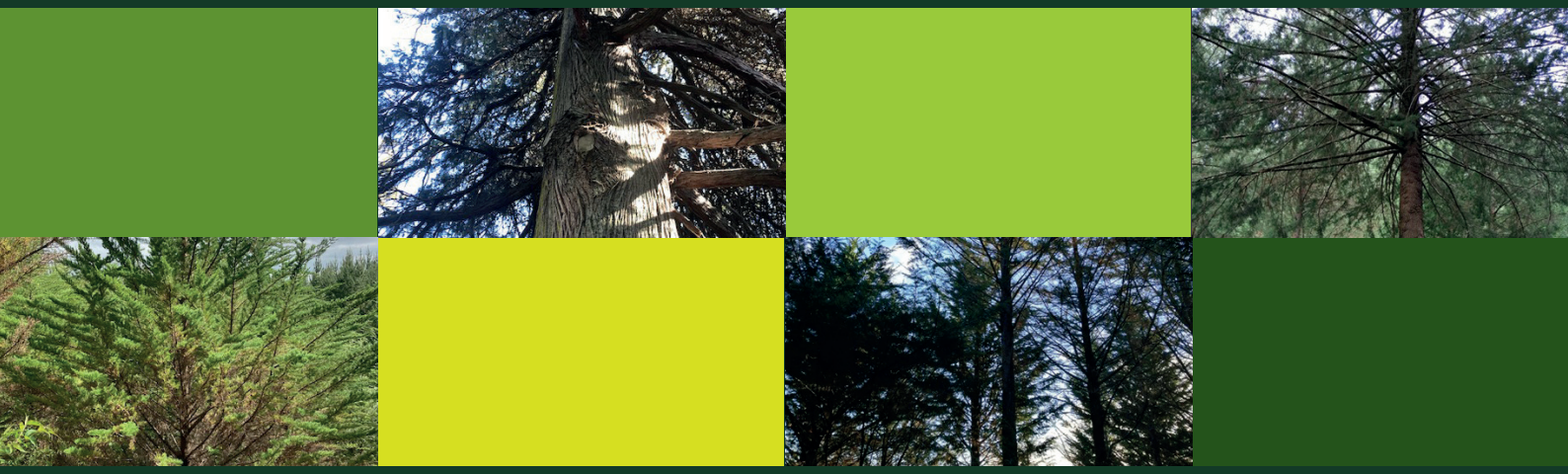
New Zealand Cypress Strategy 2024 – 2044

Whakamahere Cypress
Encouraging Investment in the Cypress Industry



- **Prepared for central government, regional government, and those involved in the forestry and farming sectors of New Zealand.**

Cypress Development Group, NZFFA, Forest Growers Research SWP-T138

Specialty Wood Products Research Partnership

Farm Forestry New Zealand

Contents

This strategy has been written by Vaughan Kearns, ably assisted by the Cypress Development Group, branch of the NZ Farm Forestry Association.

Executive Summary

This strategy presents the business case for developing a cypress forest industry, in particular the required market development for cypress timber and growing a plantation industry that is of a sufficient scale to support further development and growth.

Cypress provides a chemical free alternative to treated pine for the domestic market, appealing to the discerning consumer who seeks a chemical free product. Being a niche, high quality product, cypress timber should continue to attract a premium over commodity timbers. However, market barriers currently limit applications for the timber and growers lack confidence in planting the species because of its reputation for being prone to disease.

The reputation of cypress as a premium plantation timber species needs to be reinstated. Clones (cutting grown trees) are becoming available that perform very well across a range of challenging sites, revealing the considerable potential for clonal cypress forestry in New Zealand. It is feasible to claim that a Cypress variety can be found to suit all regional differences in New Zealand.

Promotional activities are required that present the current state of play and dispel the failures of the past. A strong promotional campaign needs to be supported by regional demonstration plots and field days showing growth rates and health of the latest cultivars to prospective growers.

For confidence to plant the right (canker resistant) cypress species in the right place to produce profitable returns, land owners must be adequately informed. Comprehensive, detailed information (including productivity models, economic models etc) and regularly updated general information (Cypress Growers handbook) is essential to inform stakeholders decisions.

Market development efforts are required to expand the cypress processing industry to generate greater demand for the timber and also provide growers with confidence in planting trees. New and innovative products are required that take advantage of the special properties of cypress timber. Changes to the building code are required so that cypress is no longer disadvantaged for traditional products such as timber framing. This will lead to a market where supply does not meet demand in the short term, but would encourage growers to plant more trees, a positive outcome that generates resilience in the sector and confidence in the species.

Matching timber demand with supply is going to eventually require development of an export market for logs and sawn timber to ensure that as the industry grows, logs that are surplus to local demand can be sold so growers' confidence continues to match the expansion of the industry.

Regional cypress industries are viable in all regions throughout New Zealand. Matching species and cultivars to regions and sites is essential. Matching demand with supply should take place at the regional level and involve co-operative supply chains.

Introduction

Cypress has a significant contribution to make to plantation forestry and New Zealand's emerging bio-economy. Cypress plantations offer a productive and sustainable land use option, one that generates favourable revenue, employment and high quality chemical free product options.

This strategy presents the business case to encourage investment in the industry and describes the measures necessary for the emerging industry to achieve a sustainable scale. Both growers and processors have a contribution to make to develop a lucrative industry based on efficient production of high quality timber that is consistently and reliably supplied into the market.

The forest industry as a whole also has a key role to play, that of embracing diversification into a species that complements radiata pine and produces high-value specialty timber products. Cypress offers a unique recipe for success, with a versatility that is unique among plantation softwoods. To realise, however, the potential that cypress offers, requires a supportive forest industry willing to let go of past paradigms, embrace the new and invest in the future of forestry. The future will bring a transition from resource exploitation and chemical treatment to a circular bioeconomy that embraces natural timbers and sustainability.

Renewed confidence is emerging in this highly valued timber species, noting that history has not always been kind to cypress growers and success has at times been elusive. Past mistakes offer important insights for building a resilient future and work has been quietly and progressively resolving the issues. However, the results of research and innovation do take time to filter through to investors and the challenge for industry will be to overcome any residual negative perceptions and advance the rewards that cypress now offers.

The case for a Cypress Strategy

The Specialty Wood Products (SWP) Research Partnership programme was established by Forest Growers Research (FGR) and Ministry of Business Innovation and Employment (MBIE) with a key research goal:

Delivering specialty wood products through embedding regional strategies with localised plantations networked to local wood processors to ensure a sustainable commitment and continuity of supply.

This includes research of the cypress grown in forestry plantations in New Zealand. Following a mid-term programme review of the SWP programme by MBIE in late 2018, the SWP Project Steering Group decided that a strategy should be developed for the NZ cypress forest industry. The MBIE requirement was for a 'business case' to encourage investment in the cypress industry.

This Strategy document draws on information from foresters, sawmillers and merchants that have expertise or have interest in plantation cypress and the timber. This group set out to inform a detailed strategy document for the development of a cypress industry in New Zealand.
Cypress in New Zealand today

Cypresses hail from the northern hemisphere, and are well known for their durable, scented, decorative timber. There are a number of cypress species, some introduced into New Zealand as early as the 1860s. These introductions were supplemented by a number of commercial clones and hybrids, introduced in the late 1970s.

A number of cypress species are grown in New Zealand for timber. Cypress has long been a favourite alternative to radiata pine for New Zealand's farm foresters, small-scale plantation owners, and some large-scale growers.

The most commonly grown species are (i) *Cupressus macrocarpa* – 'macrocarpa' and (ii) *Cupressus lusitanica* – 'lusitanica' or Mexican cypress. Other cypresses and cypress hybrids grown for timber include:

- *Cupressocyparis ovensii* – Ovens cypress or ovensii
- *Cupressocyparis leylandii* – Leyland cypress
- *Chamaecyparis lawsoniana* – Lawson's cypress
- *Cupressus torulosa* – Bhutan or Himalayan cypress.

Macrocarpa 180 years old, New Plymouth

The National Exotic Forest Description (NEFD) provides a detailed description of New Zealand's production forests. It records the total plantation area of cypresses as about 10,000 ha which constitutes only one percent of the total exotic forests in NZ. The NEFD data reports all the areas and age class distribution of cypresses together.

