NEW ZEALAND FOREST RESEARCH INSTITUTE
FRI BULLETIN No.124

INTRODUCED FOREST TREES IN NEW ZEALAND: RECOGNITION, ROLE, AND SEED SOURCE

9. The cypresses (third edition)

***Cupressus* spp.**
***Chamaecyparis* spp.**

J.T. MILLER and F.B. KNOWLES

This FRI bulletin series was compiled for people with an interest in the introduced trees of New Zealand, such as foresters, farm foresters, nurserymen, and students. It includes:

1. *Pinus nigra* Arn. — European black pine
2. *Pinus contorta* Loudon — contorta pine
3. The larches — *Larix decidua* Miller, *Larix kaempferi* (Lambert) Carr., *Larix* x *eurolepis* A. Henry
4. *Pinus mugo* Turra — dwarf mountain pine; *Pinus uncinata* Mirbel — mountain pine
5. *Pinus attenuata* Lemmon — knobcone pine
6. The spruces — *Picea sitchensis* (Bong.) Carrière, *Picea abies* (L.) Karsten, ornamental spruces
7. The silver firs — *Abies* spp.
8. *Pinus pinaster* Aiton — maritime pine
9. The cypresses — *Cupressus* spp.; *Chamaecyparis* spp.
10. Ponderosa and Jeffrey Pines — *Pinus ponderosa* P. Lawson et Lawson, *Pinus jeffreyi* Grev. et Balf.
11. *Eucalyptus nitens* (Deane et Maiden) Maiden
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14. Douglas-fir — *Pseudotsuga menziesii* (Mirbel) Franco
15. The Willows – *Salix* species

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Cupressus spp.
Chamaecyparis spp.

J.T. Miller and F.B. Knowles

Third Edition

NEW ZEALAND
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OPPOSITE: ***Cupressus macrocarpa seed stand*** **aged 21-23 years, Lismore Forest, Taranaki.**

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CONTENTS

Abstract 1

Introduction and History
- Natural Distribution 1
- Introduction into New Zealand 2
- Hybrids 2
- Variation 5
- Genetic Improvement 6
- Pests and Diseases 6

Recognition
- General Description of *Cupressus* and *Chamaecyparis* 8
- Differences Between *Cupressus* and *Chamaecyparis* 8
- Less Common *Cupressus* Species 9
- Leyland Cypress 9
- Recognition of the More Common *Cupressus* Species in New Zealand 12
- Recognition of *Chamaecyparis* Species in New Zealand 14

Role of the Species
- Status of the Resource 18
- Cultivation of Cypresses 19
- Growth and Yield 22
- Uses 24
- The Wood 24
- Future Role of Major Cypress Species 26
- Future Role of Other Cypresses 27
- Vegetative Propagation 28
- Seed and Regeneration 28

Seed Users' Guide
- A. Collection and Extraction of Cypress Seed 29
- B. Nursery Practice 30
- C. Recommended Seed Sources 31

References and Further Reading 32

Acknowledgements 33

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ABSTRACT

This booklet, the ninth in the Bulletin No. 124 series, provides a general account of the cypresses in New Zealand, principally *Cupressus macrocarpa*, *Cupressus lusitanica* and *Chamaecyparis lawsoniana*. It discusses their introduction, history and role as exotic forest species, their recognition in the field, and the location and quality of current local seed sources.

KEYWORDS: *Cupressus macrocarpa*, *Cupressus lusitanica*, *Chamaecyparis lawsoniana*, cypresses, Leyland cypress, seed sources, taxonomy, provenance trials, New Zealand.

INTRODUCTION AND HISTORY

The cypresses are evergreen coniferous trees belonging to the closely allied genera *Cupressus* and *Chamaecyparis*, members of the family *Cupressaceae*. The true cypresses, belonging to the genus *Cupressus*, number about 20 species, at least 11 of which are represented in New Zealand. Of these, only *C.** *macrocarpa* (macrocarpa) and *C. lusitanica* (lusitanica) have any commercial significance, although *C. arizonica* (Arizona cypress) and *C. torulosa* (West Himalayan cypress) have a minor role as shelter species. Seven species, all present in New Zealand, are currently recognised in *Chamaecyparis*; *Chamaecyparis lawsoniana* (Lawson cypress) is the most frequently encountered and best known of these. Cypress hybrids are potentially significant in New Zealand as shelter and timber species; they include hybrids between *Cupressus* and *Chamaecyparis*, of which Leyland cypress (x *Cupressocyparis leylandii*) is the most familiar.

Natural Distribution

Cypresses grow naturally only in the Northern Hemisphere, occurring in North America, the Mediterranean basin, the Himalayas, China and Japan. *Cupressus* is found in warm temperate regions of the Northern Hemisphere; in the Old World from the Atlantic coast of North Africa to China, and in the New World in western and central North America, Mexico, Guatemala, and Honduras. *Chamaecyparis* occurs mainly in countries which border the Pacific Ocean, including Japan, Taiwan, and western North America. Exceptions are *Ch. thyoides* (Atlantic white cypress) which grows in the Atlantic and Gulf states of the U.S.A., and *Ch. funebris* (Chinese weeping cypress) from central China.

Although some cypresses inhabit cool or arid regions, most are associated with moist, mild climates. They occur from sea level to elevations exceeding 3000 m. They may form pure stands, as *C. arizonica* does occasionally, or they may occur as components of mixed forest, as does *Ch. lawsoniana*, which associates freely over most of its range with other species, including *Pseudotsuga menziesii*, *Picea sitchensis*, *Tsuga heterophylla* and *Thuja plicata*. Their natural ranges may be extensive, as in *Ch. thyoides*, which extends through 20 degrees of latitude on the east coast of North America, and *Ch. nootkatensis* (Nootka cypress) which covers 35 degrees on the west coast. On the other hand, they may be sharply restricted by soil or moisture requirements, as happens with about a dozen species of *Cupressus* scattered over California, neighbouring states of the U.S.A., and Baja California in Mexico.

Cupressus macrocarpa arguably has the most restricted range of any conifer in the world, being found only in two groves occupying about 30 ha on the shores of Carmel Bay, at Monterey, California. *Cupressus lusitanica*, however, is widely spread, being endemic to parts

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* For clarity in this bulletin *Cupressus* is abbreviated to *C.* and *Chamaecyparis* to *Ch.*

of central and southern Mexico and the highlands of Guatemala, reaching into Honduras. It grows at elevations of 1200–3000 m, in isolated pockets rather than continuous stands, usually on moist slopes or near streams. *Cupressus arizonica* is native to Arizona and northern Mexico, occurring mostly at altitudes of 1500–1800 m as small (5–100 ha) pure stands or in mixture with *Juniperus*, *Quercus* or *Pinus* species. *Cupressus torulosa* is found naturally in the outer ranges of the western Himalayas, where it usually grows on limestone at 1500–2700 m elevation. *Chamaecyparis lawsoniana* is compactly distributed in western parts of south Oregon and north California, where it occurs from low altitudes to 1950 m a.s.l.

The natural distributions of *C. macrocarpa*, *C. lusitanica*, and *Ch. lawsoniana* are shown in Figure 1.

Introduction into New Zealand

Most of the cypresses commonly encountered in New Zealand were first introduced during the 1860s. Addressing the New Zealand Institute in 1868, A. Ludlam reported the presence of *C. lusitanica*, *C. macrocarpa*, *C. sempervirens*, *C. torulosa* and *Ch. lawsoniana*, together with two minor species, *C. macnabiana* and *Ch. funebris*. Other species followed gradually; *Ch. obtusa* was in cultivation by 1871, and *Ch. thyoides* and *C. goveniana* were present by 1879. A relatively early introduction date for *C. cashmeriana* and *Ch. pisifera* may be deduced from records of local seed collections made from these species by the Forest Service between 1936 and 1948. The early presence of *C. arizonica* in New Zealand is indicated by records of seed collection (1.8 kg) from the Dunedin Botanic Gardens in 1936. This species was re-introduced via Canberra by Professor E.R. Hudson of Lincoln College in the late 1930s, after which plants were released in Canterbury and elsewhere. In the last 10 years seed of some less common species has been imported, including *C. duclouxiana* from China.

Cupressus macrocarpa, recorded as being in New Zealand by 1864, was probably the first cypress species to be introduced. Between 1869 and 1876 at least 6 kg of *C. macrocarpa* seed were obtained from Californian suppliers and distributed to growers in both islands. Seedlings were planted in Canterbury by the Selwyn Plantation Board in 1883, at Raincliff Forest in South Canterbury in 1890, and in State forests in the Rotorua district in about 1905.

Seed of *C. lusitanica* was imported and distributed in the 1860s, after which little use was made of the species until 1938 when a small planting of trees from a seed source at Milan, Italy, was made at Waipoua Forest. Between 1964 and 1969, however, 42 kg of seed were imported by the Forest Service from sources in Kenya and Guatemala, contributing to modest plantings made in the 1970s around Rotorua and Hawke's Bay.

Chamaecyparis lawsoniana has a similar history to *C. macrocarpa*, being first introduced in 1866, with subsequent seed imports from California (at least 2 kg) between 1870 and 1875. It was planted in Canterbury by the Selwyn Plantation Board in 1883, at Raincliff Forest in Canterbury in 1890, and in State forests in the Rotorua district in 1901, although sizeable plantings were not made until 1928. No further seed imports of either species appear to have been made during the long period from 1876 to 1983, after which further seed of *C. macrocarpa* was imported to help initiate a breeding programme. However, both species were so widely planted on farms that they have become a customary feature of the New Zealand landscape (Figures 6 and 9). Much of this planting was done during the 1930s, using seedlings supplied by the State Forest Service.

Hybrids

Different species of *Cupressus* and *Chamaecyparis* are rarely associated in the wild, providing little opportunity for natural hybridisation. However, morphological "intermediates"

have been reported between *C. lusitanica* and *C. arizonica*, and between *C. macnabiana* and *C. sargentii* where these pairs of species occur together in Mexico and California respectively, but evidence of hybridisation is inconclusive.

Interspecific hybrids and backcrosses between *C. macrocarpa* and *C. lusitanica*, and *C. macrocarpa* and *C. arizonica*, have arisen spontaneously in cultivation These species have also been crossed artificially. *Cupressus torulosa* was crossed with *C. arizonica* by Professor L.D. Pryor in Canberra about 1948.

Some macrocarpa plantings made in Southland and Otago over the last 30 years contain trees showing features atypical of the species. These include precocious flowering (at ages 2–4), unusually small cones (c. 10 mm in diameter), and narrow upswept crowns. These features suggest hybridisation with other *Cupressus* species (D. A. Franklin, pers. comm.).

