in this country. The study reported here was carried out as part of a larger study to evaluate the prospects for growing *C. lanceolata* in New Zealand (Fung 1993) and is intended to provide an indication of wood properties of New Zealand-grown *C. lanceolata*. Wood properties can be used to provide an indication of suitable end use; in China and Taiwan the species is used extensively for building (light structural and flooring), coffins, poles, boat building, furniture and cabinet work, boxing, and crates (Ko 1958; Dallimore & Jackson 1931; Chun 1921; Liu 1982). It is also used in particleboard manufacture (Liu 1982; Chen 1984, 1987) and in structural glue-laminated timbers (Liu & Lin 1986). While not widely used, *C. lanceolata* is also suitable for sulphate (kraft) pulps, based on experiments in both Taiwan (Liu 1982; Ku *et al.* 1987) and Brazil (Foelkel *et al.* 1978; de Lelles *et al.* 1978).

An extensive appeal for information on New Zealand-grown *C. lanceolata* produced details of three stands (plots of more than two or three trees) of the species. The largest stand was located in New Plymouth and the other two plots were in Rotorua; details of the stands are given below. Another (ornamental) plot of five trees located in the Eastwood Hills Arboretum, Gisborne, was not analysed in this study. Wood properties of a species may vary with a number of factors e.g., site, climate, geographic location, genetic origin (Haygreen & Bowyer 1982). However, as there were known stands of *C. lanceolata* of varying ages it was seen as appropriate to obtain some preliminary information on wood properties.

MATERIALS AND METHODS

All three stands were visited on 7 and 8 June 1989; breast height (1.4 m) increment core samples, tree heights, and diameters at breast height were taken. During a second visit to the New Plymouth stand on 16 January 1990, sample trees were felled and wood samples were removed for detailed analysis of the physical, mechanical, and drying properties. As there were limited numbers of available trees, not all properties (such as hardness, durability, extractives content, anatomical) could be tested.

Stand measurements are summarised in Table 1. Measurements of the sample trees at Eastwood Hills Arboretum are included as the trees were of similar age to those at Camp Huinga.

TABLE 1–Height and diameter at breast height over bark (dbhob) for four stands of *C. lanceolata*.

		WF*	LM	CH	EH
Height (m)	Mean	12.2	14.3	23.15	23.5
	n	10	12	15	5
Dbhob (cm)	Mean	19.9	28.9	39.05	67.5
	n	30	12	100	5
Approx. age (years)		25	25	58	57

* WF: Whakarewarewa Forest, Rotorua LM: Longmile Road, Rotorua
CH: Camp Huinga, New Plymouth EH: Eastwood Hills Arboretum, Gisborne

Test Trees

Camp Huinga, New Plymouth (CH)

The stand comprised some 112 trees in an area approximately 40×25 m (0.1 ha); stocking was around 1100 stems/ha.

It is thought that the stand was established around 1931, the seed source being unknown. Previous plot work on this stand had been carried out in January 1989 by Groome Pöyry Ltd, and consisted of diameter measurements of 46 trees (nearest to the middle of the plot) and height measurements of three trees.

On the first visit, diameter measurements of a further 54 trees and heights of 12 trees (chosen at random) were taken. Twenty trees were then chosen at random from the 100 which had been measured, and two 5-mm-diameter cores were extracted from each tree. The cores were taken at right angles to each other at breast height using a 5-mm increment borer. Five representative trees from an adjacent stand of *Cryptomeria japonica* of similar size, area, and stocking were also measured for diameters and heights.

On the second visit, five randomly selected trees were felled. Heights were recorded and discs were taken from the butt, at breast height, and then at 3-m intervals up the stems. A 1-m bolt was removed from each tree at below breast height. Disc material was used for analysis of physical properties, while the bolts were sawn to produce small clear specimens for analysis of mechanical properties and for drying tests.

Whakarewarewa Forest, Rotorua (WF)

This stand was part of a compartment trial established in 1964 to evaluate several species. The seed was from Taiwan. Diameters of 30 trees were measured, with heights being taken on 10 of these. Increment cores at breast height were taken from seven randomly selected trees.

Longmile GTI Block, Rotorua (LM)

Also established in 1964 from Taiwanese seed (possibly the same), this stand comprised 12 trees only. All trees were measured for diameters and heights. In addition, two randomly selected trees were felled and discs were taken from the butt, 1.4, 3, 6, and 9 m for analysis of wood properties.