Fgures 1, 2 and 3 show recent location of cypress plantations by region, and their age class distribution.

Most of the current NZ cypress resource is between 10 and 25 years old, too young for existing processors and supply chains and very different to the older farm trees currently being processed. Indeed a number of sawmills have closed down in recent years due to lack of supply of old growth macrocarpa. Marketing this young resource requires development of an export log market and/or re-developing products for domestic markets at the regional level.

Continuity of supply at the regional level will strengthen domestic markets. The focus needs to be on innovations that generate market demand and premiums for the product from young trees, supported by market research into optimising returns from the export log market.

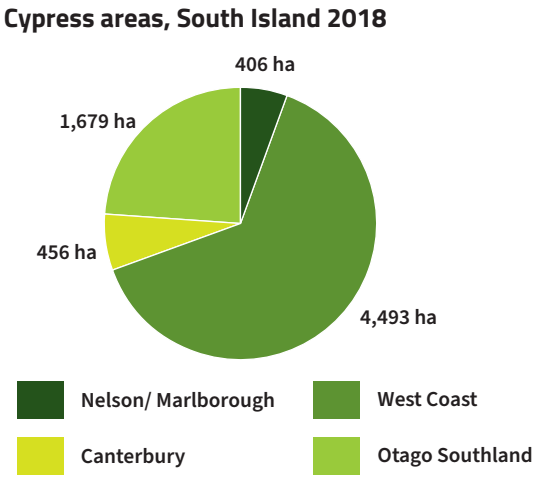


Figure 1

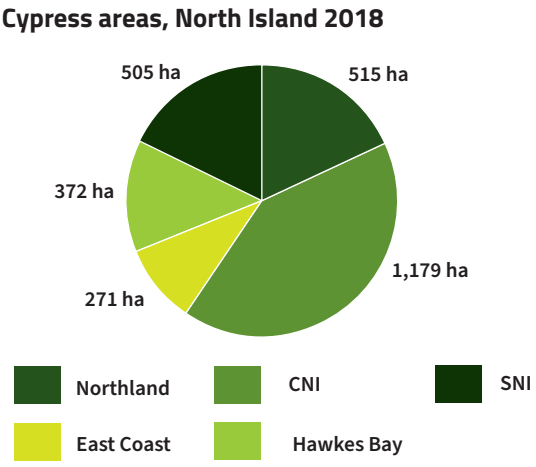


Figure 2

Distribution of cypress species forest area by age class and island as at 1 April 2022

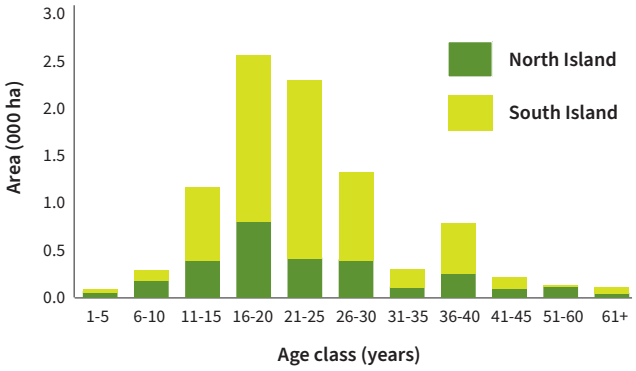
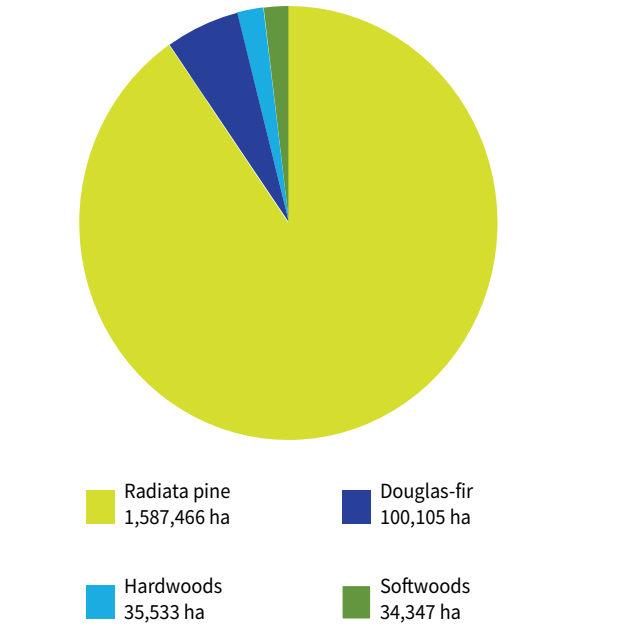


Figure 3

Species Distribution, as at 1 April 2022



Note: Softwoods includes cypress species, Hardwoods includes eucalypts.

Figure 4

As seen in Figure 4, radiata pine is the dominant species, making up 90 percent of the planted production forest area in New Zealand. The proportion of Douglas-fir is higher in Otago and Southland (26 percent) and Canterbury (18 percent) compared to the national distribution (6 percent) as growing conditions are more suitable.

Cypress species grown in New Zealand

The following species are of interest to the Cypress industry in New Zealand. A brief overview of species and the clonal selection process is in Appendix 1.

Cupressus macrocarpa is the cypress that is most familiar to the timber industry, but its reputation as a plantation species in the North Island of New Zealand has been compromised from 30 years of highly canker-susceptible seed lines dominating the nursery trade. Breeding for canker tolerance in this species began in 1983 with the third generation *C. macrocarpa* breeding populations established in winter 2019. Improved seed lines are now beginning to filter through to the nursery trade. This breeding work aims to increase tolerance to canker while also improving tree growth and form.

Macrocarpa Chambers Taihape at age 22

Macrocarpa Buller River

Cupressus lusitanica is native to Mexico and Central America. The species was promoted for plantations by the former NZ Forest Service in the 1980's because it is fast growing, produces high quality timber and tolerates a reasonably wide range of environmental conditions. It is also more resistant to cypress canker than *C. macrocarpa* but has some sensitivity to salt laden winds, so is largely an inland species. Breeding also started in the 1980's and most recently in 2017 third generation *C. lusitanica* breeding populations were established to improve tree growth and form and increase tolerance to canker.

Cupressus x Ovensii, Ovens cypress is a hybrid clone that grew in Wales from the seedlings of a *Cupressus lusitanica* tree that had out-crossed with *Chamaecyparis nootkatensis* growing nearby. It was successfully introduced into New Zealand in the early 1980's and demonstrated much higher canker resistance than *C. macrocarpa* and *C. lusitanica*, although it was slower growing. Several hundred hectares of this hybrid have been planted in the last ten years. The timber is more yellow than the golden brown of macrocarpa and lusitanica heartwood. However, natural durability is likely to be better than these two species due to the high durability of the *C. nootkatensis* parent.

Chamaecyparis lawsoniana, Lawson's Cypress is a native of the western USA/Canada and was widely planted in New Zealand prior to the introduction of cypress canker. *C. lawsoniana* has the best mechanical properties of the cypress species in current use in New Zealand. There are some genotypes that do exhibit superior growth and canker resilience but they are not currently commercially available in any volume.

Cupressus torulosa and other Asian species originating from the Western Himalayas, are currently planted mostly for their aesthetic beauty and stature, but they do have resistance to cypress canker, along with wind, drought and cold hardiness. To date little effort has been made to commercialise these species despite some showing considerable promise as clonal selections or potentially for interspecies hybrids.

C. torulosa **Brightwater Nelson**

A vision for the NZ cypress industry

"Cypress – New Zealand's No.1 natural timber"

Mission:
Working regionally to ensure a sustainable cypress industry

A sustainable supply of a consistent quality product is required, which is highly valued, and is profitable for all those in the value chain:

- Cypress should be a reliable and profitable species choice for growers. ***Growers require confidence.***
- Cypress timbers should be an easy choice for domestic construction and should be valued as a premium product. ***Domestic markets require development.***
- Cypress logs and products should be valued in export markets. ***Export markets require development.***
- Cypress should be integral with the Māori growth economy. ***Participation and partnership in the Cypress forestry strategy is required.***

The vision will be achieved by:

- Availability of elite species/hybrids and growing regimes appropriate for different regions, sites and scale of operations.
- Data and regional demonstration plots that provide confidence in clonal cypress forestry to the grower.
- Easily available, up-to-date information for growers on species choice, establishment and management.
- Development of cost-effective harvesting and processing systems appropriate for the scale achieved.
- Development of a strong, well-connected value chain, where timber processors can be confident of a supply of logs at the quality and price they require, and that growers can supply into as required.
- Development of a 'NZ cypress' brand or brands that becomes highly recognisable in both domestic and export markets and ensures all cypress timber products are highly valued in the market.

