FOREST RESEARCH INSTITUTE
FRI BULLETIN No. 119

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x Cupressocyparis leylandii (Jacks et Dall.) Dall.

Cupressus lusitanica Mill.

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This FRI Bulletin is of particular relevance to tree growers, and wood processors and users.

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PREFACE

This series of booklets details the properties and potential uses of speciality timbers grown in New Zealand. Each booklet discusses one tree species or distinct group of related species under the following headings: The Tree, Wood Properties, Processing, Uses, and Glossary. The first booklet describes briefly the tests conducted, the properties evaluated, and the commercial significance of these properties.

The booklets are based on data obtained over many years of research and they represent work from many sections of the Wood Technology Division of FRI, along with input from Forest Service Utilisation Foresters and representatives of the forest industries.

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ABSTRACT

This booklet summarises the properties and recommended utilisation procedures for the major cypress species grown in New Zealand. It includes information on macrocarpa, lusitanica, Lawson cypress, and Leyland cypress. Apart from difficulties with drying, particularly for macrocarpa, these species are relatively easy to process. The species have similar wood, characterised by an attractive grain, a medium to low density, and more importantly natural durability, low shrinkage, and excellent stability. Cypress wood is highly suitable for use in exterior joinery, weatherboards, and boat-building. Although it is currently used in furniture, the low surface hardness of cypress wood detracts from this use.

KEYWORDS: Cypress, *Chamaecyparis lawsoniana,* X *Cupressocyparis leylandii, Cupressus lusitanica, Cupressus macrocarpa,* wood properties, density, shrinkage, stability, mechanical properties, processing, sawing, drying, machining, uses.

THE CYPRESS GROUP

Natural Distribution and Availability

The cypress group includes *Cupressus, Chamaecyparis,* and several hybrids. It is widely distributed throughout the Mediterranean to the Himalayas and China. Cypresses are capable of growing in a wide range of soil conditions.

The cypress species of major interest in New Zealand are:
Cupressus macrocarpa (macrocarpa) originally from California;
Cupressus lusitanica (lusitanica) originally from Central America;
Chamaecyparis lawsoniana (Lawson cypress) originally from Oregon;
X *Cupressocyparis leylandii* (Leyland cypress) "Leighton green" clones originating from England.

Planting of cypress in New Zealand began in the 1860's; macrocarpa was by far the most common species. Because most of the cypress under private ownership has been planted in small woodlots and shelterbelts, there is no information available on the area of cypress planted privately. In 1981, nearly half of the existing 1585 ha of State Forest cypress plantings was Lawson cypress, the remainder being in macrocarpa and lusitanica. The largest areas of cypress are found in the Auckland, Wellington, and Canterbury conservancies. Apart from lusitanica, there is a major imbalance of age distribution — the bulk of the State resource is over 30 years old.

Less than 25% of the State Forest plantings have received silvicultural tending, which has often been incomplete. Trees from the tended stands generally have acceptable stem form, the major defect being stem fluting. In contrast, since shelterbelts are untended, they consist of over-mature trees with poor form (e.g., trees having multiple-leaders, heavy branching, and stem fluting). However, trees from shelterbelts have provided the bulk of the cypress resource to date and, despite their poor form, enjoy a favourable reputation among sawmillers.

Under the Exotic Special Purpose Species Policy the annual planting target for the cypresses is 670 ha with an emphasis on silvicultural tending. Lusitanica and macrocarpa are the two cypress species nominated for planting in New Zealand.

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TABLE 1: Existing State Forest cypress plantings

Species	Single species (ha)	Mixed species (ha)	Total area (ha)
Lawson	610	211	821
lusitanica	181	135	316
macrocarpa	244	204	448
Total area (ha)	1035	550	1585

Target Tree

To produce the ideal final crop tree or 'target tree' at a reasonable cost, a compromise between stocking and rotation age is required. The target tree for macrocarpa and lusitanica should have a diameter at breast height (d.b.h.) of 60 cm and a height of 30 m. The target tree could be grown in about 40 years at a final crop stocking of 200 stems/ha. Regular thinning and pruning will produce pruned butt logs 5 to 6 m long (Fig.1).