Several intergeneric hybrids between *Chamaecyparis* and *Cupressus*, including the well-known Leyland cypress, have arisen in cultivation in the United Kingdom. They have been introduced into New Zealand as clonal material, and most are propagated under official cultivar names (Table 1).

TABLE 1: Hybrid cypress clones [1]

Hybrid name	Parent species	Cultivar name or clone number	Date introduced to New Zealand
x *Cupressocyparis leylandii* Leyland cypress	*Cupressus macrocarpa* x *Chamaecyparis nootkatensis*		
		'Leighton Green'	1952
		'Naylor's Blue'	1962
		'Green Spire'	1963
		'Haggerston Grey'	1963
		'Rostrevor'	1985
		Stapehill clone 20 – 'Stapehill'	1989
		Stapehill clone 21 – 'Ferndown'	1989
x *Cupressocyparis ovensii* Ovens' cypress	*Cupressus lusitanica* x *Chamaecyparis nootkatensis*		1978
x *Cupressocyparis notabilis* Alice Holt cypress	*Cupressus arizonica* var. *glabra* x *Chamaecyparis nootkatensis*		1978
x *Cupressocyparis* sp.	Uncertain (probably *Cupressus arizonica* var.*glabra* x *Chamaecyparis nootkatensis*)	FRI 850/329 [2]	–

[1] Excluding numbered U.K.clones which have not received cultivar names and ornamental Leyland cypress clones, e.g., 'Castlewellan Gold', 'Robinson's Gold', 'Silver Dust', etc., *see* Sturrock (1989).

[2] Initially referred to as "Arilosa cypress". Now referred to only under FRI clonal number pending clarification of parentage.

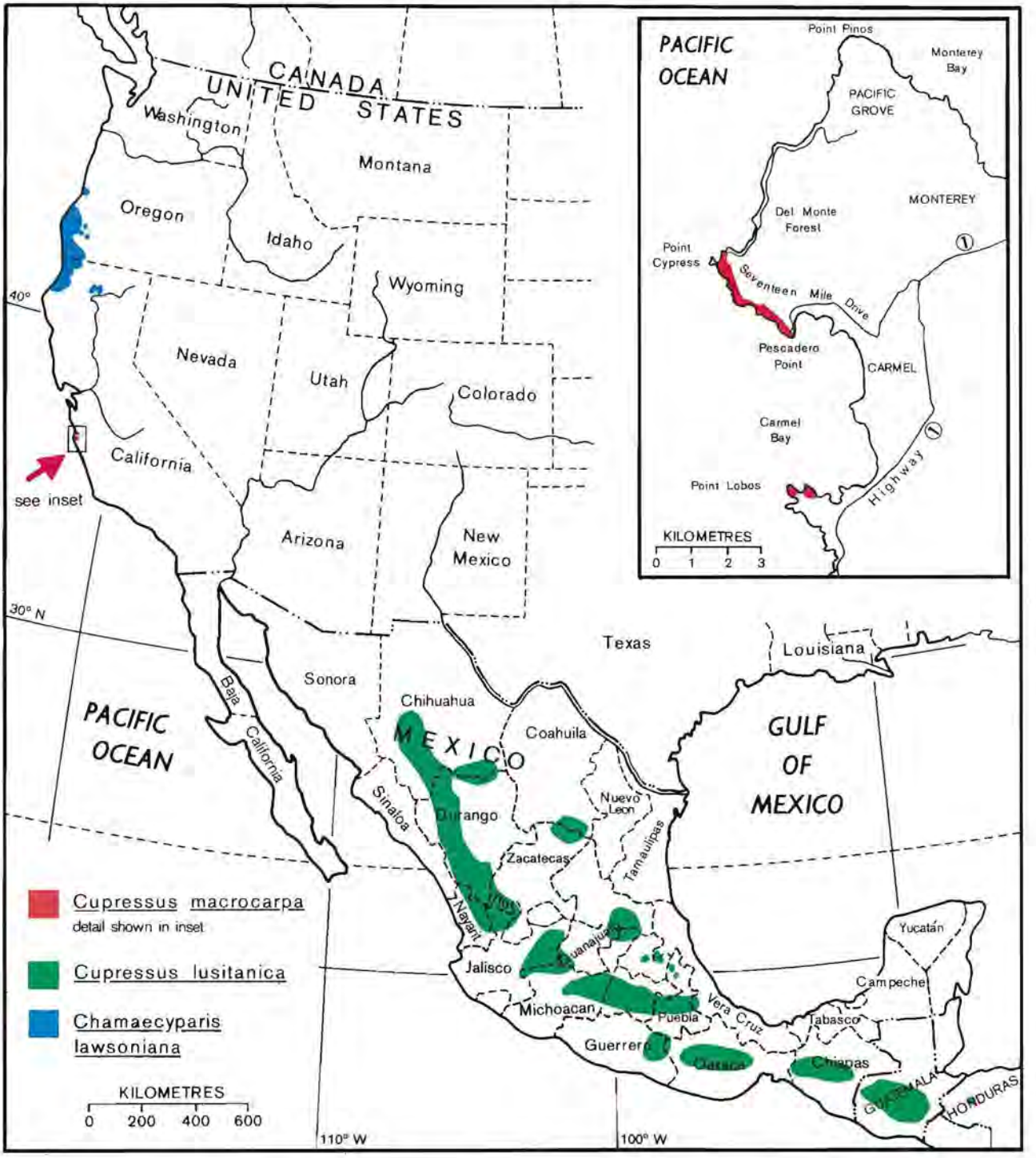

Fig. 1 — Natural distribution of *Cupressus macrocarpa* (based on Little,1971, and Griffin and Critchfield,1972); *Cupressus lusitanica (based on Martinez,1963); and *Chamaecyparis lawsoniana* (based on Little,1971).**

*** The extent of the natural distribution of *C. lusitanica* in Guatemala and Honduras is unclear, however it is thought to be native to much of the area in central and southwestern Guatemala between 2,700 m and 3,700 m (Martinez,1963) and to the summit of Cerro Santa Barbara in northwest Honduras (Little,1970).**

Variation

A high degree of tree-to-tree variation is often a feature of cypresses (Fig. 2). In *C. macrocarpa* and *C. lusitanica*, stem, branch, and foliage characteristics may be highly variable; in the case of macrocarpa, this variability in habit is all the more remarkable considering its minuscule natural range. Extreme variability in *C. lusitanica* over its extensive natural range has, in the past, contributed to confusion in its taxonomy. In particular, two Mexican forms, *C. lindleyi* and *C. benthamii*, have been variously regarded as separate species, as subspecies of *C. lusitanica*, and as varieties of this species. A. Ludlam recorded trees under two early synonyms of *C. benthamii* (*C. thurifera* and *C. uhdeana*) growing at Wellington in 1868, and T. Mason (1896) included *C. benthamii* in trees named at "The Gums", Taita. During the 1940s and 1950s "Bentham's cypress" was widely recommended as a shelter species on account of it being reputedly more tolerant of moist soils than *Ch. lawsoniana*.

Between 1928 and 1967 the Forest Service collected 146 kg of seed of *C. lusitanica*, some of which was named as Bentham's cypress, from several local seed sources. Some of the seed produced very uneven crops of seedlings. Subsequently, many shelterbelts and some plantations established from these seedlings were found to contain a bewildering range of forms, some very inferior to true *C. lusitanica* from the seed source at Waipoua Forest or from seed imported from Kenyan sources in the 1960s. This has clearly demonstrated the need for careful identification of seed sources of *C. lusitanica* in particular and of cypresses in general.

Following its re-introduction into New Zealand in the 1930s, *C. arizonica* also produced very variable seedlings in the nursery. Some subsequent outplantings of this species have shown well-formed uniform trees while others have shown much variation in foliage, branching, and general habit. The seed for this re-introduction was imported from Australia but nothing is known of its American ancestry.

Chamaecyparis lawsoniana in New Zealand is of unknown provenance. Although renowned among horticulturists for its capacity to produce diverse forms and varieties, it presents a generally uniform appearance in New Zealand plantations. Height growth, however, is often severely reduced on wet, dry or shallow soils, or on exposed sites.

Fig. 2 – *Cupressus macrocarpa* aged 5 years, FRI nursery, Rotorua. Each row was raised from seed collected from a different individual parent tree.

Genetic Improvement

The first step towards genetic improvement of cypresses in New Zealand was to stabilise the quality of locally collected seed. Seed stands of *C. macrocarpa*, *C. lusitanica* and *C. torulosa* were developed in 1981-1983. In *C. macrocarpa* and *C. torulosa* these were selected for superior form, while seed stands of *C. lusitanica* were confined to the reliable "Waipoua" strain, and commercially reputable provenances of Kenyan origin (*see* Seed Users' Guide— p. 31).

In 1983 programmes for further genetic improvement of *C. macrocarpa* and *C. lusitanica* were initiated. For *C. macrocarpa*, this involved collecting seedlots from 157 trees distributed throughout the natural stands in California which were pooled with seedlots from 88 trees selected for superior quality in New Zealand plantations and shelterbelts. For *C. lusitanica*, 24 family seedlots were imported from trees in current improvement programmes in Kenya and Colombia, and added to those from 85 trees selected in New Zealand. Four *C. lusitanica* seedlots from central America were also included. Stock raised from this seed was planted out in progeny tests in 1984 (*C. lusitanica*) and 1985 (*C. macrocarpa*) at two sites per species. Potential seed stands, or additional gene resources, were established with surplus plants.

The most vigorous *C. macrocarpa* and *C. lusitanica* progenies in the trials are rapidly approaching a size at which they can be effectively assessed. After assessment, options for future improvement of both species include the formation of seed orchards and use of vegetative propagation.

In 1985 and 1986 small supporting trials were established at one North Island and three South Island sites to compare the performance of *C. macrocarpa*, *C. lusitanica*, and *Ch. lawsoniana*. At Ashley Forest in Canterbury *Cupressus arizonica* and *C. duclouxiana* were included in these trials, and *C. guadalupensis*, *Ch. funebris* and *Ch. nootkatensis* were included at Gwavas Forest in Hawke's Bay. Additionally, clonal tests of hybrid cypresses — including Ovens', Alice Holt, and five Leyland cypress clones — were planted by the Forest Research Institute, at Rotoehu in 1981 and at Gwavas in 1985.

In 1983 a series of tests, which included Ovens', Alice Holt and six Leyland cypress clones, was established at eight South Island sites by the DSIR, Lincoln, in cooperation with the NZ Farm Forestry Association. At the first evaluation of these tests (Sturrock *et al.*, 1986) at the close of the third growing season, trees were 1.4–2.0 m high, in good health, and showing prospects of useful variation in habit and adaptability to site.