Engagement with central and local government will be required. Māori, farmers and farm foresters, forest industry organisations and other industry groups are other essential partners for taking the industry forward on a regional basis.

Industry Research and Development

Scion has a significant stake in cypress research and has invested in genetic improvement, selection trials and permanent sample plots (PSPs). Scion staff have considerable expertise in cypress genetics, selection and breeding and have recently set out a 15-year plan for future research activities with input from the NZFFA Cypress Development Group.

The six categories align with the six proposed focus areas of this strategy:

1. Implementing a cypress forestry research plan
2. Modelling forest productivity and economic feasibility
3. Educating growers on cypress forest management
4. Identifying markets for cypress timbers of all types
5. Working regionally to encourage new cypress forests
6. Building industry partnerships to enhance support and capability

The NZFFA's Cypress Development Group has also become heavily involved in research, providing support for Scion by provision of trial sites, collection of data, evaluation of trials and leading innovative research projects, both in the growing and processing fields. Detailed reports on clonal selections and research outputs are regularly produced by the Cypress development Group and can be found on the Farm Forestry website: *www.nzffa.org.nz/farm-forestry-model/species-selection-tool/species/cypress/reports/*

An industry structure is required to oversee commercial development of the species.. The Cypress Development Group intends to lead industry research and commercialisation of the species.

Investment in cypress research can only be made if there is confidence in the value proposition, so it is essential that the whole industry is aware of progress made by the CDG and shares a long-term vision of a sustainable NZ cypress forest industry.

The challenge is to prioritise research activities and secure funding for that research to go ahead. There will also need to be agreement on ownership of IP and other outputs such as germplasm.

Genetics and Propagation

Work has been ongoing for several decades and continues into breeding new canker-resistant macrocarpa as well as improved C. lusitanica and hybrids. This effort is beginning to reap rewards, but that momentum must continue and further genetic improvement is required.

Hybrid cypress Buller River

Clonal (i.e. cutting grown) cypress cultivars offer the greatest level of improvement in the shortest time and are the current focus of efforts to deploy improved plant stock. A limited number of clones have been through the full 15 year testing cycle recommended by Satchell (2017) for final selection, and work is underway to grow these in stool beds for supply of cutting material to the nursery market. Other newer clones are also becoming available, but issues such as susceptibility to crown breakage and windthrow require greater tree maturity to evaluate. These newer, less thoroughly evaluated improved clones could still be deployed at scale, provided growers are aware of the risks where these offer advantages over previous selections that have a longer history of success.

NB2 Hybrid Clone at Taihape

Immediate priority needs to be given to clonal reproduction work, including rejuvenation of material from mature trees, improving the rooting percentage of clones and exploring more cost-effective methods of producing clonal tree stock. Price remains a barrier to mass deployment of clones and reproduction efficiency improvements are necessary in order to bring the price of clones down to compete with seedlings.

Performance evaluation research must continue for new clonal selections, which should be planted and evaluated across a full range of different sites throughout New Zealand to test their limitations and optimise their siting. Resilience across sites can only be identified by trialling clones across a large range of sites (Satchell, 2017).

Growers need to be forward thinking and be willing to participate in demonstration trials of new selections. Research has identified a clear, game-changing opportunity in clones, but this journey has just begun and performance of clones varies by region and site. Industry-good work is essential to generate a further-improved future resource that is even more healthy and productive than today's plantings.

Seed orchards and breeding for improved seedlines should continue while interest in cypress for plantation forestry grows via clonal forestry. However, the consistent wood properties offered by clonal selections offer a market advantage to growers. A future refocus of breeding work into production of parents for a hybrid breeding programme may be on the cards, especially if the price of clonal plant stock becomes competitive with seedlings.

Selection criteria recommended by Satchell (2017) for clonal cypress includes growth, form, low levels of fluting, high heartwood content, sufficient wood density and stiffness, a low incidence of stem breakages, toppling and canker disease over fifteen years of ramet growth. Satchell evaluated performance of mature clones by using a rating method for four performance criteria: tree size (as diameter), tree form, stem quality and foliar (crown) health. This method proved very successful for selecting best-performing clones and could continue to be used for evaluating clones for consistency going forward. A single evaluation method that is consistently applied by all stakeholders is required.

The Ovensii clone has proved to perform consistently well throughout New Zealand and is now considered to be the performance benchmark for assessing new clones against. This clone should be planted in all trials as the control for evaluating new clones against.

Processing research

Typical pruned cypress sawlog regimes are for 30-40 year rotations. This is expensive and is a significantly longer rotation length than for radiata pine. Because of the young age class of cypress plantations becoming available for processing, attention to processing methods for short rotation/no-prune regimes and continuous cover regimes is required.

Cypresses can be grown at a high stocking to increase early volume production so that over 400 m^3 per hectare is possible by age 20. Recent research has demonstrated high grade recoveries of sawn timber from smaller diameter unpruned trees grown at a high stocking in a low cost regime. Further research is required to improve the cost-efficiency and sawn recoveries from smaller diameter logs at the smaller sawmill scale. This would accompany sawn timber product development from small diameter trees and include work on durability and code compliance for various products, including structural no.1 framing, structural appearance, window joinery, cladding and decking.

This work could contribute to an economic assessment of regimes and seed the development of markets for sawn timber from short-rotation cypress. Developing the market for co-products (oils etc) is a processing opportunity that may increase returns to growers.

Working regionally to ensure a sustainable cypress industry

A strong cypress forest industry will require establishment of coordinated regional value chains so that a consistent supply of a consistent quality product is available for the market. Standing volumes and age classes will require quantifying so that processing scale can be adapted to those volumes and to facilitate investment in processing facilities.

Kinleith Forest – Guptill Clone

Planting should be encouraged at any scale possible within each region because logs surplus to domestic processing capacity can supply the export market. However, regional contributions would need to be made towards developing export markets for both sawn timber and logs at a national level.

Promotion to growers

Promotion of cypress forestry will require regional industry champions who engage with local government and Te Uru Rākau in providing extension activities, to then inform prospective growers on the opportunities to grow cypress. Extension activities would focus on land owners on a regional basis, including Māori.

Demonstration sites and trials will be essential to generate enthusiasm and provide evidence of the potential for cypress within a region.

A national industry body (the Cypress development Group) would coordinate activities between regions, engage with forest industry organisations and other industry groups in promotional activities and develop the export strategy.

The support of stakeholders throughout the value chain will be required at both the regional and national levels.

Regional harvesting and processing

Goal: "That domestic processors will have access to a sustainable supply of good quality logs at a fair price, and will produce a range of new and traditional products for sale into premium markets."

The need to take a strategic regional approach recognises that different regions have different strengths when it comes to growing, processing and marketing cypress, and that these differences should be recognised, communicated at all stages in the value chain, and capitalised on.

The value proposition for new regional processing operations must clearly demonstrate positive returns to investors. Research is required to identify new market opportunities, available log volumes and market development efforts that then informs investment decisions.

***C. torulosa* Brightwater Nelson**

Establishing a strong, fair and well-connected value chain will require development of efficient small-scale harvesting systems that are able to adapt to the regional volumes required by processors and that meet contemporary environmental and health & safety requirements. Innovation and technology will play an important part in the evolution of small-scale harvesting systems.

Local processing for local markets should be a regional goal pursued collaboratively by growers and processors. Growers should be confident that their trees will be utilised locally and that the value chain maximises their returns to then motivate expansion of the industry.

Optimised small-scale processing systems along with collective harvesting across multiple small woodlots is required on a regional basis. Processors should be confident that the log supply meets the quality they require and at a price that is fair to both buyers and sellers. Grading standards for logs should be developed and applied consistently across the industry with a standardised system for valuing trees (stumpage) and logs (delivered).