For the second and third logs, intergrown knots are preferred, so branches must remain alive even in old stands. This end can be achieved by early thinning to the final stocking (200 stems/ha). Delaying production thinning, to provide an early return on investment, may jeopardize these objectives and produce smaller trees with bark-encased (dead) knots.

Details on recommended silvicultural regimes may be obtained from Forest Service Advisory Officers.

WOOD PROPERTIES

General Description

The wood of all the cypress species is similar. Because of their yellow-brown colour, fine even texture, and lustre, they are frequently compared to kauri *(Agathis australis)*. Cypress wood has a characteristic odour.

Colours: The narrow (40- to 50-mm-wide) sapwood of all the cypresses is light brown.
In general, all the cypresses have a yellow-brown heartwood with small differences in colour between individual species (Figure 2). The wood of macrocarpa, particularly from over-mature shelter belts, tends to be slightly darker than that of lusitanica. In turn the heartwood of both Lawson and Leyland cypresses are slightly lighter in colour than that of lusitanica.

Grain and Texture: The generally straight grain of cypresses can be adversely affected by grain deviations around large branches (particularly common in open-grown, shelterbelt macrocarpa) or by stem fluting. The wood of the cypresses has a fine even texture with pronounced growth rings and, when quarter sawn, the rays give the wood a lustrous appearance similar to that of kauri. The cypresses have a fragrant, spicy odour.

Density: The wood of the cypress species can be classed as being of medium to low density, slightly below that of radiata pine. There is very little variation in density between trees or within a tree (there is only a slight trend for density to increase with distance from the pith).