Test Material Preparation

Bolts from the Camp Huinga trees were recut according to the pattern in Fig. 1. The (centre) diametric plank was sawn to produce 1-m-long side-matched specimens for green and air-dry testing of mechanical properties. The diametric plank was further sawn to 20 × 20-mm small clear samples for three mechanical tests.

Planks from either side of the centre plank were next sawn to produce samples for evaluation of drying properties. The 1-m planks were resawn to two matching sections with dimensions of 60 × 60 mm. These were then cross-cut to give two samples of 480 × 60 × 60 mm per section.

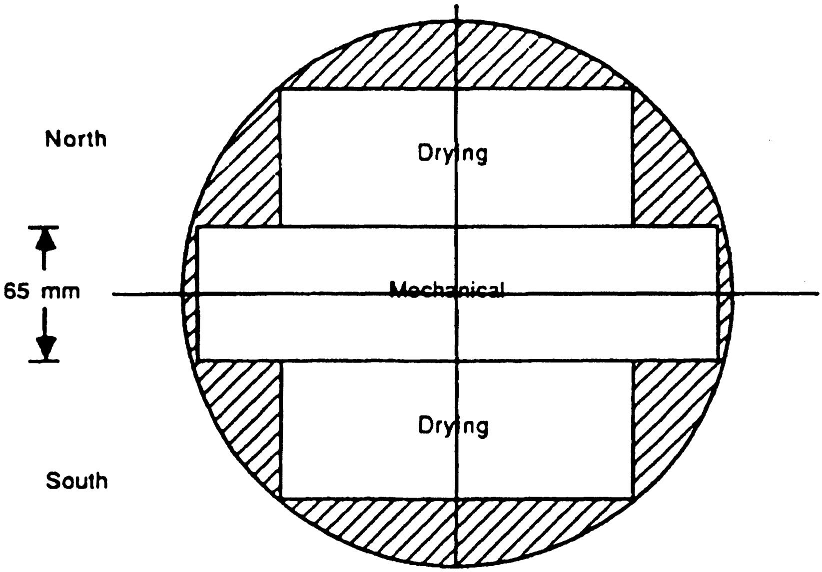

FIG. 1–Overall sawing pattern

Analysis

Physical properties

Discs were measured for diameter over and under bark, and for diameter of heartwood. They were then divided into sample sectors of either five or 10 growth ring sections or heartwood and sapwood sections. Green weights and volumes of sector samples were recorded, and sector samples were then oven dried. The discs taken at a height of 3 m up each stem were also sectioned and analysed for dimensional shrinkage: longitudinal (Lon), radial (Rad), and tangential (Tan).

Parameters calculated were:

green density (kg/m^3)
basic density (kg/m^3)
green moisture content (%)
volumetric shrinkage (%)

as defined by Harris (1986) and Haygreen & Bowyer (1982), as well as cumulative volumes and heartwood percentage for each tree.

Core samples were divided into sections of approximately five rings or 30 mm, whichever was the longest. Basic densities were derived using the maximum moisture content method (Smith 1954).

Drying properties

A total of 48 sample boards from the five trees were obtained. Samples from the matched sections were either placed in an experimental kiln and dried at 70°/60°C dry/wet bulb temperatures, or allowed to air-dry. After drying, the samples were placed in an environmental chamber set at 65% relative humidity (25°C).

After the kiln-dried samples had been in the environmental chamber for 74 days and air-dried samples for 9 days, radial (Rad_t), tangential (Tan_t), and volumetric (Vol_t) shrinkages were measured. Samples were then cross-cut to determine moisture content. In order to assess collapse recovery after steaming, the central one-third length of each sample board was steamed for 4 hours and placed back in the environmental chamber. After re-equilibrium, dimensions were remeasured (Rad_r, Tan_r, and Vol_r). Drying curves and shrinkages were calculated for both types of drying, and degrade (e.g., collapse, checking, distortion) was assessed visually.