Regional timber markets would apply national grade standards (e.g. Farm Forestry Timbers grades) to ensure wood supply is of a consistent quality and meets building code requirements for each product.

Proposed actions:

- Improve national resource information for cypress*
- Support research into small-scale harvesting and processing systems, including the introduction of new technologies
- Further develop the NZFFA Farm Forestry Timbers website to increase its value as a sales hub for both growers and timber product suppliers.
- Ensure Farm Forestry Timbers grading standards are well-publicised and taken up by processors and relied on by timber buyers.
- Set up collective harvest of multiple small woodlots on a regional basis.

* SWP/FGR work underway

The Informed Grower

Growers need to be confident that cypress forestry is a profitable and environmentally sustainable land use. A clear value proposition is required on the market advantage cypress offers growers as a specialty timber. Both domestic and export value should be defined and economic data on regimes, yields and product values should be available to prospective growers.

A plethora of information resources for cypress are available, but are not readily accessible and many of the resources are outdated. Easily accessible extension resources are required, summarised in an updated Cypress Handbook.

Industry champions are required who can educate those directly involved in making land-use decisions involving forest establishment. Extension activities could include direct engagement with landowners and their advisers, including regional councils, farmer groups, Māori bodies, along with extension services such as Te Uru Rākau NZ Forest Service. Easily accessible information is required via a range of media. Forestry consultants should have the opportunity to upskill and diversify away from radiata pine, and there needs to be means for them to do this – for example, via workshops or other professional development tools.

High quality demonstration sites and trials will be essential to generate enthusiasm and provide sensory evidence of the potential for cypress within a region.

The support of stakeholders throughout the value chain will be required at both the regional and national levels.

Cypresses are acknowledged as an ideal woodlot species, but there may also be opportunities to grow the species at scale. Corporate growers and large land owners should be engaged and informed of the opportunity as part of a wider industry education programme.

***C. torulosa* planted 1865 Brightwater Nelson**

Modelling forest productivity and economic feasibility

All forest growers want to plant trees with improved growth and form as well as known wood properties. Growers also need to be informed on regimes (e.g. longer sawlog vs short rotation joinery products) to manage their forest investment and to assess the potential economic feasibility each of these regimes offers.

Cypress growth models have been developed in the past, but these now need updating to include newer cypress species (e.g. Ovens cypress and newer clones). Models also need to be extended to a range of site types and regions. The aim should be to produce site/species guides for growers and accurate data on growth according to site.

Milestones of the current SWP-Work Plan 120 involve using data from permanent sample plots (PSPs) to produce an economic evaluation of Ovens cypress. This will be a first step in the development of economic models.

Growth models then provide data to feed into economic models. Economic data is also required, including price data for traditional and new innovative products, along with grade recoveries and processing costs for logs from the range of regimes available, to provide residual log values and models of annualised revenue per hectare. The resulting economic model will allow growers to make informed and confident investment decisions about the feasibility of establishing and managing cypresses under different regimes and on different sites.

Collaboration

A key outcome of the strategy will be to bring members of the cypress value chain together, and to agree on an organisational structure which can work cohesively to support the industry – e.g. by coordinating funding bids, promoting cypress products in domestic regional or off-shore markets. In this way the whole industry will share a long-term vision of a sustainable NZ cypress industry.

The NZ Farm Forestry Association's Cypress Development Group (CDG) offers an existing industry structure to lead, support and promote the cypress industry. The CDG represents and advocates for all cypress growers. However, currently the cypress-growing sector is small, lacking investment and with weak links between the research sector, nurseries, growers, the processing and marketing sectors, and local and national government. Species research and development via collaboration between Forest Growers Research and the CDG is essential.

A national industry body would need to coordinate regional activities and engage with forest industry organisations and other industry groups and develop the export strategy.

Involvement with Iwi

This strategy recognises the need to fold in the principles of the Treaty of Waitangi and through participation, partnership and protection, offers cypress forestry as a good fit for Māori land users. Cypress forestry is an environmentally sustainable land use, one that supports local production and consumption of a natural product that is valued. Ngāti Tuwharetoa are currently involved in research and development trials in their rohi. This group is currently in discussion with Ngāti Tuwharetoa and a relationship based approach to this Cypress Strategy will be ongoing. Lake Taupō Forest Trust (Ngāti Tuwharetoa) has planted trials of cypress in order to diversify the species they grow. Their land will be in forest in perpetuity. Further relationships with this Iwi are intended to strengthen industry collaboration. Ngāi Tahu are directly involved in cypress genetics through their subsidiary company, Proseed.

Cypress markets and marketing

Goal: "NZ-grown cypress and cypress products are recognised as a premium product and are in high demand across a wide range of sustainable domestic and international markets."

It is proposed that a 'NZ Cypress' brand is developed. This will allow development of market acceptance of timber from ALL cypress species including cypress hybrids and all age classes. The aim is to ensure that all cypress timber and products are recognised and highly valued by architects, builders, joiners and all other potential domestic end users. The development of alternatives to traditional products e.g. engineered or thermally modified products will enhance marketing opportunities.

The goal is to have cypress recognised and highly valued across a range of products. This begins with understanding what builders and architects want and this market information is fed back to researchers and industry stakeholders.

If products are well branded, and exemplars are promoted throughout the value chain, a flow through from the breeders and growers to the end users will ensure product brand recognition. Marketing campaigns could be based on new names, such as 'golden cypress' with buyers clubs' established on the Farm Forestry Timbers website.

Proposed actions:

- Domestic markets are identified and understood.
- Future domestic and international market opportunities are clearly defined (30-50 year time frame).
- Product branding is developed and industry uptake enabled.
- Marketing campaign/s based on cypress strengths (e.g. natural durability) and/or new names (e.g. 'golden cypress').
- Continued research to better understand differences in wood properties between species (e.g. durability) and promote exemplars of product use.
- Market information becomes readily available to sellers and buyers with various options for website development, either just for NZ cypress or as part of a broader strategy for all NZ-grown specialty timber species, for example *www.woodsolutions.com.au/*
- Develop a 'buyers club' via the Farm Forestry Timbers website and use that platform for promotion.

Kinleith Forest – Munro Clone

Kinleith Forest –Taylor Clone

Cypress Work Priorities 2024-2044

Cypress breeding programmes

Immediate priority

- Clonal evaluation and selection
- Rejuvenation of mature selections, improving rooting percentage of cuttings

Five year priority

- New selections from hybrid trials and stool bed production underway
- Assessment of new generation provenances producing selections for further trials
- Efficient propagation system developed for clonal cypress

Ten year priority

- Full evaluation of timber properties of clonal selections completed

Site productivity and growth models

Immediate priority

- Measurement of existing PSP network and update growth models

Five year priority

d Economic model completed

Ten year priority

- Improve productivity and growth models for clonal selections

Silvicultural practices

Immediate priority

- Evaluate growing over a shorter rotation (20 - 25 years), model diameter over black knots according to stocking under a no prune regime
- Evaluate technology and options for pruning

Five year priority

- Update of Cypress Growers Handbook completed www.nzffa.org.nz/farm-forestry-model/species-selection-tool/species/cypress/information-resources/#cypress-handbook

Ten year priority

- Data and models available on the effect of DOS on value according to different regimes

Erosion Mitigation

Immediate priority

- Promotional activities targeting Regional Councils showing economics and suitability for steepland forestry

Five year priority

d Efficient single tree extraction systems are available and costed, contributing to the economic model.

Ten year priority

- Steep slope demonstration blocks are available in every region and well promoted as the choice for permanent forestry.