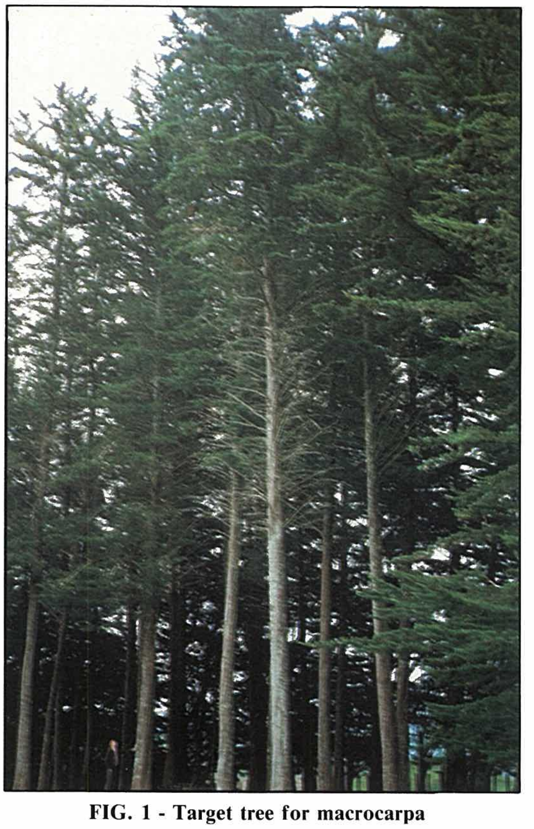

FIG. 1 - Target tree for macrocarpa

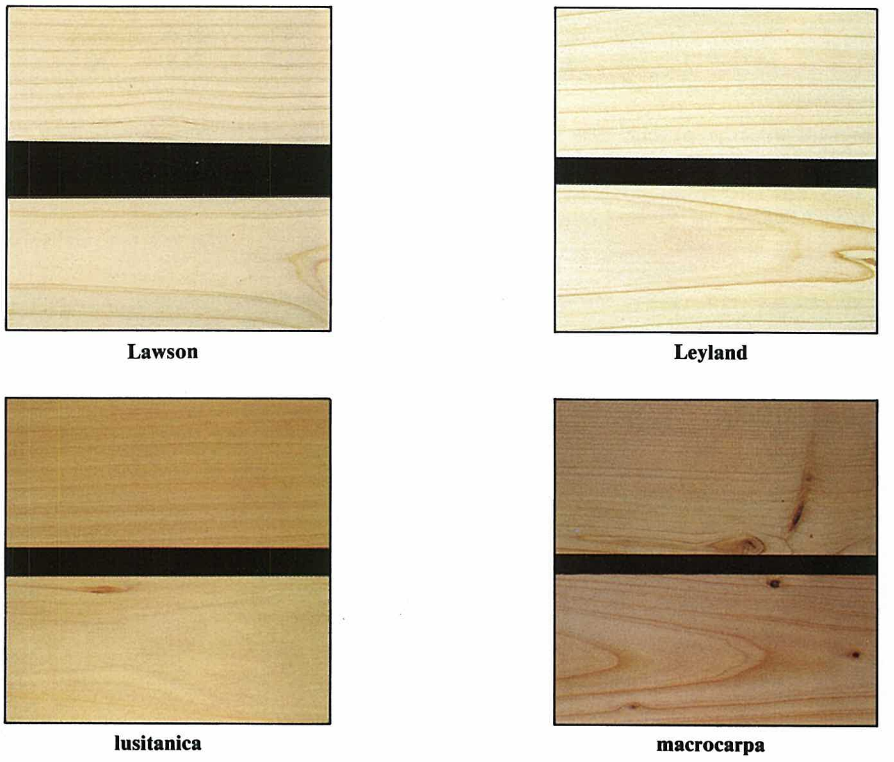

FIG. 2 - Typical heartwood colour and figure of both quarter-sawn (above) and flat-sawn (below) boards of major cypress species

TABLE 2: Density of cypress species (in kg/m^3)

Species	Green	Density Air dry[1]	Basic
Lawson cypress	850	480	400
Leyland cypress	820	495	415
lusitanica	910	460	385
macrocarpa	820	475	405

[1] Air dry = 12% m.c.

Strength

New Zealand-grown Lawson cypress has similar mechanical properties to that of American-grown material — it is lightweight, stiff, and moderately strong with higher bending and compression properties than radiata pine. The other cypresses are similar to radiata pine and kauri in all mechanical properties except for surface hardness values, which are lower in these cypresses.

The low surface hardness of the cypresses discourages their use in furniture but their moderate strength and stiffness suits cypresses for use in boat building and general construction.

TABLE 3: Strength properties of cypresses compared with those of kauri and 30-year-old, medium-density radiata pine

Properties	Modulus of Rupture (MPa)		Modulus of Elasticity (GPa)		Compression parallel (MPa)		Hardness (kN)	
	Green	12%	Green	12%	Green	12%	Green	12%
Lawson cypress[1]	50.0	97.7	8.5	12.1	28.8	37.3	1.8	2.5
Leyland cypress	42.5	85.6	5.5	6.9	19.8	38.0	NA	NA
lusitanica[1]	45.4	69.6	5.5	6.5	24.7	38.0	2.1	2.6
macrocarpa	53.0	74.3	7.1	7.9	23.0	40.3	1.9	2.5
kauri[1]	46.7	88.4	7.2	9.1	21.0	41.3	NA	3.5
radiata pine[2]	38.1	85.8	5.5	8.2	15.4	36.7	2.3	3.6

NA = data not available

[1] Bier, H. 1983: Strength properties of small clear specimens of New Zealand-grown timbers. *New Zealand Forest Service, FRI Bulletin No. 41.*

[2] Walford, G. B. 1985: The mechanical properties of New Zealand-grown Radiata pine for export to Australia. *New Zealand Forest Service, FRI Bulletin No. 93.*

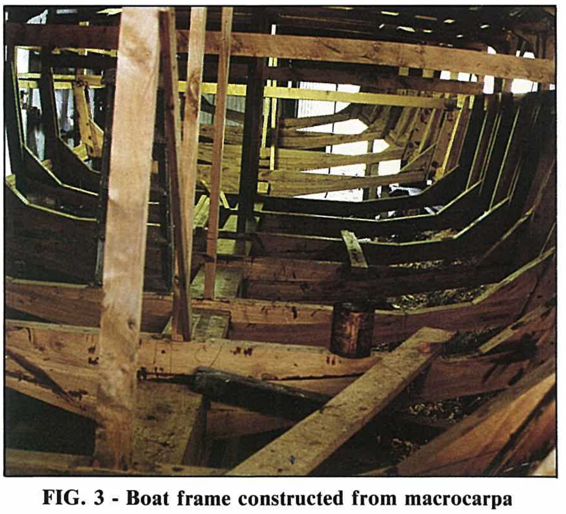

FIG. 3 - Boat frame constructed from macrocarpa

FIG. 4 - Macrocarpa weatherboards

FIG. 5 - Boat planked with macrocarpa

Shrinkage, Dimensional Stability and Related Properties

All the cypress species, particularly lusitanica, have low shrinkage. Shrinkages from green to 12% m.c. are