Mechanical properties

Small clear specimens were tested for static bending, compression parallel to the grain, and shear parallel to the grain. Modulus of elasticity (MOE), modulus of rupture (MOR), fibre stress at the proportional limit (FSPL), maximum compression strength (MCS), compression strength at the proportional limit (CSPL), and maximum shear strength (MSS) were all calculated from the above tests. The tests were carried out on an Instrom 1195 universal testing machine. Nominal density at the time of testing, basic density, and moisture content at time of testing were calculated. Preparation of samples and methods were as per British Standards Institution (No. 373-1957), with slight modification to rates of crosshead movement.

RESULTS

Physical Properties

Heartwood percentage and densities for each whole tree are given in Table 2. The means of each stand are also shown. Younger trees from LM clearly had a higher green moisture content than those from CH. This was reflected in a higher green density (and slightly lower basic density) for the LM stand. Reduction in moisture content with age is due to increased

TABLE 2–Heartwood as a percentage of total stem volume, density, and green moisture content (m.c.) of *C. lanceolata* trees (LM = Longmile, CH = Camp Huinga)

Trees	Ht	Heartwood	Density (kg/m^3)		Green m.c.
	(m)	(%)	Basic	Green	(%)
LM 4	9.0	35	309	1076	248
LM 12	9.0	17	320	1047	226
CH 4	9.0	62	284	729	157
	21.0	58	288	729	153
CH 9	9.0	49	314	855	172
	18.0	45	317	851	168
CH 14	9.0	52	312	921	195
	21.0	48	310	893	188
CH 41	9.0	52	345	907	163
	15.0	48	343	898	162
CH 42	9.0	44	337	973	189
	18.0	41	339	949	180
Whole tree means:					
LM		27	315	1062	237
CH		50	319	864	171

N.B.: Measurements are shown at 9.0 m for comparison and at total height.

heartwood formation as a general rule (Cown & McConchie 1982; Zobel & van Buijtenen 1989) and this was also apparent in *C. lanceolata.*

Weighted means of disc densities, and moisture contents by position in the tree are shown in Fig. 2–4. Between-tree variation was quite large (Fig. 2 and 3), but there was a general trend of high densities and moisture contents at the butt which dropped quickly further up the tree, then levelled and began to increase with further height up the tree.

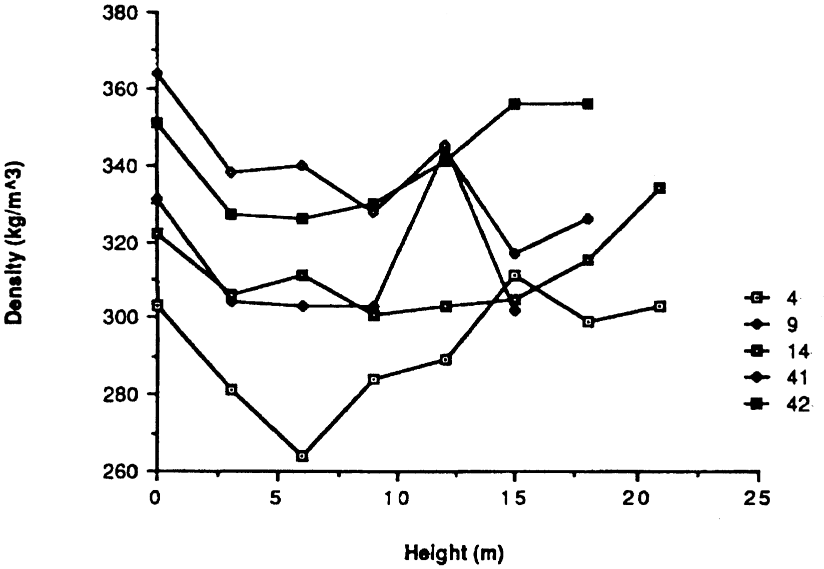

FIG. 2–Disc weighted mean basic densities (for Camp Huinga trees)