Carbon Sequestration

Immediate priority	Five year priority	Ten year priority
■ Produce growth and carbon models according to region and class of land ■ Participate in updates to the lookup tables to better reflect species growth rates	■ Biomass allocation to calibrate Carbon change	■ Biomass allocation and decomposition analysis

Market Access

Immediate priority	Five year priority	Ten year priority
■ Building code updates and market opportunities identified and promoted ■ Provide access and ease of use for construction in domestic market ■ Assess laminated cypress heartwood window joinery d Assess glulam produced from machine-graded cypress for stiffness and strength	■ Durability assessment completed for thermally modified cypress sapwood and alternative solution produced for cladding and/or decking	■ Markets established regionally to support sustainable small scale industry

Wood Quality

Immediate priority	Five year priority	Ten year priority
■ Continuing durability and strength analysis research ■ Sample core analysis to enable preliminary durability assessment	■ In ground testing for durability (graveyard testing) correlated with accelerated decay methods for cypress	■ Wood strength and durability validated for all clonal selections

Timber Products from Cypress

Cypress Timber – a premium, sustainable product, for both export and the New Zealand markets.

Using New Zealand grown Cypress enhances the goal of New Zealand becoming a circular bio-economy. It has natural durability, so does not require imported chemicals to increase its durability for building uses. A range of cypress products exist that can replace the imported products that threaten the ecosystems in the countries from where they are sourced. Current imports of raw timber (not furniture) total $120 million per annum for softwoods alone, with the bulk of this being Western Red Cedar for house cladding (Harrington, Bayne. Scion Research, Sept. 2023). NZ grown Cypress could fill this importation without difficulty, being a timber with equal natural durability and is somewhat superior in terms of strength and density.

Cypress hedge

Export Opportunities

Cypress timber is well understood in Asian markets. Hinoki and Torulosa are revered tree species in their home countries and have been used for centuries for buildings of high importance. A significant market exists for the export of scented timber for the manufacture of coffins. At present there is high demand for what can only be termed, low quantity cypress wood from farm windbreaks, for this purpose.

But even these low log grades are attracting prices at three times the value of our best pruned Radiata pine sawlogs.

High grade cypress sawlogs or timber from pruned trees grown in a woodlot could expect to sell at a much higher rate than that from windbreaks. But the resource does not as yet exist in any marketable volume.

Sawlog from a Macrocarpa x Lusitanica hybrid NB 2

Cypress fence

Rustic, bandsawn Macrocarpa door

Macrocarpa shiplap on a cabin

Barn style door, Macrocarpa

Cypress beams

Cypress ceiling lining

Cypress ceiling lining , linseed oil finish

Cypress staircase and interior wall lining

Cypress cladding

Lawson Cypress, red timber stain, rustic bandsaw finish

Hybrid Cypress bowl

Hybrid Cypress bowl

Cypress bar furniture

Appendices

Appendix 1: Clonal selection process

Selection process for Macrocarpa *C. macrocarpa*

In Figure 1, the tree on the left has quite bad stem and foliar canker and the tree on the right has mild canker disease. The central tree has great form with a strong central leader, light branching and an almost perfectly cylindrical pruned stem. This tree appears resistant to canker but for release as a cultivar ramets (cutting grown trees) would require trialling across a range of locations.

Figure two focuses on the lower half of the tree to show superior growth and form to its neighbours. This specimen has straight growth and shows significantly smaller branching resulting in smaller knot size in the top logs. The effect of Canker in neighbouring trees is clearly evident.

High quality trees are identified and selected for further work. Cuttings are taken to produce clones, rejuvenated and propagated in stool beds. These are then trialled and tested before being promoted as new cultivars.

Figure 1: Twenty-year old macrocarpa, Otago

Figure 2

Selection process for Himalayan cypress *C. torulosa*

Figure 3

Figure 4

Figure 3 shows trial seedlings of Himalayan cypress grown in the Raetihi CDG trials. The variability of seedlings from a single tree is clearly evident. Cuttings are taken from the best trees to create clones that are then available for trials. Selection criteria for these canker resistant clones (canker has never been found in *C. torulosa*) include growth rate, form, a single straight leader and small branches. Figure 4 shows a five year old "Angus" clone of *C. torulosa* from a select seed lot. At five years old it has a height of 4.2m, exceptional for this species. Clones from this are available from the Cypress development Group. Figure 4 has the man whom the tree is named after in the photo.

Selection process for lusitanica

Figures 5 and 6 show trees from the Rotoehu seedlot at 23 years old. These trees are low pruned but not thinned and the photos profile straight trunks, lack of fluting, and canker resistance. Figure 7 shows 5 year old Rotoehu saplings.

Figure 5

Figure 7

Figure 6

Selection process for lawson cypress *C. lawsoniana*

Lawson Cypress is a well known timber and is favoured for construction and premium boat building in the USA. This is due to its phenomenal strength to weight ratio. However, due to its slow growth and canker susceptibility it has fallen from favour in New Zealand. The CDG is, however, working on fast-growing canker-resistant clones. Figure 8 shows the "Glenbervie" clone at 5 years old, notable for its upright form, wind stability and proven canker resistance over other Lawsons. This clone has been released and is becoming available in increasing numbers.

Selection process for hybrids

Comprehensive work on cypress hybrids has been undertaken by Scion. The hybrids are a mixture of macrocarpa, lusitanica, arizonica, guadalupensis, and nootkatensis (Alaskan Cedar). The species have been crossed to achieve a raft of individual hybrid ortets. From these the best have been selected at an early age for ability to root along with growth and form and canker resistance. Figures 9, 10 and 11 show hybrid ramets at 3 years 8 months of growth.

Note the radiata pine seedlings that have popped up after the previous harvest. They have a one year head start on the Cypress Hybrids, but they are far from dominating on this dry site.

Some of these clones have shown phenomenal growth at this age. The CDG is propagating cuttings of these selections and a license has been granted from Scion to produce these for sale going forward.

Other successful hybrid clones are already available for sale and trial plantation lots have been established nationwide.

Figure 8

Figure 9

Figure 10

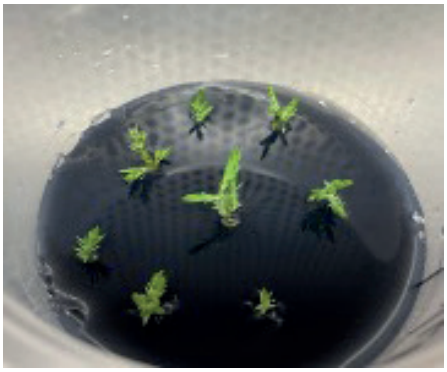
Figure 11

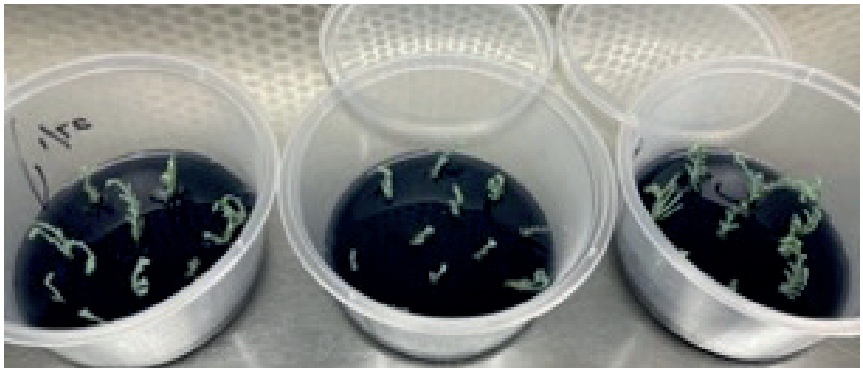
Propagation techniques

Figures 12 ,13 show seedlings of Macrocarpa cultivar Rangitoto #3, commissioned for propagation by CDG.

Figures 12 and 13

Figures 14 and 15 demonstrate tissue culture of elite clones commissioned by CDG for production of trees for deployment at scale, likely the first example of cypress tissue culture / micro cuttings clonal propagation technique in the world .





Figures 14 and 15

Current suite of nationwide Cypress Development Group trials

The following table outlines seedlines and clones available in 2024 from CDG as part of their promotional activities. CDG are conducting annual trials and plantings nationwide.