Pests and Diseases

The most significant disease of cypresses in New Zealand is cypress canker. Two fungi, *Seiridium cardinale* and *S. unicornis*, are responsible and give rise to identical symptoms. These include resin bleeding and bark discolouration, usually followed by distorted growth of the cambium, forming the easily recognised cankers (Figures 3 and 4). Cankers may spread and girdle the stem or branches causing weakening, dieback, or breakage; and secondary fungal and insect attacks may follow at the canker site. The fungal spores are dispersed either in running water or by splash droplets, and infection is usually through bark wounds incurred by natural cracking, as in branch axils, or by insect chewing or pruning cuts. Cypress canker affects at least 5 cypress species in New Zealand (*C. macrocarpa*, *C. lusitanica*, *C. arizonica*, *C. torulosa* and *Ch. lawsoniana*) and has also been recorded on *Calocedrus decurrens* and *Thuja orientalis*. Although widespread, it is generally more apparent in shelterbelts than in plantations, probably because of their greater exposure to damage and stress. Both *C. macrocarpa* and *C. lusitanica* appear susceptible to infection by *S. cardinale*, the more common pathogen, but relatively resistant to *S. unicornis*. *Chamaecyparis lawsoniana* on the other hand is more susceptible to *S. unicornis*. Overall, *S. cardinale* is more common, but *S. unicornis* remains significant because of its presence in the widely planted *Ch. lawsoniana*.

One of the first questions often asked by prospective growers of cypress concerns the economic significance of cypress canker in New Zealand. At present, the disease, though locally obvious, does not create a general threat to productivity or timber quality. However, the situation could change if planting rates increase, and especially if *C. macrocarpa* and *C. lusitanica* are planted on sites where stress and slow growth rates predispose trees to attack.

A root-rot fungus, *Phytophthora lateralis*, which invaded natural stands of *Ch. lawsoniana* in California and Oregon before 1950, has killed trees on a wide scale and no effective treatment has yet been found. This fungus has not been recorded on cypresses in New Zealand, but it was found on kiwifruit (*Actinidia deliciosa*) in 1982, highlighting the need for vigilance.

A range of insects and their larvae has been found in dead or decaying cypress wood on the forest floor (e.g., termites), but few attack living cypresses. Among those that do are the cypress bark beetle (*Phloeosinus cupressi*) which breeds under the bark of dead and dying trees but emerges to bore into small twigs, causing death of foliage and breakage of twigs. Species attacked include *C. macrocarpa*, *C. arizonica*, *C. lusitanica*, and *C. torulosa*. Although the killing of terminal twigs may temporarily disfigure ornamental trees, they soon recover, and the insect is of only minor importance. Larvae of the native two-toothed longhorn beetle (*Ambeodontus tristis*) bore in softwoods, including *C. macrocarpa* and *Ch. lawsoniana*. The heartwood of living trees may be attacked if access can be gained through logging wounds or dead branch stubs, and timber containing undetected larvae may constitute a source of further infestation. Clean and timely pruning would seem to be the best insurance against attack. Another native longhorn beetle, the lemon-tree borer (*Oemona hirta*), is occasionally found in cypresses. Emergence holes, about 6 mm in diameter, may constitute a defect in finished timber. An aphid, *Cinara fresai*, may occasionally damage *C. macrocarpa* foliage.

Fig. 3 – *Cupressus macrocarpa* infected with *Seiridium unicornis* showing lesion and bark discolouration, Fielding Nursery.

Fig. 4 – Canker caused by *Seiridium unicornis* on *C. lusitanica*, Mangatu Forest, Gisborne.

RECOGNITION

General Description of *Cupressus* and *Chamaecyparis*

Habit: Evergreen trees, occasionally shrubs, conical or spreading with drooping, ascending or spreading branches.

Bark: Usually shallowly fissured and stringy. In some species, smooth and becoming scaly.

Foliage: Seedling and juvenile leaves very different from adult leaves, needle-like, up to 8 mm long. Adult leaves small, hard, scale-like, closely pressed to the branchlets, rounded to pointed at the tip, often with a central resin-secreting gland. Leaves arranged in two opposite pairs, forming four rows.

Branchlets: Encased in leaves, rounded or 4-angled, finely divided. In *Cupressus* usually radiating at various angles (Table 2); end branchlets occasionally flattened on one plane. In *Chamaecyparis*, arranged in flattened frond-like systems, usually in one plane (Table 3).

Male cones: Usually appearing during autumn and winter at the tips of branchlets (Tables 2 and 3), small, ovoid to oblong, usually yellow, occasionally pink, red or brown.

Female cones: On short stalks, more or less globose. Yellow, green or bluish white when young, becoming brown, occasionally with 4 but usually 6–12 scales, each scale with a raised central projection or umbo. In *Cupressus*, usually 15–35 mm across, woody when mature, taking 2 years to ripen and often remaining on the tree for many years. In *Chamaecyparis*, small, scarcely woody, ripening in the first year except for *Ch. nootkatensis* and *Ch. funebris*, which take 2 years to ripen.

Seeds: Circular to oblong, broadly to narrowly winged, released by the separating of cone scales. In *Cupressus*, 6–20 per fertile scale; in *Chamaecyparis*, usually 2–4 (occasionally 1 and rarely up to 5) per scale.

Differences Between *Cupressus* and *Chamaecyparis*

The distinction between *Cupressus* and *Chamaecyparis* is not entirely clear-cut, with at least one species (*Ch. funebris*) regarded by some taxonomists as belonging to *Chamaecyparis* and by others to *Cupressus*. Generally recognised distinguishing features are summarised below:

	Cupressus	***Chamaecyparis***
Branchlet arrangement	Radiating at various angles.	Flattened into frond-like systems usually on one plane.
Female cones	15–35 mm across.	5–15 mm across (up to 20 mm in *Ch. funebris*).
	Taking 2 years to ripen	Ripening in the 1st year except for *Ch. nootkatensis* and *Ch. funebris* which take 2 years.
Seeds	6–20 per fertile scale	Usually 2–4 (occasionally 1–5) per fertile scale.

Botanical details of the *Cupressus* species commonly found in New Zealand are summarised on pages 12 to 13. All of the currently recognised *Chamaecyparis* species occur in New Zealand; these are described on pages 14 to 15.

Less Common *Cupressus* Species

Less common species encountered in parks, arboreta and private collections include the Californian species *C. goveniana* Gordon and *C. sargentii* Jepson. Both are shrubs or small trees in the wild. *Cupressus goveniana*, closely related to *C. macrocarpa*, has slender, bright green branchlets, cones 10–15 mm in diameter, and dull dark-brown to nearly black seeds 3–4 mm wide. *Cupressus sargentii* has dull green to grey-green foliage, cones from 15 mm to at least 30 mm in diameter and large glaucous seeds up to 5–6 mm in diameter.

Cupressus duclouxiana Camus, from China, is an attractive species with very slender bright green or blue-green branchlets and cones 20–25 mm in diameter.

The extremely ornamental tree commonly known as *C. cashmeriana* Carrière (Fig. 11) is of uncertain botanical status. It has leaves intermediate between the juvenile and adult states of other cypresses and is considered by some taxonomists to be a fixed juvenile form of *C. torulosa*. Drooping grey-green branches and extremely pendulous branchlets give it a very distinctive appearance. Cones are mostly 13–15 mm in diameter.

Cupressus guadalupensis Watson, from California and Mexico, has a distinctive ovoid habit in New Zealand, multi-stemmed from the base with twiggy, upswept branches, glaucous foliage and distinctive flaky dark red-purple bark. Cones have not been recorded on this species in New Zealand.

Leyland Cypress

The intergeneric hybrid, Leyland cypress [x *Cupressocyparis leylandii* (A.B. Jackson et Dallimore) Dallimore] was first raised by J.M. Naylor in 1888 from seed of *C. macrocarpa* growing near a stand of *Ch. nootkatensis* at Leighton Hall, Welshpool, Wales, and again in 1911 from seed from *C. macrocarpa* in the same locality. A number of clones showing differences in habit, foliage colour and ease of propagation from cuttings, have been named. Leyland cypress grows to a tall tree, 30 m or more in height. In Britain it attains a dense, narrow, conical to columnar crown, with upswept branches (Ovens *et al.*, 1964). In New Zealand the tree is usually more spreading, with larger branch diameters. As well, it shows plasticity of habit over different sites, from a broad columnar form to a more open, loose and less dense form. The leaves are similar in size, arrangement and form to those of *Ch. nootkatensis* but the branchlets are finer, longer and more slender. Foliage colour varies from grey-green, as in 'Haggerston Grey', to blue-green, as in 'Naylor's Blue, to the bright green of 'Leighton Green' and 'Green Spire'. Cones are uncommon in Leyland cypress except in the 'Leighton Green' clone. They are up to 20 mm across, mostly with eight scales, and almost invariably the seeds are warty on the surface like those of *C. macrocarpa*. The seeds of Leyland cypress are almost always infertile.

Fig. 5 - *Chamaecyparis nootkatensis*, one of the parent species of Leyland cypress.

Fig. 6 – *Cupressus macrocarpa*, Eskdale, Napier.

Fig. 7 – Shelterbelt of Leyland cypress, aged 10 years, Waioeka Gorge.

Fig. 8 – *Cupressus lusitanica* aged 52 years, mean d.b.h. 50cm, mean top height 27m, Whakarewarewa Forest, Rotorua.

Fig. 9 – A good shelterbelt of *Chamaecyparis lawsoniana*, Rotorua.

Fig.10 – (Above and right) *Cupressus torulosa* aged 45 years, at Victoria Park, Christchurch.

Fig.11– *Cupressus cashmeriana*, Gwavas Station, Hawke's Bay.

Fig. 12 – *Cupressus arizonica*, Isel Park, Nelson.

Fig. 13 – *Cupressus sempervirens*, Havelock North, Hawke's Bay.