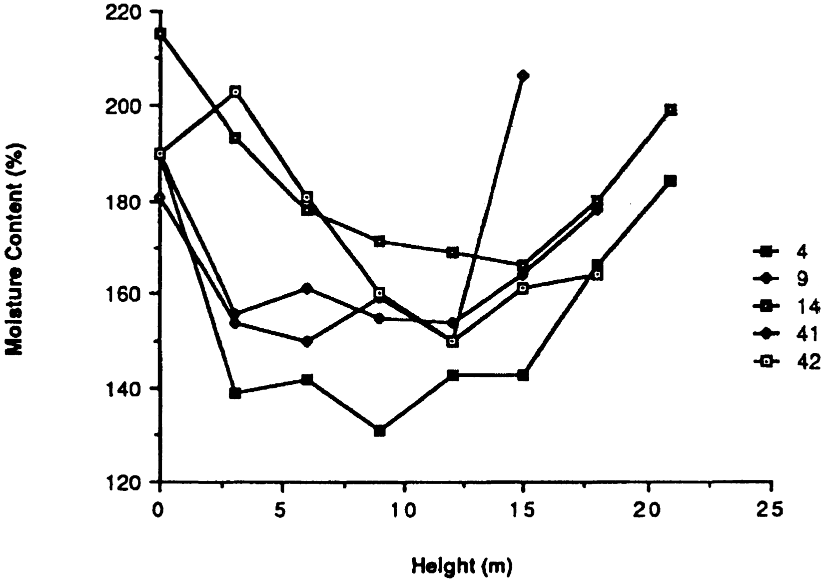

FIG. 3–Disc weighted mean moisture contents (for Camp Huinga trees)

Core samples from breast height were used to examine radial variation of basic density. Average values from CH are shown in Fig. 5. The trend was similar to the variation along the log. Mean basic density of core samples from the 20 CH trees was 327 kg/m^3 (with a range of 276–412 kg/m^3). This was similar to the mean basic density of the five, randomly selected, CH trees felled for further analysis (322 kg/m^3, range 297–348 kg/m^3). It is likely, then, that these trees were indicative of the stand as a whole.