Species	Reference name	Origin
Macrocarpa	Mangahoe 1	
	Mangahoe 3	
	Rangitoto 3	Bulls, Rangitikei District
	Chatham Island 1	Chatham Islands, Rēkohu
	Chatham Island 2	Chatham Islands, Rēkohu
	DT1 Chambers	Taranaki
	Taffes Glen	
	Kahutara	Kaikoura District
	Raukawa	Whanganui District
	Waitetoko	Turangi District
Lusitanica	Puketi 9	Puketi Forest , Northland
	Waipawa Daroux	
	Gwavas forest	Taumahapu, Hawke Bay (Scion)
	Rotoehu	Rotoehu Forest. Bay of Plenty
	Rangiwahia	Manawatu District
	Blue Haze	Manawatu District
	Wairakei	Taupo District
Torulosa	Vaughan	Raetihi, Waimarino District
	Dean	Raetihi, Waimarino District
	George	Raetihi, Waimarino District
	Angus	Raetihi, Waimarino District
	Terry	Raetihi, Waimarino District
	A1, D1, Damian	Ashburton
	Rongoiti	Taihape District
	Torulosa Blue	Brightwater Nelson District
Lawson Cypress	Glenbervie	Glenbervie Forest, Hikurangi, Northland
	Gowan Hills.	West Southland District
Mac x Lusi Hybrid	Neil Barr 1	Wakanui Conifers, Taihape, Rangitikei District
Mac x Nootka Hybrid	Taylor	Whakarewarewa (Scion)
	de Grandhomme	Whakarewarewa (Scion)
	Sodhi	Whakarewarewa (Scion)
	Guptill	Whakarewarewa (Scion)
	Williamson	Whakarewarewa (Scion)
Lusi x Nootka Hybrid	Ovensii	Wales
	Henry	Whakarewarewa (Scion)
	Stead	Whakarewarewa (Scion)
	Conway	Whakarewarewa (Scion)

Appendix 2: Sources of Funding for Industry Development

Sources of funding for cypress forestry development

The **Forest Growers Levy Trust** is the industry body, with NZFFA as a partner in the Forest Growers Levy. The Cypress Development Group is a NZFFA Action Group. Funding allocation is contestable and work plans that reward levy payers tend to be prioritised. Cypress, being relatively well understood by growers fits this category.

MPI Sustainable Food and Fibre Futures *Te anamata o ngā kai me ngā weuweu toitū*

"SSF Futures supports problem-solving and innovation in New Zealand's food and fibre sectors by co-investing in initiatives that make a positive and lasting difference."

Te Uru Rākau NZ Forest Service – although no funding streams are operational at present, Forestry extension services are a key plank in this new Government entity. It is expected that a funding mechanism will be developed in this area before long.

Sources of funding for cypress industry development

The Agricultural and Marketing Research and Development Trust (AGMARDT) strategically invests in programmes that enable individuals and businesses to innovate, to be industry leading, and to exploit valuable opportunities – all with the ultimate vision of driving continued growth of New Zealand's diverse agricultural sectors. The following opportunities are relevant to the cypress development plan.

Market Insight Investment ($50k - $400,000k, matched dollar for dollar)

- Consumer and Market Insight - AGMARDT will consider funding assistance for businesses, or established industry groups, to undertake market research and consumer insight
- activities within specific international markets.
- Establishing Collaborative Relationships - AGMARDT will consider providing funding for businesses or industry groups to enable them to explore the prospect of developing collaborative relationships that are beneficial to the agribusiness community in New Zealand.

AGMARDT Accelerator loans ($100,000 to $300,000)

Accelerator loans support New Zealand agribusinesses that may require additional short-term capital to further enhance projects that are commercial in nature or close to commercialisation and which would not otherwise attract commercial funding.

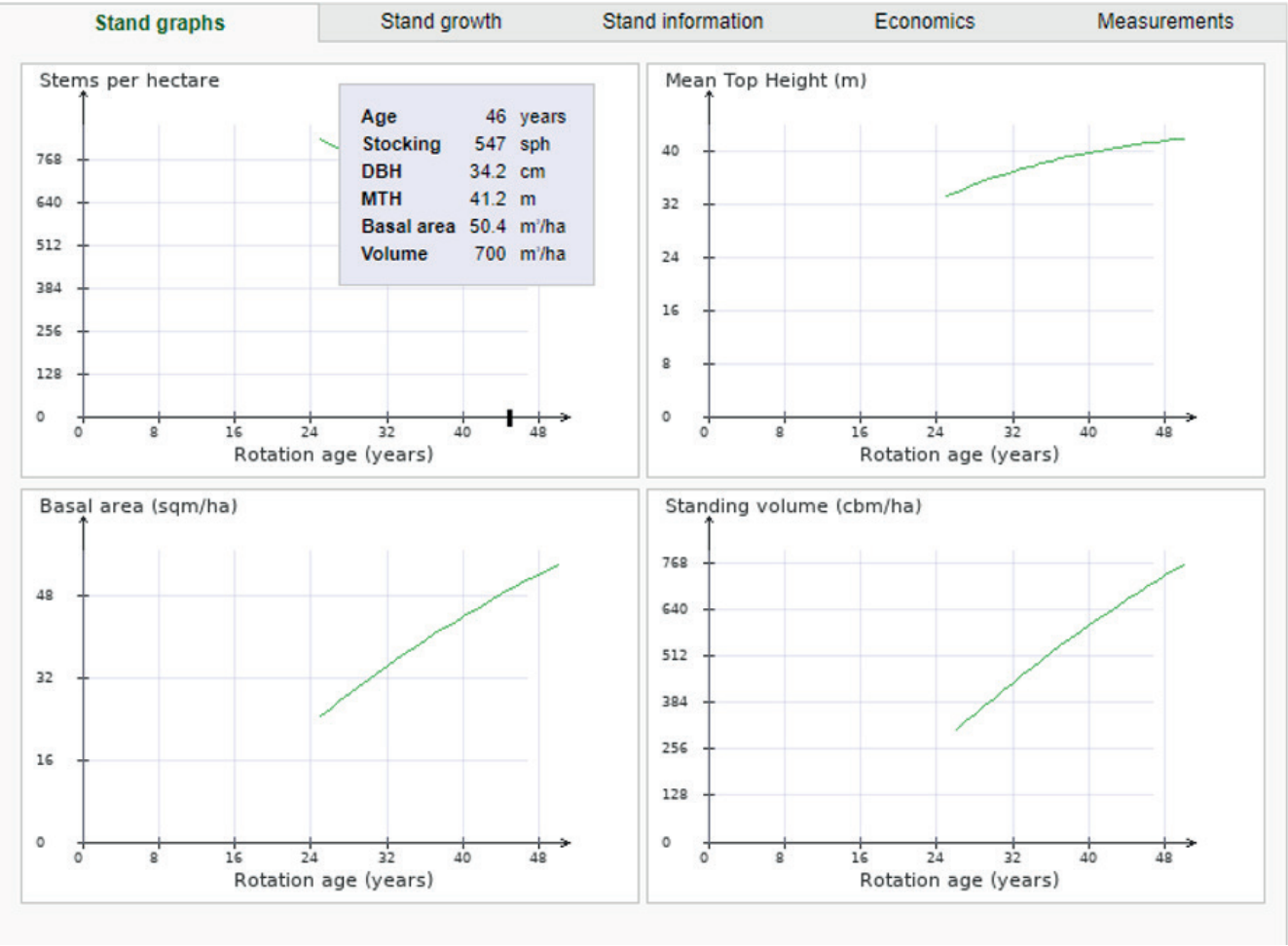
AGMARDT Accelerator Loans provide an opportunity to initiate further business growth by assisting applicants to:

- Fund expansion requirements to improve capacity and efficiencies within their business and immediate supply chain
- Adopt new technologies, production and processing capabilities to add value within the New Zealand agribusiness sector
- Initiate distribution and/or marketing programmes to enhance early adoption and speed to market within the agri-business sector
- Develop proven prototypes to commercialisation
- Fund acceptable website and software development
- Partially fund start-up projects in conjunction with approved commercial Bank lending where additional capital is required

Appendix 3: Cypress regimes and the case for change

Macrocarpa can grow at 80 to 150 cm a year with a diameter growth of >2 cm. At age 10 trees may be 8 - 12 m tall with a mean diameter at breast height of 15 - 25 cm. Stands on reasonable sites will put on volume of 20 m3/ha/annum or more, and trees with a mean diameter at breast height of 60 cm may be produced within 35 to 40 years.

Using sample plot information, industry has developed an interactive growth model for cypress. This is available via Forest Growers Research as the Cypress calculator.