TABLE 2: Recognition of the More Common

	***Cupressus macrocarpa* Gordon** **macrocarpa**	***C. lusitanica* Miller** **lusitanica**
Natural distribution	North America: California. Confined to 2 small groves on the Monterey coast. Altitude: 0–20 m.	Central Mexico, Guatemala, Honduras. Altitude: 500–3500 m.
Habit[1]	Height to at least 45 m. Very variable, crown ranging from narrow to broad and branches from horizontal to more or less fastigiate. Base of trunk often strongly fluted at maturity.	Height to at least 35 m. Very variable, conical at first, becoming broad. Usually with fairly dense, ***often drooping foliage***, and heavy branches. Trunk sometimes rather deeply fluted at base.
Bark	Pale pinkish to reddish brown, or grey, with age becoming thick and sometimes very pale and divided into shallow, flat, scaly ridges.	Greyish to reddish brown. More or less smooth in young trees, becoming thicker and fibrous with longitudinal fissures.
Leaves[2]	Mostly 1–2 mm long, dark green with paler margins, closely pressed to the branchlets, ***tips blunt and slightly swollen***, gland usually inconspicuous but occasionally quite obvious. 	0.75–2 mm long, green to blue-green, tips usually ***long-pointed*** and ***free*** (not pressed against branchlet) occasionally short-pointed or blunt, gland often inconspicuous or absent, sometimes well developed. 
Branchlets	1.5–2 mm wide, numerous, round or four-sided, spreading at various angles.	1–1.5 mm wide, 4-sided, often pendulous, irregularly arranged. Flattened and regularly pinnate in var. ***benthamii*** .
Male cones	3–6 mm long, yellow, pollen shed from September–November.	4–6 mm long, orange or yellow, pollen shed from April–August.
Female cones	***Large, 20–35 mm across;*** purplish-brown to chestnut brown when mature, shining; globose to elliptical; 8–14 scales, each furrowed and with a short central projection (umbo). 	10–15 or occasionally 20 mm across; usually ***bluish to whitish-green in the 1st year***, ripening to dark purplish-brown or grey-brown in the 2nd year; globose; usually 6–8 (occasionally 4–10) scales, each striated on the surface and with a slender pointed umbo. 
Seed[3]	8–20 per scale, 5–6 mm long; ***dark brown***; narrowly winged, 0.5–2 mm wide; shiny; ***warty with minute resin tubercles***.	8–10 per scale, mostly 3–4 mm long, rich brown when ripe, wing narrow (up to 1 mm wide) or almost absent, seed sometimes with conspicuous resin tubercles on the surface.
Comments	Distinguished from species other than *C. **sempervirens*** by its large cones, dark green foliage, vigorous growth and shredding bark. Distinguished from *C. **sempervirens*** by its coarser foliage, larger leaves swollen at the tips, and warty seeds.	A very polymorphic species, varying greatly in leaf colour, shape and branchlet arrangement. Usually distinguishable from other ***Cupressus*** species by the long free pointed tips to the leaves and very glaucous young cones.

[1] Heights refer to New Zealand.

[2] Leaf measurements refer to terminal branchlets of mature trees. Leaves on main branchlets and seedlings are often much larger.

[3] Seed colour refers to ripe seed. Immature seed is much paler.

Cupressus Species in New Zealand

***C. torulosa* D. Don**
West Himalayan cypress

India, western Nepal.
Altitude: c. 1700–3000 m.

Height to at least 40 m. Typically broadly pyramidal in shape, with horizontal or ascending branches usually erect at the tips and ***pendulous curved branchlets***.

Dull brown, peeling off in long narrow fibrous strips, often becoming dark grey and spiralled with age.

0.5–2 mm long, yellowish or bluish green to dull mid-green with pale margins; tip bluntish, incurved, often thickened; leaf often grooved on the back; gland inconspicuous.

Slender, curved, whip-like, sparsely branched, hanging in bunches.

4–5 mm long, dark purple to yellowish green, shedding pollen about July.

10–20 mm across; ***often purple tinged when young*** becoming yellowish to reddish-brown or grey-brown when ripe; globose to elliptical; usually 8, occasionally 10–12 scales, each with a small central umbo.

6–8 per scale, c. 4 mm long, red- brown, shiny, narrowly winged, often with resin vesicles on the surface.

Can be distinguished from other *Cupressus* species by the slender curved branchlets, particularly long and whippy in shaded foliage, and by the frequently purplish young cones.

***C. sempervirens* L.**
Mediterranean cypress

Mediterranean north to Switzerland and through to the Himalayas.
Altitude: 650–1700 m.

Height to at least 30 m. Very variable — from the commonly cultivated narrow fastigiate form with upright branches to the form common in the wild with horizontal spreading branches.

Thin, relatively smooth, pinkish to grey-brown with broad shallow fissures and flaky ridges.

Small, 0.5–1 mm long; dark or dull grey-green; closely pressed to the branchlet; tip blunt, not swollen, incurved; leaf often with a longitudinal furrow on the back, glands indistinct.

Slender, c. 1 mm wide, rounded or 4-angled, spreading irregularly at various angles.

4–8 mm long, yellow, pollen shed in September.

Large, 25–40 mm across, usually many in clusters, dull grey or yellow-brown when mature, ***elliptical*** (rarely globose), 8–14 smoothish scales, short central umbo.

8–20 per scale, c. 5–6 mm long, brown, narrowly winged, smoothish, ***without resin warts***.

The narrow upright habit of the commonly cultivated forms is distinctive. Distinguished from species other than ***C. macrocarpa*** by its large cones. Distinguished from ***C. macrocarpa*** by finer, more delicate foliage with smaller leaves not swollen at the tips and by smooth seeds without resin vesicles.
C. sempervirens has smoother, yellowish grey cones.

***C. arizonica* Greene**
Arizona cypress

North America: Nevada, Arizona, New Mexico, west Texas; northern Mexico.
Altitude: 1000–2400 m.

Height to 35 m. Narrow and pyramidal when young, becoming broad and densely to somewhat openly branched.

Reddish, ***smooth***, peeling in thin flakes in young trees and in var. ***glabra***. Usually furrowed and fibrous with fine shallow ridges in older trees.

1.5–2 mm long; ***usually blue-green to grey-green***, sometimes with a few white spots; ***tip acutely pointed***; glands variable, sometimes very conspicuous and exuding white resin, especially in var. ***glabra***.

Relatively stout, 1–2 mm wide, irregularly arranged, 4-angled.

2–5 mm long, pollen shed in August–September.

20–30 mm across, glaucous to dark brown, globose, 6–8 flat or slightly depressed scales each with a prominent central umbo.

Approximately 15 per scale, 4–5 mm long, yellow-brown to red-brown, occasionally glaucous, narrowly winged, smooth or with a few warts.

Distinguished by stout branchlets, usually with grey-green or glaucous foliage, pointed leaves, and often glaucous cones. In Mexico where ***C. arizonica*** and ***C. lusitanica*** overlap, intermediate forms occur. Var. ***glabra***, treated by some authors as a separate species, has smooth reddish bark throughout most of its life and usually more glaucous foliage with very conspicuous resin glands.

TABLE 3: Recognition of *Chamaecyparis*

	***Chamaecyparis lawsoniana* (Murray) Parl. Lawson cypress**	***Ch. nootkatensis* (D. Don) Spach Nootka cypress**	***Ch. pisifera* (Siebold et Zucc.) Endl. Sawara cypress**
Natural distribution	North America: south-west Oregon and north-west California. Altitude: 0–c. 2000 m.	Western North America: Alaska to Oregon. Altitude: 0–1000 m.	Japan: south Honshu and central Kyushu. Altitude: 0–2400 m.
Habit[1]	Large tree to at least 70 m in the wild, less than half this height in New Zealand, very variable, usually broadly pyramidal or columnar, ***leading shoot usually drooping, dense foliage to ground level, branches pointing upwards, branchlets drooping.***	To at least 40 m, narrowly pyramidal at first, becoming broader and conical, base broadly buttressed and often fluted, leading shoot usually drooping, ***branchlets weeping***.	To at least 50 m, narrow pyramidal at first, becoming broadly conical with an open rounded crown, branches horizontal, lower ones sometimes drooping to ground level, trunk frequently forked.
Bark	Dark reddish or purplish brown, deeply furrowed into thick scaly or spongy plates.	***Thin***, greyish to reddish, fissured into long scaly strips.	Red-brown, closely and finely fissured into rather smooth, peeling strips.
Foliage	Leaves mostly 1.5–2 mm long (up to 6 mm on vigorous shoots) closely appressed, ***lateral leaves longer than facial leaves***, dull to bright green or bluish green, ***indistinct x-shaped white markings on the under surface especially round leaf margins***, pointed or blunt with ***free tips***, glands usually visible as translucent oval dots when held against the light.	Leaves mostly 2–3 mm long; closely appressed on short shoots; lateral and facial leaves of more or less equal length; yellow green to dull dark green, ***without white markings on under surface***; narrow, sharp or bluntly pointed tips; thick and rough to the touch; usually without glands.	Leaves c. 3 mm long; loosely appressed; lateral leaves equal to or slightly longer than facial; bluish to yellowish green ***with a distinct whitish patch at the base of each leaf; tips slender, sharp and spine-like***; glands indistinct.
			
Branchlets	In broad, flattened frond-like sprays, more or less pendulous at the ends.	Flattened and frond-like, pendulous.	Fairly dense, spreading sprays.
Cones	Usually in large numbers; 8–10 mm across; blue-green at first, becoming red-brown or purplish-brown when ripe; 8–10 scales each with a small reflexed projection (umbo).	Mostly 8–14 mm wide; green at first, becoming ***plum-coloured*** with a ***slight bloom***, red-brown when ripe; 4–6 scales each with an erect pointed umbo; ***taking 2 years to ripen***.	Often abundant, crowded across branchlets well back from the tips; ***small, 5–8 mm wide***; glaucous green when young, ripening to dark brown; 8–12 (usually 10) scales each with a minute point, depressed in the centre.
			
Seeds	2–4 (occasionally 5) per scale, c. 4 mm long, light chestnut to reddish brown, conspicuous resin tubercles, broadly winged.	2–4 per cone scale, 4–5 mm long, red-brown, no resin tubercles, broadly winged.	1–2 per cone scale, 2–3 mm long, brown, conspicuous resin tubercles, broadly winged.
Comments	A variable species giving rise to a large number of cultivars. Indistinctly defined x-shaped white markings on the undersides of leaves and the larger size of side leaves compared to facial leaves are distinguishing features. Also distinctive are drooping branchlets and the pink or crimson male flowers in spring.	Weeping branchlets, thin smoothish bark, bloomy plum-coloured cones with prominent pointed umbos, more or less equal-sized pointed leaves with a median ridge and no white on the underside, foliage rough to the touch, and cones concurrently at two stages of development on the tree are distinguishing features.	Distinguished from all other ***Chamaecyparis*** species by ± equal-sized, sharp, spine-pointed leaves with conspicuous whitish markings below and small (pea-sized) cones. A large number of cultivars have been named, many of which retain the juvenile foliage form indefinitely, including the well known 'Plumosa' and 'Squarrosa'.

[1] Height refers to natural habitat unless otherwise stated.

Species in New Zealand

***Ch. funebris* (Endl.) Franco**
Chinese weeping cypress

Central China: Yangtze River valley, Anhui to Yunnan.
Altitude: 1100–2000 m.

To at least 35 m, broadly conical with spreading, horizontal or ascending branches, becoming rounded or flat-topped with age, slender branchlets.

Grey-brown, smooth, shallowly fissured.