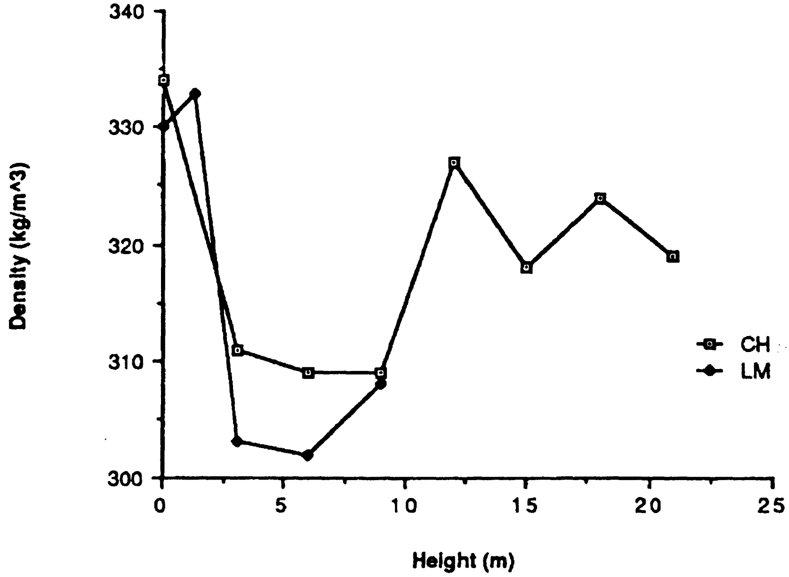

FIG. 4–Disc weighted mean basic densities by sites

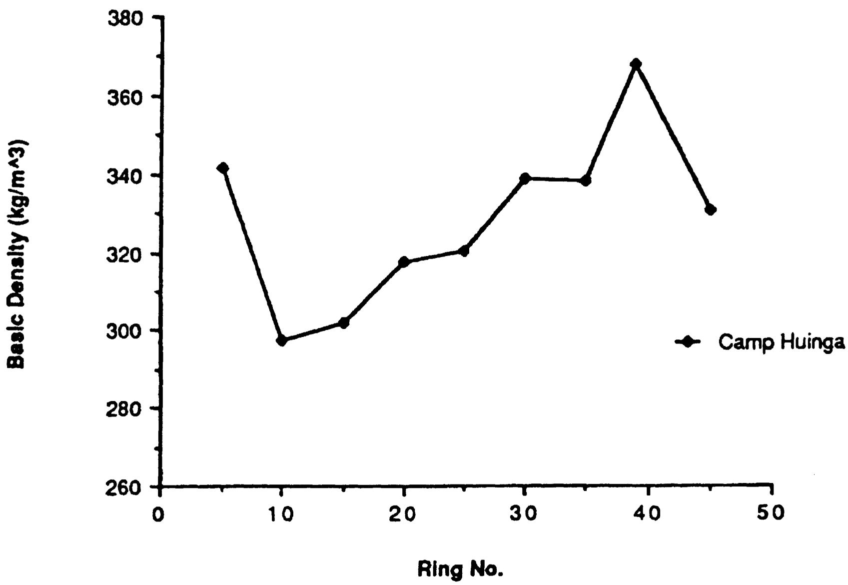

FIG. 5–Basic densities (5-year averages) from core samples of Camp Huinga trees

Dimensional shrinkage is summarised as disc-weighted means in Table 3. There was little variation between trees, and volumetric shrinkage was comparable to those values obtained from the previous disc sections (differing by only 1.2% or less). There was little variation in shrinkage according to radial position, further emphasising the uniformity of this property. The species can be classified as having medium shrinkage.

TABLE 3–Shrinkage of *C. lanceolata* from green to oven dry (at 3.0 m height)

Tree	Dimensional shrinkage (%)			Volumetric shrinkage (%)
	Lon	Rad	Tan	
CH 4	0.13	3.1	6.0	9.2
CH 9	–0.03	3.0	6.4	9.4
CH 14	–0.08	3.5	5.6	9.0
CH 41	0.10	3.2	6.2	9.5
CH 42	–0.06	3.0	5.6	8.5
Mean	0.01	3.2	6.0	9.1

Drying Properties

Drying curves of both kiln-dried and air-dried samples, based on mean moisture contents, are shown in Fig. 6. Times for air- and kiln-drying to 60% m.c. are compared in Table 4. Drying times to lower moisture contents are given for the kiln-dried material only as many air-dried samples had not fallen below 30% (approximate fibre saturation point).

Degrade was estimated visually; two kiln-dried samples showed very slight collapse but this was negligible over the entire sample dimensions. Steaming after drying (reconditioning) is used to recover collapse as steaming can reverse this by causing enlargement in

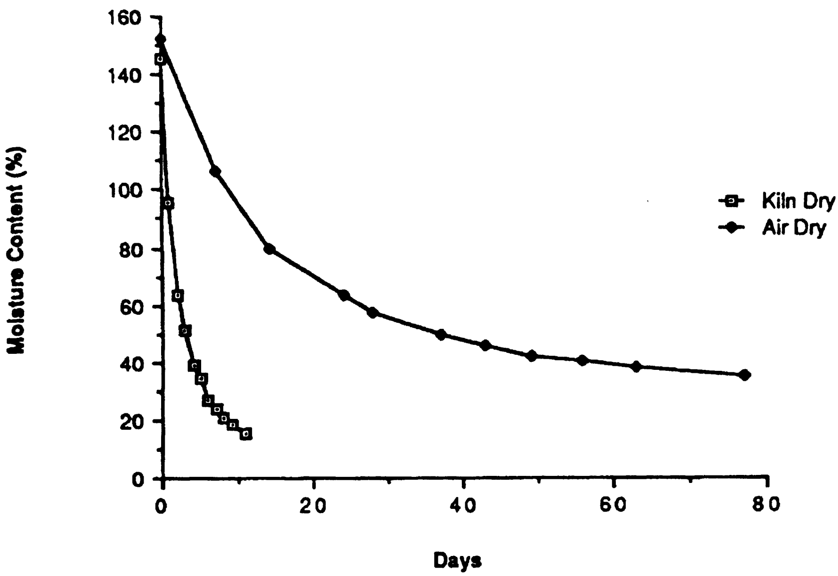

FIG. 6–Drying curves of *C. lanceolata* samples

dimensions. Volumetric shrinkage is given in Table 5 and, where possible, dimensional shrinkage is also shown.

As samples were not truly flat-sawn, only a proportion of them could be measured for dimensional shrinkage. Figures for final shrinkage after reconditioning are also included.

TABLE 4–Days of drying to various moisture contents (24 samples, except for 15% m.c. which had 13 samples)

	60% m.c.		30% m.c.		15% m.c.	
	mean	s.d.	mean	s.d.	mean	s.d.
Kiln drying	2.5	2.6	5.5	2.4	7.0	2.5
Air drying	29.2	19.6				

TABLE 5–Mean shrinkage (%) after drying (t) and after recovery by steaming (r)

Schedule	Vol_t	Rad_t	Tan_t	Vol_r	Rad_r	Tan_r
Kiln drying	5.74	1.89	3.87	5.73	2.12	3.61
Air drying	3.53	1.06	2.75	5.38	1.82	3.60

Mechanical Properties

Mean results of the tests for static bending, compression, and shear are given in Table 6. Because of the small sample size of 36 specimens per test (and 72 for shear), analysis by radial position (or cambial age) or tree side (east or west) was not carried out.