Traditional cypress regimes involve pruning and thinning and rotation ages are often 30 to 40 years, making return on investment at harvest variable. The SWP programme conducted a sawing/recovery study evaluating grade recoveries from 20-year-old untended C. x ovensii and C. lusitanica clone GH5 from Rotoehu forest.

To complement the sawing study, this evaluation looked at the economics of growing a 20-year untended C. x ovensii regime over a range of sites by modelling existing PSP data to predict volumes at age 20 and returns to the grower for a range of scenarios. The outcome from this analysis of a short rotation (20 year) no prune and no thin C. x ovensii regime suggests this regime is profitable based on a range of site productivities, log prices and starting land values.

Table 2 below shows the sensitivity of returns to land price, in green where projected IRR falls below 7% and in yellow where land with a high site index is unlikely to be available at the low per hectare land price.

Senstitivity to land price (Rate of return 7% and log price average $166/cm^3$)

	Site Index 31		Site Index 28		Site Index 26		Site Index 24	
	NPV@7%/ha	IRR(%)	NPV@7%/ha	IRR(%)	NPV@7%/ha	IRR(%)	NPV@7%/ha	IRR(%)
$3000/ha	10492	12.1	7802	10.5	4655	9.8	4213	9.8
$4000/ha	9699	11.3	7008	10.5	3862	9.0	3419	9.0
$5000/ha	8905	10.5	6215	9.8	3068	8.2	2626	8.2
$6000/ha	8112	9.8	5421	9.0	2275	8.2	1832	8.2
$7000/ha	7318	9.8	4628	9.0	1481	7.4	1039	7.4
$8000/ha	6525	9.0	3834	8.4	688	7.4	245	7.4
$9000/ha	5731	9.0	3041	8.2	-106	6.6	-548	6.6
$10000/ha	4938	8.2	2247	7.4	-899	6.6	-1342	6.6

Over a range of site quality and log price scenarios tested in this evaluation, a 20 year no prune and no thin regime using *C. x ovensii* appears to be profitable. One cautionary note is that the evaluation was carried out using a *C. lusitanica* growth model, which may not accurately represent the performance of C. x ovensii.

Appendix Four: Cypress research plan 2020 - 2035 Scion

Research into small-scale harvesting systems, including the introduction of new technologies is helping develop best-practice guidelines for processing cypress (e.g. sawing, drying, grading).The goal is to investigate options and markets for co-products (oils etc) to increase the returns. Work is to continue in R&D to better define the wood properties (e.g. durability) between species where appropriate and to collate data on wood properties and regulations around use of cypresses to produce fact sheets for architects, specifiers etc.

The table opposite demonstrates the commitment of Scion to these goals over a 15 year period. From establishment dates of 2008 to the present, countrywide trials are underway. The table shows this planning and data collection as a systematic plan

Ongoing evaluations of existing hybrids - growth/form/wood properties, over the newer sites continues as they get to size. To get more market share and/or acceptance, the durability work, modification, stiffness etc is a high priority.

Compartment 179 - Kaingaroa Hybrid Cypress trials

Cypress Research 2020-2035

Year Est'd		Forest Site		Year of Activity	Focus of study	Proposed data collection activty															
						20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31	31/32	32/33	34/34	34/35	
	Characterisation of hybrids																				
2008	Hybird	Kaingaroa 320	Clonal Test Rows	2021	Heartwood																
2008	Hybird	Kroa 320	Clonal Test Rows	2023	Durability (1000 samples)																
2008	Hybird	Whakiangiangi	Clonal Test Rows																		
2009	Clonal Blocks	Kaingaroa 179	Clonal Blocks	2021	Heartwood																
				24	Durability																
2014	Hybrid Blocks	Kinleith	Clonal Blocks	22	Growth and From																
2014	Hybrid Blocks	Whaka	Clonal Blocks	22	Growth and From																
2014	Hybrid Blocks	Paparoa	Clonal Blocks	22	Growth and From																
				25	Durability (one site)																
2015	Hybrids	Kroa 1051	Clonal Blocks	24	Growth and form																
2017	Hybrids	Pipiwai	Clone Test Single Tree	25	Growth and form																
2017	Hybrids	Tarawera	Clone Test Single Tree	25	Growth and form																
2017	Hybrids	Kaingaroa	Clone Test Single Tree	25	Growth and form																
2017	Hybrids	All Sites	Clone Test Single Tree	26	Heartwood screening																
				26	Durability testing																
				26	Identify new commercial Clones																
	Long term perfomance monitoring (PSP)																				
2009	Clonal Blocks	Kaingaroa 179	Clonal Blocks	2-3 yearly PSP measure	PSP Remeasures																
2014	Hybrid Blocks	Kinleith	Clonal Blocks	2-3 yearly PSP measure	PSP Remeasures																
2014	Hybrid Blocks	Whaka	Clonal Blocks	2-3 yearly PSP measure	PSP Remeasures																
2014	Hybrid Blocks	Paparoa	Clonal Blocks	2-3 yearly PSP measure	PSP Remeasures																
2015	Hybrids	Kroa 1051	Clonal Blocks	2-3 yearly PSP measure	PSP remeasures																
2019	Site Species Mapping	Pamu Te Anau	Clonal Blocks	2028	PSP install(remeasures)																
2019	Site Species Mapping	West Mauriceville	Clonal Blocks	2027	PSP install(remeasures)																
	Breeding Populations Management																				
2017	3rd generation Lusitanica	Pipiwai	Progeny Trial	25	Growth and form/New selections/ 4th generation																
2017	3rd generation Lusitanica	Tarawera	Progeny Trial	25	Growth and form																
2017	3rd generation Lusitanica	Kaingaroa	Progeny Trial	25	Growth and form																
				25	Rogue existing seed orchards																
2017	3rd generation Luisitanca	All sites	Progeny Trial	26	New Selections for 4th generation																
				26	Seed Collection/Raise Trials																
				27	Plant 4th generation trials																
2019	Macrocarpa Canker Tolerance	Tarawera	Progeny Trial	Will depend of arrival of infection	Canker assessment/New selections																
2019	Macrocarpa Canker Tolerance	Pamu Foxton	Progeny Trial	Will depend of arrival of infection	Canker assessment																
2019	Macrocarpa Canker Tolerance	West Mauriceville	Progeny Trial	Will depend of arrival of infection	Canker assessment																
2019	Macrocarpa Canker Tolerance				Rogue existing orchards																
2019	Macrocarpa Canker Tolerance				New Selections/seed collection																
2019	Macrocarpa Canker Tolerance				New Trials																
	Wood Properties																				
	Recoveries from small logs/ clone			21-23	Sawing study on two new clones/silviculture regimes																
	Heat treatment/novel products				Thermal modification for durability - *C. lusitanca*																
					Outdoor durability *C. ovensii*																
					Framing durability 1 species/clone																
					Characteristic stiffness of *C. lusitanica*																
	Nursery Research/Propagation			22 onwards	Improving rooting % of desired clones																
				23 onwards	Rejuvenation by repeated propagation																
	Model development(if new PSP data available)			22/23																	

Priority/Expected year
1 High
2 Med

FORESTS ▪ PRODUCTS ▪ INNOVATION

Appendix 5:

Cupressus Ovensii Bending Testing to AS/NZS4063:2010

For Ruapehu Sawmills

Te22-071 – October 2023

Authors Doug Gaunt, Bruce Davy
Client Ruapehu Sawmills
Signed off by Doug Gaunt
Date October 2023

OBJECTIVE

To evaluate in terms of the Australian/New Zealand standards AS/NZS4063 the bending strength/stiffness and wood properties of dry 100x50 Cupressus Ovensii timber as supplied by Ruapehu Sawmills (Table 1).

Table 1: 100x50 Cupressus Ovensii supplied
Composite sample of four twenty year old trees, from butt logs and head logs, graded to Number 1 framing grade by Ruapehu Sawmills.