Leaves 1–2 mm long, loosely appressed with slightly spreading pointed tips, lateral and facial leaves about equal, light greyish or bluish-green without any pale markings, often with a white or translucent gland.

Sparse, slender, pendulous.

8–***20 mm wide***; on slender often curved stalks; blue-green at first, turning dark brown and ± glaucous; 6–8 scales each with a small central umbo; ***taking 2 years to ripen.***

3–5 per cone scale, 3–3.5 mm long, shining red-brown to dark brown, scattered resin tubercles, 2 narrow wings (wing half width of seed).

Distinguished by its sparse slender drooping foliage and large cones (up to 20 mm wide). Juvenile foliage may occur 2–3 m into the crown of trees up to 5 m tall and is dissimilar to adult foliage with soft, spreading, linear-pointed leaves up to 10 mm long. Some authors include this species in ***Cupressus*** which it resembles in resin features and largish cones which take 2 years to ripen.

***Ch. obtusa* (Siebold et Zucc.) Endl.**
Hinoki cypress

Taiwan, Japan: Honshu to Yaku Island.
Altitude: 400–2800 m.

To at least 50 m, pyramidal when young, becoming broadly conical with age with a rounded crown, branches horiziontal or ascending.

Red-brown to grey-brown, becoming fibrous, fissured into thin peeling strips.

Leaves c. 3 mm long, tightly appressed on short shoots, lateral leaves much larger than facial, shiny green, ***conspicious white waxy lines along leaf margins on the underside of the shoot***, usually ***blunt***, with or without a resin gland.

Short flattened sprays drooping at the tips.

Often in large numbers, solitary on short branches; 8–15 mm wide; green at first, ripening orange-brown to red-brown, sometimes with a glaucous tinge; 8–10 scales each with a minute central ridge.

2 or occasionally 3–5 per cone scale, c. 3mm long, dark brown, conspicuous resin tubercles, wings same width or narrower than seed.

Distinguished by blunt, rounded, unequal-sized, bright green leaves with clearly defined white waxy markings on the lower surface leaf margins. Not common in New Zealand except as garden cultivars.

***Ch. thyoides* (L.) B.S.P.**
Atlantic white cypress

Eastern North America: Maine to Mississippi.
Altitude: 0–c. 500 m.

To at least 30 m, slender columnar when young, becoming conical to broadly conical with a narrow pyramidal crown, branches upcurved or horizontal.

Reddish or grey-brown, fissured into narrow, often spirally twisted ridges. Old trunks shaggy.

Leaves 1.5–3 mm long, tightly appressed on short shoots, lateral leaves equal to or longer than facial leaves, usually dark blue-green or grey-green with white margins and marked white near the base, sharply pointed spreading tips, usually with a conspicuous resin gland.

Irregular ***fan-shaped flattened sprays.***

Stalkless or short stalked, ***small, c. 6 mm wide***; at first blue-grey or bluish-purple, ripening dark reddish-brown, bloomy; 4–6 (occasionally 8) scales, small recurved umbos.

1–2 per cone scale, 1–2 mm long, dark shiny brown or grey-brown, without resin tubercles, wings approx. same width as seed.

Branching very distinctive among ***Chamaecyparis*** spp. with foliage bunched in flattened fan-shaped sprays. Small glaucous cones distinguish it from species other than ***Ch. pisifera*** which, however, does not have flattened fan-shaped branchlets. Not common in New Zealand.

***Ch. formosensis* Matsum.**
Taiwan cypress

Taiwan.
Altitude: 1000–3300 m.

To 65 m, broadly conical with slightly nodding leading shoot, horizontal branches, ***branchlets sparse and pendulous.***

Rich red-brown to pale grey-brown, peeling off in vertical strips between shallow fissures.

Leaves 1.5–2.0 mm long, loosely appressed, lateral leaves much larger than facial leaves, light yellowish green or shiny green, ***often tinged with bronze***, white markings round leaf margins, leaves with curved pointed tips, gland indistinct.

Flattened, arranged in horizontal planes.

8–12 mm across; green at first, becoming brownish; 10–12 scales, surfaces very wrinkled, small triangular umbos.

2 per cone scale, 3.5–4.0 mm long, grey-brown, wing equal to or wider than seed.

Most closely related to ***Ch. pisifera*** from which it differs in bronzed foliage lacking strong white markings below, leaves without spiny tips and larger cones. Rare in New Zealand.

C. macrocarpa

C. lusitanica

C. torulosa

C. arizonica

C. sempervirens

Ch. lawsoniana

Ch. pisifera

Ch. nootkatensis

Ch. funebris

Ch. formosensis

Ch. obtusa

Ch. thyoides

Leyland cypress (x *Cupressocyparis leylandii*)

Fig. 14 – Foliage of *Cupressus* spp., *Chamaecyparis* spp., and Leyland cypress.

C. macrocarpa

C. lusitanica

C. torulosa

Ch. lawsoniana

Fig. 15 – Bark of common species

C. macrocarpa

C. lusitanica

C. torulosa

Ch. lawsoniana

Fig. 16 – Examples of cypress seed

ROLE OF THE SPECIES

Status of the Resource

In 1986 there were approximately 3400 ha of cypresses in plantations in New Zealand. The most widely planted species were *C. macrocarpa*, *Ch. lawsoniana*, and *C. lusitanica*, in that order, but the age-class distribution of the plantings was markedly dissimilar (*see* Table 4). Whereas planting of macrocarpa has spanned about 70 years, with peaks in the 1950s and the 1980s, only 7% of the total area in lusitanica was older than 30 years, most plantings having occurred in the 1960s or 1980s. Lawson cypress, on the other hand, appears almost a species of the past; plantings made over the last 40 years amounting to only 320 ha, 34% of the total for the species. In addition to stands, cypresses have been widely planted for hedges and shelterbelts, particularly on farms in the late 1920s and early 1930s.

TABLE 4: Estimated areas of cypress planting (ha) as at 1986*

Age Class (years)	*Cupressus macrocarpa*	*Cupressus lusitanica*	*Chamaecyparis lawsoniana*
0-10	1298	511	125
11-20	40	138	4
21-30	102	61	72
31-40	167	1	119
41-50	99		197
51-60	30	55	403
Over 60	3		26
Total	1739	766	946
Proportion in pure plantations (%)	88	82	78

* Younger age classes are probably under-estimated because of incomplete records of planting in the private sector.

In New Zealand, different cypress species tend to be concentrated in different regions. Macrocarpa is the principal cypress of Southland, although also common in parts of Auckland and Wellington Provinces. Lusitanica predominates in Northland, and the Bay of Plenty. Most of the area planted in Lawson cypress in the North Island is in Wellington Province and, in the South Island, in Westland. In these two provinces it is clearly the dominant cypress species. The areas planted in cypresses in North and South Islands as at 1986 are shown in Table 5. Clearfelling of many stands of macrocarpa and lusitanica over 40 years of age has occurred in the past few years.

TABLE 5: Areas of cypress (ha) planted in North and South Islands as at 1986

	North Island	South Island
Cupressus macrocarpa	439	1300
Cupressus lusitanica	674	92
Chamaecyparis lawsoniana	329	617
Total	1442	2009

Cultivation of Cypresses

Cypresses must be grown without check to realise their full potential as tree crops. They have special silvicultural requirements and, generally, are more sensitive to handle than radiata pine. Recommendations concerning the nursery treatment of cypresses are given in the Seed Users' Guide — p. 30.

Climate and siting

Cypresses share a common need for moderately fertile, moist soils, and, predominantly, a preference for mild climates and reasonably sheltered sites.

Macrocarpa survives in a wide range of New Zealand climates, from coastal situations to inland sites up to altitudes exceeding 600 m. It tolerates annual rainfall ranging from 500–2000 mm and is hardy, withstanding up to 10°C of ground frost, and thriving in the cooler parts of both islands. Generally it does best on fertile lowlands but is intolerant of poorly drained soils and is apt to be short-lived on very dry soils. In native groves of the species in California, trees on the coastal fringe are severely sculptured and distorted, but erect form and light branching is apparent only a short distance inland, showing that the species, although capable of enduring wind and salt-blasting, responds well to shelter. In New Zealand, ideal macrocarpa sites lie below an altitude of approximately 400 m in cooler parts of the country on moist, fertile, well-drained soils receiving 700–1300 mm of rainfall. Coastal sites are tolerated, but the species' response to shelter should be considered wherever timber is an important goal. The form of macrocarpa is generally better than average on cold, dry sites, or where the availability of nitrogen is low. Branching may be coarse on very fertile soils. On infertile soils, trees in the interior of stands may tend to stagnate.

Lusitanica is best suited to mild areas of New Zealand away from the immediate coast. It does well in inland parts of North Auckland, Auckland, Gisborne and Taranaki, and it may well be successful on as yet untried sites in Nelson and Westland. It is relatively demanding in respect of shelter, fertility, and — to a greater degree than macrocarpa — sustained soil moisture supply, especially during summer. It can withstand 5°C of ground frost, and generally requires 1000–3000 mm of rainfall annually. Observations of lusitanica in Kenya and in its Mexican homelands suggest the best sites are also those where atmospheric humidity is fairly constant. In New Zealand stands, the largest trees almost invariably follow the courses of streams or lie in the sheltered confines of fertile, free-draining gullies, beyond which growth declines. In dry, cold or exposed situations trees tend to be small, squat, and generally inferior. Although, eventually, lusitanica may be grown successfully over a wider area than at present, in cold or dry areas suitable sites are noticeably fewer.

Preferred soils for Lawson cypress are deep, fertile, and moist but well-drained: bogs and shallow pan formations are unsuitable. The species tolerates high rainfall, growing best with 1000 mm or more annually. On very dry soils or in low rainfall areas, growth is slow. However, Lawson cypress is a hardy species, surviving severe conditions at altitudes up to 900 m in Canterbury and Otago, and producing well-grown trees at several locations up to 600 m.

Site preparation, establishment

The fertile, sheltered sites recommended for growing cypresses are naturally those most prone to weeds, so good weed control is needed both before and after planting. Cypresses are more sensitive to herbicides than is radiata pine. In particular, recommended residual dispersion periods must be observed before planting.

Following weed control, deep cultivation at the planting position is desirable. A winged ripper may be used for extensive work, or a spade for individual trees. Substantial soil breakage helps to preserve soil moisture and facilitate fresh root growth, but trees must nevertheless be planted firmly to avoid socketing or loosening by wind.

Fertilising with nitrogen and phosphorus may be unnecessary on rich farm soils but is recommended elsewhere, particularly on soils with a high clay content. A convenient technique is to incorporate 30 g of slow-release fertiliser into the planting hole, and to follow up within 1–2 months with an application of superphosphate (50 g) plus di-ammonium sulphate (30 g) per tree, slotted into the ground on contour with the tree, about 20 cm from the stem. Excessive nitrogenous fertiliser tends to promote coarse branching.