	Tangential	Radial
Lawson cypress	3.6%	2.2%
Leyland cypress	3.2%	1.4%
lusitanica	2.6%	1.4%
macrocarpa	3.3%	1.6%.

Detailed values on dimensional stability and related properties are not available for either Lawson cypress or Leyland cypress but they are likely to be similar to those of macrocarpa and lusitanica.

Lusitanica and macrocarpa have similar dimensional stability properties. Both have better short- and long-term dimensional stability than radiata pine.

TABLE 4: Dimensional stability (in %) of two cypress species and radiata pine

	Lusitanica	Macrocarpa	Radiata pine
Shrinkage Intersection Point	24.2	25.0	28.7
e.m.c. at 90% RH	18.5	18.5	21.2
e.m.c. at 60% RH	11.9	11.7	12.3
Long-term movement			
tangential movement from 60% RH to 90% RH	1.7	1.4	2.0
radial movement from 60% RH to 90% RH	0.8	0.8	1.0
Short-term movement			
tangential swelling after 24 h at 95% RH	1.4	1.2	2.2
m.c. increase after 24 h at 95% RH	5.1	5.7	7.4

FIG. 6 - Likely end-uses for cypress wood: interior joinery and framing (top left); weatherboards surrounding kauri door (top right); panelling (bottom left); stockyard fencing (bottom right).

PROCESSING

Sawmilling and Grade Recoveries

All the cypresses are easy to saw — they have no growth stress and their timber has no marked blunting properties. Commercial experience has shown that they can be readily sawn on both portable and traditional sawmills with saws and cutting patterns normally used for radiata pine. Logs may be through and through sawn.

Sawn timber grade recoveries from macrocarpa are primarily dependent upon the source of logs. Logs from over-mature, untended shelterbelt trees are typically poor in form, with kinks, eccentricity, fluting, and large branches causing low recoveries, bark enclosures, and large intergrown knots (which in turn cause large areas of cross-grain), respectively.

Full length clearwood production is limited although it is possible to obtain short lengths of clearwood from internodes. While logs from plantation-grown macrocarpa yield a greater proportion of clearwood than those from shelterbelts, the proportion is still not high because the stands seldom receive adequate thinning. Branch diameter and hence knot size are smaller but knots are more frequent in plantation-grown material.

In general the tree form of the other major cypresses is superior to macrocarpa, and sawn timber grade recoveries are less dependent upon log source.

Drying

Macrocarpa is particularly difficult to dry successfully since collapse and internal checking cause substantial degrade. However, there are indications that plantation-grown material is less susceptible to degrade than material from over-mature shelterbelts.

The severity of degrade depends upon the initial drying temperatures; temperatures over 30°C accentuate its occurrence. Even when air dried, over-mature shelterbelt material can suffer from collapse and internal checking. This open-grown material also has large knots and consequently more knot checking and grain deviation (causing warp) than plantation-grown material.

TABLE 5: Recommended kiln schedules for cypress species

Species	Thickness (mm)	Moisture content (%)	Temperature (°C) Dry bulb	Temperature (°C) Wet bulb	Hours final conditioning	Comments
Macrocarpa (shelter-belt-grown)	25	30	54.5	49.0		Shelterbelt macrocarpa must be carefully air dried to reduce collapse and internal checking.
		20	60.0	49.0		
		Condition	65.0	64.0	4	
	50	30	54.5	49.0		
		20	60.0	49.0		
		15	63.0	49.0		
		Condition	68.0	67.0	6	
Macrocarpa (plantation-grown), lusitanica, Leyland cypress	25	green	45.0	40.0		Preferable to air dry to 30% m.c. before kiln drying. Kiln drying will increase collapse and knot checking.
		40	50.0	43.0		
		30	54.5	49.0		
		20	60.0	49.0		
		Condition	65.0	64.0	4	
	50	green	45.0	40.0		
		40	50.0	43.0		
		30	54.5	49.0		
		20	60.0	49.0		
		15	63.0	49.0		
		Condition	68.0	67.0	6	
Lawson cypress	25–50	green to dry	71.0	60.0		
		Condition	75.0	74.0	4-6	