TABLE 6–Mechanical properties of *C. lanceolata* small clear specimens

Test	Samples	Property	Green	Air-dry
Physical properties	36	Basic density (kg/m^3)	315	339
		Nominal density (kg/m^3)	800	385
		Moisture content (%)	154.2	13.6
Static bending	36	MOE (GPa)	6.03	7.43
		MOR (MPa)	38.92	51.00
		FSPL (MPa)	24.57	32.51
Compression (parallel)	36	MCS (MPa)	19.17	28.79
		CSPL (MPa)	17.01	21.06
Shear (parallel)	72	MSS (MPa)	5.66	7.73

DISCUSSION

Comparison With *Pinus radiata* in New Zealand

Comparative data for New Zealand-grown *P. radiata* and *C. lanceolata* are given in Table 7; data for *C. lanceolata* are from CH stand only. In general, *C. lanceola*ta had lower basic and air-dry densities, and lower air-dry mechanical properties than *P. radiata*. Green moisture content was higher for *C. lanceolata* and green MOR was very similar for both species. Dimensional shrinkage was similar for both species and is small in comparison to many other conifer species.

TABLE 7–Comparison of wood properties of New Zealand-grown *P. radiata* and *C. lanceolata*

	P. radiata	*C. lanceolata*
Density (kg/m^3)		
Air-dry	480	385
Basic	400	339
Shrinkage, to 12% m.c. (%)		
Radial	1.9	1.8
Tangential	3.5	3.9
Volumetric	5.8	5.7
Shrinkage, oven dry (%)		
Longitudinal	0.11	0.01
Radial	3.4	3.2
Tangential	6.2	6.0
Volumetric	9.8	9.0
MOE (GPa)		
Green	5.5	6.0
Air-dry	8.1	7.4
MOR (MPa)		
Green	38	39
Air-dry	85	51
FSPL (MPa)		
Green	16	25
Air-dry	41	33
MCS (MPa)		
Green	15.4	19.2
Air-dry	36.7	28.8
MSS (MPa)		
Green	5.2	5.7
Air-dry	11.6	7.8

N.B.: *Pinus radiata* data compiled from Harris (1961, 1986), Clifton (1990), Kininmonth (1974).

Dry *C. lanceolata* is not as strong as *P. radiata* and this is almost certainly due to the much lower basic density of the species. Generally, density is closely correlated with most mechanical properties (Haygreen & Bowyer 1982) and this is true for *C. lanceolata* (Liu 1982). Because of its lower mechanical properties, timber of *C. lanceolata* is not suitable for use in the same dimensions and over the same spans as *P. radiata*. However, in properties such as shrinkage and ease of drying, it is very similar to *P. radiata*.

Comparison With Chinese-grown Trees

New Zealand-grown *C. lanceolata* appears to have lower density and mechanical properties than Chinese-grown *C. lanceolata*. Basic densities of material grown in China and Taiwan range from approximately 300 to 490 kg/m^3 (Ye & Zhang 1987; Chang & Duh 1988; Chen 1962; Chiang 1967; Liu 1982) and *C. konishii*, a Taiwanese species morphologically very similar to *C. lanceolata*, has basic densities of 410 to 450 kg/m^3 (Keating & Bolza 1982). This compares with basic densities of 329 kg/m^3 for Brazilian *C. lanceolata* (de Lelles *et al.* 1978) and 319 kg/m^3 for the Camp Huinga material. This is most likely to be older than the Chinese material, which is usually harvested well before age 58 years (samples examined by Liu (1982) were up to 36 years, and those by Chang & Duh (1988) were 35 years) and hence has a greater density due to more heartwood formation and more dense outerwood. Volumetric shrinkage for New Zealand-grown *C. lanceolata* (Table 3) was slightly greater than the 8.2 % reported by Chen (1962) for Chinese material.