Experience has shown that cypress seedlings can be greatly stressed by conditions which would not be at all damaging to pine seedlings, so great care is necessary in handling stock between lifting and planting out. Seedling roots should be dipped in water as soon as lifted and tops kept moist, cool and in a humid atmosphere until planting. Packing should be in waterproof containers, e.g., plastic bags sealed or nearly so, and kept in cool storage. Large seedlings are considerably more vulnerable to shock than smaller ones. Well-grown 1-year stock of macrocarpa or lusitanica — 25–35 cm tall, with a 5–6 mm root collar — is preferable to larger, older stock. However, Lawson cypress may take 2 years to reach planting size.

The relative palatability to sheep of *C. macrocarpa* and *C. lusitanica* has been tested in agroforestry trials (V. Paton: pers comm., 1989). Compared with *Pinus radiata*, *Eucalyptus regnans*, *E. nitens*, *Acacia melanoxylon* and *Juglans nigra*, *C. macrocarpa* was highly resistant to browsing damage during periods of spring grazing, and relatively resistant during autumn grazing. In contrast *C. lusitanica* proved less browse-resistant and was moderately damaged during grazing in both spring and autumn.

Older macrocarpa is well known to be prone to bark stripping by stock, especially if stems have been exposed by pruning or the shading out of lower branches. In some severe cases only the deeply flanged nature of the butt has prevented complete ringbarking.

Releasing

Cypresses usually need releasing from weeds at least once after planting. Care is needed to avoid wounding trees because of the possibility of canker infection. Releasing by overspraying with chemicals is effective, using any of the triazines (atrazine, simazine and terbuthylazine) available under various proprietary names such as "Gardoprim" and "Gesaprim". For grass weeds only haloxyfop (Gallant) or quizalofop (Zero) may be applied directly over the trees. Dichlobenil granules spread around trees will maintain control of a wide range of grasses and broadleaved weeds. Short-term control can be achieved with glyphosate spray, but shields are essential to prevent contact with foliage of the trees.

Stocking rates, pruning and selection

Being relatively shade-tolerant, cypresses will grow well at higher stocking levels than those normal for pines, the closer spacing helping to maintain good stem form. Stocking, pruning and crop-tree selection should be regarded as strongly interdependent aspects in cypress silviculture. This is particularly applicable to macrocarpa in which regulation of branch size, and elimination of malformed and fluted stems have much bearing on ultimate timber quality.

High initial stockings (1000–2000 stems/ha) are recommended. These promote rapid canopy closure, suppress weeds, reduce branch size, and provide a large number of stems from which to choose crop trees.

Soon after planting, cypresses tend to develop wide or pyramidal crowns, the lower parts of which arise from vigorous branches near ground level. Drastic pruning regimes borrowed from pine silviculture usually remove a disproportionately large portion of cypress crowns. This leaves pruned trees disadvantaged and neighbouring unpruned trees free to expand their crowns coarsely into the new space provided. Early treatment of cypresses should aim at

light, frequent pruning to avoid formation of dead knots. In macrocarpa, it may be beneficial to shorten or remove some of the coarsest branches at the outset (2–4 years after planting) even though these may arise above the current pruning height. This is particularly appropriate if trees are planted at wider than normal spacing, as in some agroforestry regimes. Meanwhile stocking should be maintained at the original level at least until good bottom logs (from which as much as 40% of the final volume may be expected) can be distinguished in the crop.

Selection of crop trees in macrocarpa and lusitanica is thus likely to be an extended task, marked by progressive attention to pruning of the straightest and most vigorous stems. However, trees occur in which grooves associated with deeply flanged butts tend to continue, or to recur, up the lower and middle length of the stem. This familiar feature, which has not been satisfactorily explained on genetic or environmental grounds alone, is commonly termed fluting. It is usually more pronounced in macrocarpa than in lusitanica, and may have a significant effect on conversion of the butt log during processing.

Although a clear link has not been established between the incidence of fluting and branch angle, it is probably wise to select trees having light horizontal branching rather than those with heavy acute branching. This may minimise the risk of fluting in the final crop.

Thinning and final-crop spacing

If the planted area is small, as is typical of many farm woodlots, timing of thinnings can be flexible and material removed as needed. A rational approach to stocking suggested for South Island macrocarpa by Franklin (1989) entails the use of a stem diameter/spacing ratio of 10; an average final crop d.b.h of 50 cm being consistent with a final-crop spacing of 500 cm (5 x 5 m or 400 stems/ha), or final d.b.h. of 60 cm with an ultimate spacing of 600 cm (6 x 6 m or 280 stems/ha), etc.

In growing cypress for special-purpose timber the general aim should be to produce a substantial bottom log. A silvicultural regime based either on heavy early thinning or on production thinning can be used to achieve this (Table 6). Suggested regimes should be flexible according to circumstances or species; for example it may be desirable to retain final stockings of up to 300 stems/ha. For Lawson cypress, maintenance of growth rate will always be a chief objective, as will be regulation of branch size in macrocarpa. Lusitanica, which is shallow rooting, should not be severely thinned on soils known to be conducive to windthrow. Heavy early thinning encourages rapid diameter growth, but also stimulates the development of branches. Where dense stocking is maintained, dead branches can lead to timber defects.

Mixtures

Cypresses have frequently been planted in mixture with other species in New Zealand. In 1981 about 20 different conifers or hardwoods were growing in mixture with one or other of the principal cypresses, the total area exceeding 550 ha. Species planted with cypress have been chiefly *Pinus radiata*, *Pseudotsuga menziesii*, *Larix* spp., *Eucalyptus* spp. and, less frequently, *Cryptomeria japonica*, *Thuja plicata*, *Acacia melanoxylon* and slower-growing pines such as *P. patula*, *P. nigra*, *P. ponderosa* and *P. strobus*. *Cupressus macrocarpa* and *C. lusitanica* have proved silviculturally compatible when planted together, but both species are rapidly outgrown by radiata pine or, over a longer period, are shaded out by Douglas fir when that species is numerically predominant. When grown with more open-crowned eucalypts or larches, or with some pines, cypresses tend to compete well for at least 15–20 years, showing both reduced branch size and good stem form. Thus, there appears to be scope for growing cypress with either an appropriate nurse species or one which will provide an intermediate yield (e.g., posts, firewood) or contribute to a self-thinning mixture. A further prospect may entail "enrichment" of cypress stands by including at planting time a proportion of rooted cuttings of Leyland cypress, relying upon clonal uniformity in growth rate and habit to provide a better selection of final-crop trees.

TABLE 6: Possible silvicultural regimes for the production of clear cypress timber*

Thinning regime	Mean top ht. (m)	Residual stocking (stems/ha)		Operations
Heavy early thinning				
		2000		Plant at a spacing of 2.0–2.5 m
	5	600		Waste thin, and prune to 2 m
	9	200		Waste thin and medium prune to 4 m
	13	200		High prune to 6 m
	30			Clearfell
Production thining				
		(a)	(b)	
		1000	2300	Plant at spacings from 3 x 3 m to 1.8 x 2.4 m
	3	600		Malform thin when visible
	5		1000	Waste thin (as appropriate), and low prune to 2m
	9	600	1000	Medium prune to 4 m
	13	300	600	Waste/production thin, and high prune to 6 m
	20–25	150-200	200	Production thin (optional)
	30–40			Clearfell

* Ref: "Growing Cypresses" — What's New in Forest Research, No. 127, 1984.

(a) Preferable regime for site where windthrow may occur.

b) Preferable regime for sites with minimal windthrow hazard.

Growth and Yield

Growth rates of the common cypresses in New Zealand appear to be similar to, or faster than those occurring in the natural stands. Macrocarpa grown in plantations normally forms a single-leadered, relatively narrow-crowned tree, markedly different in habit from open-grown specimens, and particularly to the celebrated windswept individuals found on the foreshore in the natural stands in California. On fertile, sheltered sites in New Zealand macrocarpa readily attains top heights of 30 m, and diameters exceeding 50 cm, within 40–45 years. The tallest open-grown macrocarpa recorded by Burstall (1984) was near Tauranga, and stood 47.7 m high and 148 cm in diameter at age 92 years At ages 40–45 years and on good sites, lusitanica may reach heights of 30 m and diameters of 50–70 cm, which are similar to size limits reached by the species in Mexico, but fall behind those expected on the best quality sites in Kenya, where, at similar age, top heights of 36–44 m have been recorded. However, on a good site in Tairua Forest several lusitanica individuals attained heights of up to 38 m at an age of 52 years. These included one tree 115 cm in diameter, and having a total volume of 11.0 m^3. An impressive lusitanica in New Zealand, growing at Wakefield, was measured at 29.9 m high with a diameter of 138 cm at an age of about 119 years.

Lawson cypress is generally regarded as the tallest of the cypresses, having exceeded heights of 60 m and diameters of 1.9 m in natural stands in Oregon and California. In New Zealand it has been disadvantaged both through lack of thinning and attempts to grow it on unsuitable sites. The best trees in local plantations are now about 25 m in height and 40–50 cm in diameter at ages 50–60 years. An outstanding open-grown individual, reported by Burstall at Geraldine in South Canterbury, was 32 m in height and 159 cm in diameter at an age of about 100 years.

Data are available from 51 growth sample plots located in macrocarpa and lusitanica stands throughout New Zealand. Generally, height growth for age on good sites is similar for both species to around age 25 years, but there is insufficient information on lusitanica to compare the species after this age. Typical mean top height values for macrocarpa on good sites for ages 10, 20, and 30 years would be 10.5 m, 20 m, and 26.5 m respectively. On poor sites or sites with heavy weed competition heights can be very much less.

New Zealand cypress plantations have generally suffered from widespread silvicultural neglect, and particularly they have lacked thinning during early- and mid- rotation. Where mature macrocarpa stands have been thinned this has usually been late and heavy, retaining only low residual volumes (mean annual increments for the remaining trees have usually ranged from 6 to 15 m^3/ha). By comparison, mature but unthinned stands of macrocarpa (over 40 years) usually maintain very high stockings (1200 to 1300 stems/ha); diameters tend to be small and the stands themselves show wide variation in productivity. Some of these stands carry very high total standing volumes (1000 to 1600 m^3/ha) and are still growing with exceptional current annual increments of 30 to 70 m^3/ha/annum, but others are, by contrast, dismal in performance with total volumes of no more than 200-450 m^3/ha (A. Somerville, pers. comm.).