It is recommended that over-mature shelterbelt macrocarpa be carefully air dried down to 30% m.c. in protected stacks prior to final kiln drying. Plantation material may be kiln dried from green if temperatures are kept below 40–45°C for a majority of the drying cycle. Since close control of humidity is also required, dehumidification drying is an ideal method for drying.

Lusitanica and Leyland cypresses are more similar to plantation-grown than shelterbelt-grown macrocarpa. At temperatures below 45°C internal checking is minimal, but other factors such as variability of drying rate and the checking of intergrown knots may make it preferable to air dry to approximately 30% m.c. before kiln drying. After air drying the wood may then be kiln dried at settings of up to 60°C dry bulb, 50°C wet bulb. Warp is not a problem.

Lawson cypress is not prone to either internal checking or collapse when kiln dried from green. It is recommended that Lawson cypress be kiln dried from green at 70°C dry bulb, 60°C wet bulb. Drying according to this schedule will take about four days for 50-mm-thick material.

TABLE 6: Correction figures for an electrical resistance moisture meter calibrated for Douglas fir

If meter reading is	10	11	12	13	14	15	16	17	18	19	20	21	22
average corrected moisture content will be													
lusitanica	11	12	13	14	15	16	16	17	18	19	20	21	22
macrocarpa	11	11	12	13	14	15	16	17	18	18	19	20	21

Durability and Preservation

New Zealand-grown Lawson cypress, lusitanica, and macrocarpa have the most durable heartwood of all the exotic softwoods grown in New Zealand. Their collective moderate durability rating means that they have an expected life of 10–15 years in ground contact situations and well over 15 years in aboveground situations.

No information is available for New Zealand-grown Leyland cypress but overseas sources indicate that the heartwood durability is at least equivalent to that of the other cypresses. The sapwood of all cypresses is perishable.

It is not possible to successfully pressure-treat the heartwood of any of the cypresses with CCA salts. Although their sapwood can be treated with boron salts by the diffusion processs, in practice it is preferable to exclude pieces containing sapwood from exterior uses.

The cypress species are resistant to the common house borer *(Anobium punctatum)* but not to the native two-tooth longhorn beetle *(Ambeodontus tristis).*

Working Properties

There are no major differences in the working properties of the individual cypress species. All are easily worked and machined, provided cutters are kept sharp and free from extractives.

Blunting: Dulls knives more rapidly than radiata pine; can get a build-up of extractives on the knives.
Boring: Generally good but can get chipping at exit.
Nailing: Advisable to pre-drill before nailing.
Planing: A very good finish can be achieved, but some knife dulling results from extractives.
Sanding: Soft, need care in sanding.
Sawing: No problems.
Screwing: No problems.
Spindle moulding: Generally good, but can get some chipping in areas of cross-grain.
Turning: Turns well at high speeds but some chipping in sapwood; cutters must be sharp and kept free of extractive build-up.

Gluing

A variety of glues may be used successfully.

Steam Bending

The cypresses are reputed to have very poor bending properties.

Staining and Polishing

Wipe-on interior stains tend to give a "streaky" appearance. Clear finishes enhance the natural lustre of these species but yellowing occurs with time.

Favourable dimensional stability and recent improvements in exterior oil based stains systems mean that the cypresses have good potential for use in "natural finish" form. The cypresses may also be finished with the traditional paint coat systems.

USES

Because of the fine even texture, lustrous golden colour, and favourable machining properties of cypress wood, it is often compared to that of kauri and, for this reason, is often used for similar purposes (e.g., furniture and turnery). However, the long term performance of furniture manufactured from cypress timber will be adversely affected by its low hardness value (about two-thirds that of kauri and radiata pine). Therefore, the cypresses are not highly recommended as furniture timbers. However the wood of cypresses may be used for knobs, handles, and perhaps panelling and mouldings.