In terms of mechanical strength, Taiwanese *C. lanceolata* has MOE of between 7.5 and 10.3 GPa (Liu 1982) while Chinese material has MOE of 6.6–10.6 (Lin *et al.* 1984), which are comparable to that of *P. radiata* (Table 7). Camp Huinga material had an average MOE of 7.4 GPa, again demonstrating the difference. Comparisons of other properties are given in Table 8. Basic density and MCS are similarly greater in Taiwanese- and Chinese-grown *C. lanceolata* than in the New Plymouth material and comparable to *P.radiata*. Initial spacing and thinning can significantly affect the physical properties of *C. lanceolata*. Tracheid length, ring width, latewood percentage, basic density, and shrinkage were all affected by spacing and thinning according to Xiong (1987); this subsequently affected mechanical properties such as compressive strength, MOR, and MOE. Similarly, mechanical properties MOR, MOE, MCS, and IBS (impact bending strength) are highly correlated with specific gravity; correlation coefficients range from 0.73 to 0.93 (Shi *et al.* 1987). It must be remembered that the wood properties are strictly only indicative of that site (New Plymouth), seed source (unknown), and tending regime, and a broad extrapolation can be made only with caution. However, it appears from these results that New Zealand *C. lanceolata* may well have generally less desirable wood properties than its Chinese/Taiwanese counterparts. In this respect it is similar to species such as *Sequoia sempervirens* and *Pinus taeda* L. (Clifton 1990; Harris 1986; Haygreen & Bowyer 1982).

TABLE 8–Comparison of wood properties of New Zealand-, Chinese-, and Taiwanese-grown *C. lanceolata.*

	Taiwan*	China†	China‡	China§	NZ¶
Density (kg/m^3)					
Air-dry (12% m.c.)	–	310–346	–	296–435	385
Basic	310–400	358–411	295–423	–	339
Shrinkage, to 12% m.c. (%)					
Radial	1.5–1.9	–	–	0.8–1.3	1.8
Tangential	2.6–3.3	–	–	2.0–3.0	3.9
MOE (GPa)					
Air-dry	7.5–10.3	6.6–10.6	–	5.1–9.6	7.4
MCS (MPa)					
Air-dry	28.1–55.4	35.3–43.3	25.4–44.6	24.7–42.6	28.8

* Liu (1982). Values represent range from six plantations.
† Lin *et al.* (1984). Values represent range from six plantations.
‡ Yeh & Chen (1964). Values represent range from three plantations, age 15–36 years.
§ Ko (1958). Values represent range from 16 plantations.
¶ This study. Values from one stand, age 58 years.

From the literature it does not appear that durability tests have been carried out, although the wood is referred to as "durable" (Dallimore & Jackson 1931; Chun 1921) and "moderately durable" (Ko 1958; Chiang 1967). Buried timber (over 200 years) in China has been reported to be in an excellent state of preservation (Chun 1921). *Cunninghamia lanceolata* is used in joinery because of its durability and stability (NZFS 1985). Keating & Bolza (1982) gave a durability rating of 1 (greater than 25 years) for *C. konishii* so it would seem that the heartwood could be used in exterior situations.

Variation Across a Radius and With Height in the Stem

Radial variation in wood properties shows a very clear pattern for green and basic densities. Radial variation at breast height is shown in Fig. 5 and is similar for all other heights sampled in disc sections. The initial high density around the core rapidly drops and then increases towards the outside. Moisture content is not graphed but in all samples there was an increase from the centre of the log to the outside.

It is possible that resin deposition (extractives) occurring at the centre or heart of the tree accounts for the initial high densities, as has been found in other species (Zobel & van Buijtenen 1989), although changes such as earlywood-latewood transition can also account for this. Thereafter, the increase in density is consistent with a change from juvenile to mature wood (Zobel & van Buijtenen 1989; Wang & Tserng 1987). The increase in moisture content away from the pith is probably also due to heartwood formation. Extractives (terpenes, polyphenols, inorganic compounds) content affects densities as heartwood formation around the pith may contain a higher proportion of extractives (Haygreen & Bowyer 1982; Uprichard 1963). In Chinese-grown trees, specific gravity at breast height increased rapidly away from the pith and stabilised at rings 13 to 18 (Ye & Zhang 1987).