Although lusitanica stands are generally younger and have usually received some thinning, growth data are similarly highly variable. Data for stands around 20 years of age show stockings ranging from 240 to 1000 stems/ha; total standing volumes from 160 to 650 m^3/ha; and current annual increments from 17 to 58 m^3/ha/annum (A. Somerville, pers. comm.).

At present all too little is known about the true productivity of macrocarpa and lusitanica, but evidence shows that with good management and silviculture applied to well-sited trees, it could be greatly improved in future.

Table 7, derived from data from 28 thinned permanent sample plots, provides some indication of the growth potential of Lawson cypress.

TABLE 7: Growth and volume of Lawson cypress in New Zealand

Age group	Mean age	No. plots	Stocking (stems/ha)	Mean top ht (m)	Mean diam. (cm)	Vol. thinnings (m^3/ha)	Vol. residual (m^3/ha)	Vol. total (m^3/ha)	MAI (m^3/ha)
31-40	38.6	7	490-700	16.2	31.4	67	140	207	5.3(3.1-11.4)
41-50	43.4	13	290-2320	14.3	32.1	225	463	688	9.9 (6.6-14.8)
51-60	55.4	7	150-930	21.8	40.8	345	41	386	7.1 (0.8-21.3)

(1) MAI = mean annual increment.

Uses

Cypresses are planted for timber (Frontispiece, Fig. 8), shelter (Figures 7 and 9) and ornamental value (Figures 11 and 13). Better-grown shelterbelts of macrocarpa, lusitanica and Lawson cypress can also be expected to yield high-quality timber. If grown to maturity (over a somewhat longer period), *C. arizonica* or *C. torulosa* should do the same. Leyland cypress probably has good timber-producing potential both in shelterbelts and plantations. It is still essentially an experimental species, however, and trees are too young to be evaluated.

Shelterbelts and clipped hedges of both macrocarpa and Lawson cypress are common around houses and in home paddocks in many districts of New Zealand. With their wide diversity of size, form, habit, and foliage colour, combined, usually, with hardiness and ease of cultivation, cypresses are popular ornamental trees for parks and gardens (Figures 10-13). A large number of horticultural cultivars, many of dwarf form, have been named. The diversity of seedling form and colour found in Lawson cypress has stimulated selection and propagation by growers, resulting in more than 200 named cultivars of that species alone.

The Wood

Rightly regarded as "special-purpose timbers" of high quality, macrocarpa, lusitanica and Lawson cypress produce a range of similar fragrant woods, yellow-brown in colour, of fine, even texture and lustre, which are frequently compared to kauri (*Agathis australis*). Wood densities are medium to low, ranging from 475 to 495 kg/m^3, air-dry, slightly lower than in radiata pine (in which densities range from 350-560 kg/m^3). Densities in cypress vary little within a tree (i.e., from pith to bark) or between trees. Macrocarpa, lusitanica and Leyland cypress resemble radiata pine and kauri in all mechanical properties except surface hardness which is lower in the cypresses. This low surface hardness may demand careful use of cypress timbers in furniture but their moderate strength and stiffness makes them very suitable for use in general construction. New Zealand-grown Lawson cypress has similar mechanical properties to those of American-grown timber: it is light, stiff and moderately strong, with higher bending and compression properties than radiata pine. Cypress timbers have proved very stable in both the long and short term, showing less dimensional change and lower shrinkage than radiata pine.

Fig. 17 – Bandsawing 53- year-old *Cupressus macrocarpa*.

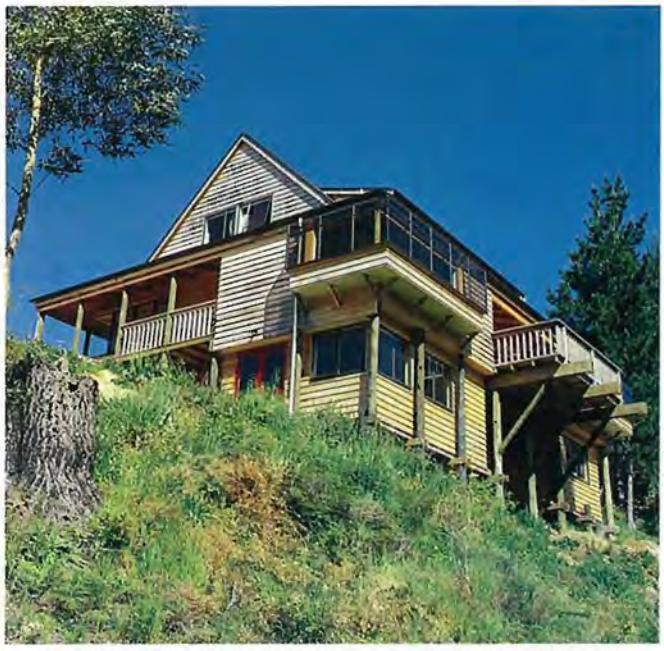

Fig. 18–House clad in macrocarpa weatherboards, Rotorua.

Cypresses also have good wood properties for sawmilling; trees show little growth stress and the timber has no marked blunting properties. It is of particular advantage that logs can be sawn on both portable and traditional sawmills on patterns normally used for radiata pine, including through-and-through sawing (Fig. 17). However, in cypresses, and in macrocarpa in particular, saw-timber-grade recoveries have been influenced by low log quality. Sometimes this has resulted from silvicultural neglect in plantations. More frequently, however, it results from the use of logs from over-mature, untended shelterbelts, in which general eccentricity, sinuosity and kinks, fluting, large branches, intergrown knots, and bark enclosures are common.

Generally, air drying of cypress timber is easier than kiln-drying. There is considerable risk of internal checking and collapse, especially in macrocarpa originating from rough shelterbelts. The end product may be improved by protecting stacks from unnecessary exposure.

Fig.19 – Sawing *Cupressus macrocarpa* (from stand in background), Te Puia Springs, East Cape.

Cypress sapwood is perishable and, although it is possible to impregnate it with boron salts by diffusion, it is customary to use only untreated heartwood for exteriors. The natural durability of the heartwood of macrocarpa, lusitanica and Lawson cypress is among the highest for New Zealand exotic softwoods, i.e., 10–15 years ground life and well over 15 years above ground. Overseas reports indicate that heartwood of Leyland cypress is also durable. Because cypress wood is durable and stable, it is suitable for a wide range of exterior uses, including exterior joinery, shingles, and boat building, and possibly also for interior use as mouldings and panelling. Farmers have long used macrocarpa for buildings, fences and gates, often employing portable sawmills on their own property (Fig. 19). Cypresses are approved building timber species, and fulfil a need in house construction where a "natural finish" to weatherboards is required.

For more detailed information on wood properties, and recommended utilisation procedures (including kiln-drying, preservation and finishing) for macrocarpa, lusitanica and Lawson cypress as grown in New Zealand, refer to FRI Bulletin 119 (Haslett, 1986).

Although rarely grown specifically for firewood, cypress shelterbelts provide good fuel when cut down. Most cypress species develop a large proportion of heartwood, which splits well, dries quickly and is clean to use, although moderately fast-burning on account of its medium density. As they are prone to sparking, however, cypress woods are recommended only for enclosed fires.

Future Role of Major Cypress Species

Recognition of the value of cypresses has been slow in New Zealand, because of the successive distractions of a once-bountiful supply of native woods, and later the ready availability and versatility of radiata pine. In the potentially important cypress species, features of interest to the tree breeder include a high degree of individual (tree-to-tree) variation, readiness of some species to hybridise, and the ease with which they can be propagated vegetatively. These attributes facilitate breeding and encourage attempts to create superior plants for diverse uses: for example as sources of commercially significant timbers, as shelter species, or as ornamental trees. The future role of cypresses is seen as one in which close association between sound commercial practice and applied research will be important.

During the last 50 to 60 years small amounts of macrocarpa timber have been used domestically (usually on farms) or experimentally marketed. Timber of lusitanica is not yet generally available, although recently an overseas sale was made of logs from a 58-year-old plantation. In the meantime, demand continues for macrocarpa timber, the chief problem being one of erratic supply. Harvesting of Lawson cypress has mainly been confined so far to small-scale operations in Westland, the main constraint being the small size of trees resulting from slow growth rates and the associated small amount of heartwood.

Although traditional uses of cypress as shelter, hedging, or general farm timber will continue, the object of management for newly-created plantations and woodlots is, increasingly, production of high-quality timber. An encouraging prospect would be to develop cypresses as a substitute for the western red cedar and redwood currently being imported for weatherboards and exterior joinery. Cypresses are also excellent interior joinery woods.

Almost certainly, future markets for cypress timber will become more competitive, requiring a combination of high-quality growing sites and appropriate silvicultural practice. In the broad sense, siting involves choice of species suitable for different parts of the country. Regional limits for optimal growth have not been defined for macrocarpa and lusitanica, although macrocarpa appears the more tolerant of cooler conditions. Over much of the North Island use may be made of both species, but in the cooler parts of the South Island lusitanica may never become a significant timber species.

Future prospects for growing cypresses are likely to be improved by continuity of timber supply. In the past, supplies of timber of minor species in New Zealand have tended to be sporadic, often originating from isolated sources and representing a single age class. Lack of continuity has hindered their acceptance commercially, as sawmillers and merchants alike are reluctant to vary procedures to accommodate transient and unfamiliar species. A co-operative approach among interested growers of cypresses, leading to sustained supply of timber to established outlets, may be well worth considering.

The future role of cypresses is likely to be strongly influenced by the extent to which they can be improved by selection and breeding. Supplies of improved seed are expected to result from ongoing, long-term breeding programmes. However, in the short term, there are excellent prospects for improvement by vegetative propagation of individual trees selected for their superiority. This may suffice to lead cypresses out of the doldrums in which, as potentially important exotic forest tree species, they have languished for too long. However, it will be necessary to select material from the widest possible range, including progeny and provenance tests. Vegetative propagules must be shown to capture and repeat the desired characteristics of the selected donor, or "parent" trees, and adequate numbers of cuttings or plantlets will need to be maintained in regular supply from the nursery.

The exploitation of hybrids offers an additional dimension in cypress improvement. Future evaluation of Leyland cypress and other hybrids may confirm their role as alternative species for shelter, or as complementary species in plantations. Part of their attraction lies in their clonally-derived uniformity of habit compared with seedling stock. Supply of cuttings of the most promising hybrid clones is limited at present, but could be improved in response to commercial demand.

A thorough evaluation of the hybrid between *C. macrocarpa* and *C. lusitanica* is highly desirable. These species hybridise spontaneously in cultivation, producing fully fertile offspring capable of backcrossing to the parents. Experiments of limited scope at the Forest Research Institute, Rotorua, have suggested that hybrid vigour may be a general feature of *C. lusitanica* x *C. macrocarpa*, at least in the first generation (M.H. Bannister, pers. comm.). Current progeny tests in *C. macrocarpa* and *C. lusitanica* should identify excellent parental selections based on superior growth and form.