Because cypress wood is durable and stable, it is suitable for a wide range of exterior uses, including exterior joinery, weatherboards and shingles, and boat-building. Recently there has been a trend to use wood with a "natural finish" and the cypresses could be expected to perform well in this area, particularly because of the developments in transparent exterior finishing systems.

The natural durability of cypresses means that these species have been widely used in general construction in a rough-sawn green and untreated form. Farmers who can hire a portable sawmill to cut logs on their property can use the timber without further processing. The timber of the cypresses are approved building species.

TABLE 7: Acceptability of cypresses for various end-uses

Furniture	*	Handles	*
Cabinet-making	**	Knobs	**
Veneers	*	Engineering	*
Turnery	**	Exterior joinery	***
Carving	-	Weatherboards	***
Gun stocks	-	Boat-building	**
Flooring (decorative)	-	Firewood	**
Panelling	***		

- not suitable
* suitable but not preferred
** moderately suitable
*** highly suitable

GLOSSARY OF TERMS

Brittleheart: Wood of abnormal brittleness resulting from *compression failures* caused by *growth stress.* Commonly occurs in the *heartwood* of hardwood species.

Collapse: A flattening or buckling of wood cells during drying resulting in excessive and/or uneven *shrinkage.*

Compression failure: A deformation or fracture of the wood fibres across the grain resulting from excessive compression parallel to the grain, either by direct end-compression or by bending. It appears as a minute fracture, or crinkling of the fibres, and is often difficult to detect until the timber is machined.

Density: The weight per unit volume at a specified *moisture content.*

Durability: The natural ability of a timber to resist decay.

Equilibrium moisture content (e.m.c.): The *moisture content* at which timber neither gains nor loses moisture when exposed to a constant condition of temperature and humidity.

Flat-sawn/sawing: Timber sawn/sawing so that the annual growth rings, as seen on the end-section, form an angle of less than 30 degrees with the board face.

Growth stress: Stress developed in the wood of standing trees. It can lead to the formation of *brittleheart,* end splitting of logs and sawn timber, and warp of sawn timber.

Hardwood: Wood from flowering tree species.

Heartwood: The non-living central zone of the tree. This may contain varying quantities of chemicals, the presence of which can impart a darker colour to the wood.

Kiln: A chamber for drying wood where temperature, humidity, and air circulation can be controlled.

Moisture content (m.c.): The amount of moisture in wood expressed as a percentage of the weight of wood substance.

Quarter-sawn/sawing: Timber sawn/sawing so that the annual growth rings, as seen on the end-section, form an angle of more than 60 degrees with the board face.

Radial direction: The direction along, or close to, a line passing through the pith and across the growth rings to the circumference of a tree or a log.

Sapstain: The discolouration of the *sapwood* by fungi which do not decay the wood. It is sometimes called bluestain because of the characteristic colour of the fungal hyphae.

Sapwood: The outer, living layers of wood in the tree.

Shrinkage: The loss in dimension of wood that occurs when the cell walls lose moisture.

Shrinkage Intersection Point (SIP): The *moisture content* at which if any further moisture is removed then *shrinkage* will occur.

Silviculture: The growing and tending of forests.

Softwood: Wood from coniferous tree species.

Stability: The degree to which timber retains its shape and size despite changing environmental conditions (commonly referred to as ''dimensional stability'').

Tangential direction: The direction along (parallel to) the growth rings on the end-grain.

Tension wood: Abnormal wood formed in leaning or crooked stems of a *hardwood.* When sawn it often gives a woolly surface. It has abnormally high longitudinal shrinkage.

Through and through sawing: Sawing logs by making a number of consecutive cuts parallel to each other and in the same plane as the longitudinal axis.

ABBREVIATIONS

e.m.c.	equilibrium moisture content
m.c.	moisture content
MPa	megapascal
GPa	gigapascal
kN	kilonewtons
SIP	shrinkage intersection point
RH	relative humidity