Variation with height shows a pattern similar to radial variation. This pattern has also been reported for *Chamaecyparis obtusa* and *Tsuga heterophylla* (Raf.) Sarg. by Zobel & van Buijtenen (1989). The conventional pattern is that of decreasing basic density with increasing height, owing to a greater proportion of juvenile wood; if there is little difference between juvenile and mature wood, there is little change in basic density.

Drying Rates

A comparison with "typical" *P. radiata* drying rates in a conventional (70°/60°C dry/wet bulb temperatures) kiln schedule using 100 × 50 × 600 mm specimens is given in Fig. 7 (data

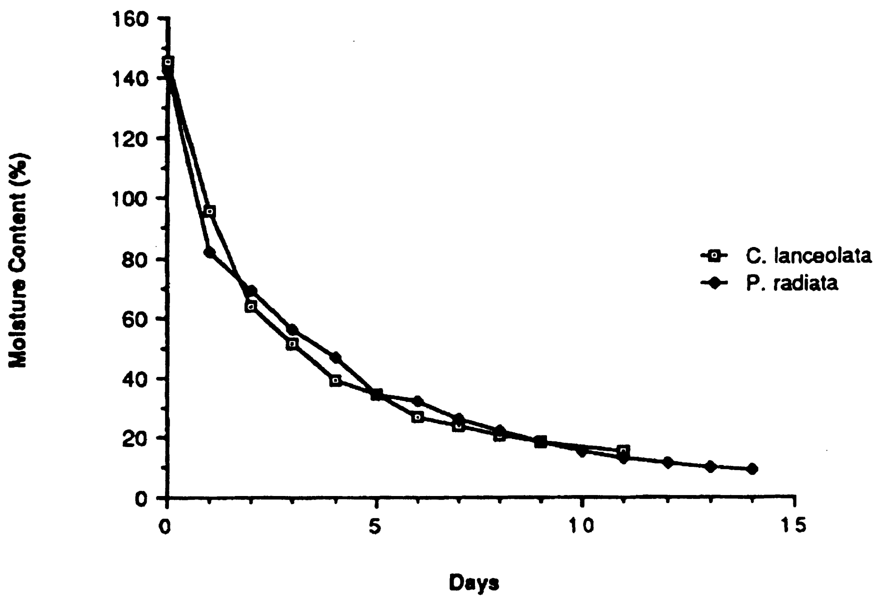

FIG. 7–Drying curves at conventional kiln schedule

from Kininmonth 1974). Drying rates in the conventional schedule were very close to those of *P. radiata*, although the *P. radiata* samples had different dimensions. Drying times for other species are given by way of comparison: untreated *P. radiata* of 50 mm thickness, 4–8 days; untreated pine species with "wet" heartwood, 8–10 days (Kininmonth & Williams 1974). The first *C. lanceolata* samples were dry by day 8 and most were dry by day 11.

Shrinkage (during drying to 12% m.c.) was comparable to *P. radiata* (Table 7). No Chinese data were available, but shrinkage was considered very small by Chiang (1967), and less than *Cryptomeria japonica* and *Taiwania cryptomerioides* (Wang 1989). Drying schedules have been developed in Taiwan including press drying (Jai & Lee 1987; Hsiung 1986). Steaming was carried out to see if recovery was possible in the slightly collapsed samples; all samples were steamed to assess any changes in dimensions (Table 5). As the air-dried samples were still drying, shrinkage was still occurring (as evidenced by small changes in dimensions) and as a result steaming did not produce any recovery. Final results are comparable, however, to those of the kiln-drying schedule, indicating that air-dried samples would have been very near to equilibrium moisture content.

CONCLUSION

Overall, mechanical and physical wood properties of New Zealand-grown *C. lanceolata* were lower than those of native-grown *C. lanceolata*. This is consistent with experience with some other exotic species. The main factor is a lower basic density resulting in reduced strength. Shrinkage, however, appears to be fairly constant. Within-tree variation in physical properties is consistent with other species, although an examination of extractives content would be of further use.

Cunninghamia lanceolata wood is not as dense and correspondingly not as strong as *P. radiata*. Shrinkage is similar for both species and there is little degrade under conventional kiln schedule or air drying. Drying curves were similar to *P. radiata*. It appears that, due to its low basic density, *C. lanceolata* would be unsuitable for heavy structural uses. However, its dimensional stability, ease of drying, and reputed durability would allow it to be used in such applications as weatherboarding, panelling, and joinery.

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