Lawson cypress will probably continue to be planted on a modest scale on favourable sites, and, with possible exports in mind, efforts to maximise growth rate could pay off. The Japanese market has taken essentially all the large timber of this species produced in California and Oregon in recent years as a substitute for the native *Ch. obtusa* (hinoki cypress), a premium timber now scarce in Japan. This source of Lawson cypress timber has been seriously affected, however, by the root-rot fungus *Phytophthora lateralis* which first invaded natural stands about 1950 and has since spread through the whole of the natural range of Lawson cypress in North America. Satisfactory alternative sources of timber have not yet been developed.

Future Role of Other Cypresses

Small numbers of *C. arizonica* and *C. torulosa* have been planted in drier regions in New Zealand (*C. arizonica* principally in Canterbury and *C. torulosa* in Hawke's Bay), and these species have been used with some success as shelter trees, however their future as timber trees is likely to be limited. Although tolerant of dry soils and cool climates, *C. arizonica* has shown highest growth rates on fertile sites where *C. macrocarpa* would be the preferred species and *C. torulosa* is relatively slow growing despite its ability to grow eventually to a large size. Results of provenance testing of *C. arizonica* in France have indicated differences in both growth rate and form, but so far no tests of different provenances of either species have been made in New Zealand. If future testing were extended to include hybrids, the attempt might

well be made to combine the hardiness of *C. arizonica* and the good timber properties of *C. torulosa* with the faster growth of *C. macrocarpa* and *C. lusitanica.*

Other cypresses with a reputation for yielding superior timbers in their natural habitats have tended to grow slowly in New Zealand. In an experimental plot at the Forest Research Institute, Rotorua, *Ch. obtusa* (hinoki) reached a height of 12 m and diameter of 27 cm in 25 years. Hinoki timber is deeply revered in Japan so it might be worth more extensive testing in New Zealand as a pure species or as a subject for interspecific hybridisation. *Cupressus sempervirens* (Mediterranean cypress), is a familiar ornamental tree in its fastigiate form (see Fig. 13), but has not been impressive as a plantation species, showing poor growth and stem form. *Chamaecyparis nootkatensis*, a fine timber species from western North America, has rarely been planted other than in arboreta. Early growth of this species appears to be too slow to justify possibly costly trials on cool, moist (and weedy) South Island sites to which it might otherwise be suited.

The ornamental role of cypresses is firmly established. Dwarf, fastigiate and coloured forms of *Ch. lawsoniana, Ch.. pisifera, C. arizonica, C. sempervirens* and *C. macrocarpa* have been much in demand, especially for small gardens. Larger specimens with pendulous foliage (such as of *C. cashmeriana* or *Ch. funebris*) and those with bluish foliage (e.g., *C. arizonica* var. *glabra* 'Blue Ice') or golden foliage (e.g., *C. macrocarpa* 'Aurea') have a role in wider landscape plantings. Periodically, new varieties of ornamental cypresses are produced, a tribute to the remarkable capacity for variation in the genera and to the nurseryman's skill.

Vegetative Propagation

Tests carried out at the Forest Research Institute have shown that scions from 8-year-old macrocarpa and lusitanica may be successfully cleft-grafted on to 10-month seedling root-stocks. Both species may also be multiplied vegetatively as cuttings taken from trees up to 14 years old. Tests showed that overall rooting from 8-year-old trees was 53% for macrocarpa and 44% for lusitanica, and from 14-year-old lusitanica trees it was 34%. Grafting success was 70% for macrocarpa and 64% for lusitanica. The application of vegetative propagation could no doubt be extended. The well-known amenability of many cypresses to vegetative propagation is a most useful attribute in breeding and improvement work.

Seed and Regeneration

Macrocarpa, lusitanica and Lawson cypress bear seed crops in most years, and heavy crops periodically (see Seed Users' Guide, p. 29). Macrocarpa often regenerates naturally, but usually only in the vicinity of large mature trees. Seedlings of lusitanica and Lawson cypress are also frequently found in the vicinity of mature trees, but usually only where weed growth is light and livestock excluded. Leyland cypress is almost 100% infertile.

Seed of macrocarpa, lusitanica and Lawson cypress, and periodically of other cypress species, is available from Proseed, New Zealand, P.B. 3020, Rotorua. All such seed originates from seed sources representing the best genetic quality available.

The cypresses are well adapted to New Zealand conditions. As sources of special purpose timbers, as shelter, and as ornamental species, their future is encouraging. However, their commercial success depends upon effective breeding and propagation programmes, careful siting, appropriate tending, and continuity of timber supply.

SEED USERS' GUIDE

A. Collection and Extraction of Cypress Seed

	Macrocarpa	Lusitanica	Lawson cypress
Age of first flowering	12–18 years	6–8 years (or much earlier)	5–20 years
Seed available in quantity	20 years	10 years	10–25 years
Pollen production	September–November (principally October)	April–August (June/July)	August–October (September)
Cone maturation period	15–18 months	15–18 months	6–7 months
Cone collection	Throughout year, or January–February for newly matured cones	July–February (N.B. Cones open and seed sheds when ripe)	January–February
Periodicity of crop	Some cones annually, heavier crops 1–3 years	Some cones annually, heavier crops 1–3 years	Some cones annually, heavier crops 3–5 years
Harvesting	Climbing; cones collected by hand-stripping branches or with secateurs		
Mature cone	Cones brown, containing brown free-running seed	Cones dull brown, containing tan-coloured free-running seed	Cones greenish-yellow to red-brown. Seed visible between cone scales
Seed extraction	Refrigerate for 2 days at 2°–4°C (to desiccate), then air-dry at 20–25°C until cone scales open. Tumble lightly.	Air-dry at 20–25°C until cone scales open. Complete if necessary by kilning 8 hrs at 45°–50°C (Do not attempt to de-wing seed)	Air-dry at 20–25°C until cone scales open.
Seed per hectolitre of cones	2–5 kg	1.5–3.0 kg	4–6 kg
No. seeds/kg	100 000–130 000	200 000–300 000	250 000–350 000
Storage conditions	..... Dry store at 4°C		
Stratification	Soak in water for 24 hrs, then stratify for 4–5 weeks at 3°–4°C	Not necessary but results in more rapid and even germination	Not necessary
Storage duration	10–20 years	10–15 years	7 years
Expected germination %	10–30	8–30	15–50

B. Nursery Practice

Seedlings:

In the North Island cypresses are usually raised as 1/1 stock. (*Cupressus lusitanica* can be raised as 1/0 stock in nurseries with very favourable climates).

In the South Island it is common practice to grow *Cupressus macrocarpa* and *C. lusitanica* as 1/0 bare-rooted seedlings or as 9-month-old root-trainer-grown stock, whereas *Chamaecyparis lawsoniana* and *Cupressus torulosa* are always grown as 2/0 or 1/1 stock, (D. A. Franklin: pers. comm.)

1st year	Broadcast sow at 600–700 viable seeds/m^2 of bed N.B. Seed is small and sowing depth should not exceed 3 mm.
Fertilisers	At FRI (light pumice soil) 30% potassic serpentine superphosphate incorporated into seedbed at 1500 kg/ha before sowing. "Magamp", a slow-release nitrogen fertiliser is also incorporated into the seed bed at a rate of 400 kg/ha.
Weedicides	*Cupressus macrocarpa* and *C. lusitanica* tolerate pre-emergence and post-emergence spraying with propazine (0.6 kg/ha) or chlorthal (5.5 kg/ha). In the second year, propazine (1 kg/ha) or chlorthal (9 kg/ha) may be applied.
Shading	Beds should remain covered with shade cloth (50% shade) until seedlings are 3–4 cm tall or, alternatively, should be lightly covered with crushed bark, and kept lightly watered until germination is complete.
Conditioning	Undercut 1/1 trees at 10–12 cm depth (February/March), then wrench at 4-week intervals until lifting.
2nd year	Transplant at 15 x 15 cm^2 spacing.

Cuttings: (e.g., Leyland cypress)

- Best time for setting is from January through to start of spring growth. If taken in summer or early autumn, misting or frequent top watering is required, while for late autumn or winter cuttings, bottom heat is beneficial.
- Choose shoots which have been actively growing. Reject weak side shoots.
- Make cuttings 10–20 cm long. If using a vigorous side-shoot, include a small heel. If using a terminal shoot make a scar, 5–6 mm, at the base, preferably by pulling off a side shoot.
- IBA or a 50/50 mix of "Seradix 3" and "Captan" (fungicide) may improve rooting.
- Spring cuttings should root in 4–6 weeks. Leave autumn-rooted cuttings over winter and plant as bare-rooted stock in nursery in the following spring.
- Inspect all cuttings 3 months after setting. Callused, non-rooted cuttings should be lightly scraped, dipped in hormone and re-set. Rooting is then usually quite rapid, although occasionally cuttings will continue to root up to a year after setting.

C. Recommended Seed Sources

Seed Stand No.	Locality	Year planted	Area	Origin
		Cupressus macrocarpa		
Wn 11	Lismore Forest, Cpt 14	1964	1.9 ha	Parent trees selected by G. H. Hocking on property of H. Groves, "Marangai", Tinui, Wairarapa
Wn 14	Ngaumu Forest, Cpt 3	1949	2.4 ha	Parent trees selected by G. H. Hocking on property of E.S. Bibby, "Blackburn", Hawkes Bay
S15	Longwood Forest, Cpt 34	1946	1.5 ha	Tapanui (1944)
		Cupressus lusitanica		
Ak 2	Waipoua Forest	1938	(30 trees)	Ex Italy 1932
Ak 8	Whangapoua Forest, Cpt 26	1967	2.2 ha	Kenya Forestry Dept (bulk seedlot)
Ro 30	Mangatu Forest, Cpt 50	1970	0.4 ha	Selected trees in Sokoro Seed Stand, Elburgon, Kenya
Ro 31	Mangatu Forest, Cpt 24	1964	2.0 ha	2nd generation Waipoua stock
		Cupressus torulosa		
Ro 40	Puha Nursery	1962	(100 trees)	Unknown
Wn 19	Pohangina Valley, Palmerston North	1972	(25 trees)	"Glazebrook", Maraekakaho, Hawkes Bay
CY 29	Victoria Park, Christchurch	c. 1945	(55 trees) 0.04 ha	Unknown

x *Cupressocyparis leylandii*

Available as cuttings only, on request from various nurseries. Initial enquiries regarding supply may be made to NZ FRI, c/o University of Canterbury, PO Box 4800, Ilam, Christchurch, or Private Bag 3020, Rotorua. (Order at least one year in advance.)

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