Ruapehu Sawmills Packet Number	Ruapehu Sawmills Description	Number of pieces
02716	Non supplied, no paint	30

MECHANICAL TEST METHODS

Characteristic bending strength and stiffness testing

- All the timber was then tested for bending strength and stiffness as a joist (on edge) in accordance with AS/NZS4063.1:2010 & AS/NZS4063.2:2010 over a span to depth ratio of equal to 18:1 at 1800mm. The test pieces were tested in their dry rough sawn state.
- All the bending testing was undertaken in our Grade 1 Baldwin Universal test machine. The strength testing was completed in the Timber Engineering laboratory of Scion, Rotorua over the period 2nd October - 3rd October 2023.

Density and Moisture content

- From ten only of the bending test samples a short cross section was then cut from an undamaged clear wood section close to the failure point of each test specimen for density and moisture content determination
- Moisture content was measured using the oven drying method.
- Nominal density was calculated for each section from the oven dry weight over volume at test.
- Density at test was calculated for each section from the test weight over volume at test.

TEST RESULTS

Strength and Stiffness

The characteristic strength and stiffness properties have been calculated using the calculations and procedures set out in AS/NZS4063.2:2010. The following Table 2 shows the characteristic strength and stiffness values for the 100x50 Cupressus Ovensii timber with Table 3 listing the New Zealand characteristic grade stresses for the 'SG' grades from the NZS AS 1720.1:2022 Timber structures, Part 1: Design methods standard.

Table 4 shows a statistical summary of the strength/stiffness and wood property data with Appendix A listing the raw test data collected.

Table 2: 100x50 Cupressus Ovensii Characteristic Bending Strength Properties

100x50 Cupressus Ovensii	**Bending Stiffness MoE As a Joist MPa**	**Bending Strength MoR As a Joist MPa**
Packet No 02716 (Indicated SG grade)	7400 (SG6)	24.10 (SG10)

Table 3: Characteristic stresses for machine graded timber NZS AS 1720.1

		Moisture Content – Dry (m/c ≤ 15%)							
	Stress Grade	**Design density** kg/m³	**Characteristic density** (ρ′) kg/m³	**Bending** (f_b') MPa	**Compression parallel-to-grain** (f_c) MPa	**Tension parallel-to-grain** (f_t') MPa	**Tension perpendicular- to-grain** (f_{tp}') MPa	**Short duration average modulus of elasticity** (E′) MPa	**Lower bound short duration modulus ofelasticity** (E_{lb}) MPa
Verified timber	SG 15	570	475	41.0	35.0	23.0	0.5	15200	11500
	SG 12	540	450	28.0	25.0	14.0	0.5	12000	9000
	SG 10	500	415	20.0	20.0	8.0	0.5	10000	7500
	SG 8	450	375	14.0	18.0	6.0	0.4	8000	5400
	SG 6	400	330	10.0	15.0	4.0	0.4	6000	4000

Notes

1. *Shear in beams for seasoned radiata pine shall be taken as $f'_s = 3.8$ MPa. Shear in beams for seasoned Douglas fir shall be taken as $f'_s = 3.0$ MPa.*
2. *Bearing perpendicular-to-grain for seasoned radiata pine and Douglas fir shall be taken as $f'_p = 6.9$ MPa. This strength has been determined in accordance with Section 2.8 of AS/NZS4063 divided by the length of bearing factor k7. This value includes stress spreading and hanging edge effects and is reported at a deformation of 2mm into the timber. Should the perpendicular-to-grain strength without the effects of stress spreading and hanging edge be required, refer to Franke, S., and Quenneville, P. (2010), The Material Behaviour of Radiata Pine Under Compression, New Zealand Timber Design Journal, VOL 18, ISSUE 3*
3. *Short duration average modulus of rigidity shall be taken as G' = E'/15.*
4. *Grades shall be verified in accordance with NZS 3622.*
5. *The design density for use only in computing the dead load due to mass of timber*
6. *The characteristic density is to be used for the design of connections using the detailed method.*

Table 4: 100x50 Cupressus Ovensii Packet 02716 Strength and Stiffness Statistical Summary as Tested

100x50 Cupressus Ovensii Packet 02716	Bending Stiffness MoE As a Joist MPa	Bending Strength MoR As a Joist MPa	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m³	Average Ring Width mm	Distance from Pith mm
Average	7533	50.17	10.19	533.65	484.29	7.94	75.10
Minimum	4870	18.46	9.89	498.27	453.17	4.78	18.00
Maximum	9900	82.65	10.47	563.45	510.44	10.65	200.00
Range	5030.0	64.19	0.57	65.18	57.27	5.86	182.00
Standard Deviation	1050	16.31	0.20	20.91	18.38	1.60	56.67
Coefficient of Variation %	13.94%	32.50%	1.99%	3.92%	3.80%	20.21%	75.46%
Count	30	30	10	10	10	10	10

Summary

1. Overall the 100x50 Cupressus Ovensii as tested for bending strength and stiffness could be assigned the Structural grade S6.
2. Potentially with machine stress grading some timber would be graded as SG8
3. The timber had been uniformly dried down 10% moisture content.

References

1. AS/NZS4063.1:2010, Characterization of structural timber Part 1:Test Methods. Standards Australia/Standards New Zealand.
2. AS/NZS4063.2:2010, Characterization of structural timber Part 2: Determination of characteristic values. Standards Australia/Standards New Zealand.
3. NZS AS 1720.1:2022 Timber structures Part 1: Design methods. Standards New Zealand

APPENDIX A: Raw Data

Table A1: Cupressus Ovensii Packet 02716– Wood

Lab No	Moisture Content %	Density at Test kg/m³	Nominal Density kg/m3	Average Ring Width mm	Average Distance from Pith mm
291918	10.35	553.95	501.97	7.7	118
291921	9.96	536.72	488.10	8.4	22
291924	10.24	526.29	477.42	10.6	18
291927	10.35	528.22	478.66	8.6	105
291930	10.38	563.45	510.44	9.6	60
291933	10.13	526.85	478.38	7.8	38
291936	10.47	561.21	508.04	6.8	30
291939	10.16	512.09	464.88	6.9	100
291942	9.95	498.27	453.17	8.2	60
291945	9.89	529.47	481.80	4.8	200

Table A1: 100x50 Cupressus Ovensii Packet 02716- Bending as a joist Strength and Stiffness

Lab No	Width mm	Depth mm	Slope N/mm	Max Load N	Bending Stiffness MoEj MPa	Bending Strength MoRj MPa	Failure Description
291918	47.35	100.42	295	15526	7630	58.53	Timber
291919	50.64	98.91	263	15372	6660	55.85	Timber
291920	49.10	98.15	277	15654	7400	59.57	Timber
291921	48.08	97.48	290	9230	8080	36.36	Knot Group
291922	49.80	101.59	357	18862	8500	66.06	Timber
291923	49.52	96.54	308	19277	8590	75.18	Timber
291924	50.60	99.51	195	5138	4870	18.46	Edge Knot
291925	49.23	97.96	242	10898	6510	41.52	Grain
291926	48.30	99.56	286	13698	7460	51.50	Knot
291927	46.15	98.20	297	15352	8440	62.09	Grain Bark pocket
291928	48.47	101.07	289	13497	7180	49.07	Edge Pruned knot
291929	49.74	97.04	346	21508	9450	82.65	Timber
291930	49.07	99.55	265	7294	6790	27.00	Edge knot
291931	50.50	95.87	259	7341	7230	28.47	Knot
291932	48.83	96.05	238	5727	6840	22.88	Face knot
291933	49.31	98.45	225	9009	5930	33.93	Spike Knot
291934	49.76	99.05	365	20296	9360	74.83	Timber
291935	51.13	98.96	395	20671	9900	74.31	Timber
291936	51.42	99.50	318	12492	7800	44.17	Knot Group
291937	52.50	99.47	269	14863	6470	51.50	Knot Group
291938	50.63	100.51	313	16062	7560	56.53	Timber
291939	48.84	99.47	304	9170	7860	34.16	Knot
291940	49.59	98.60	296	14167	7740	52.89	Timber
291941	48.34	100.36	257	14039	6540	51.90	Timber
291942	48.85	98.74	293	15788	7740	59.67	Timber
291943	49.80	98.85	262	11340	6770	41.95	Knot Grain
291944	49.98	99.21	283	9304	7200	34.04	Knot
291945	49.86	100.02	305	16518	7600	59.61	Timber
291946	50.81	98.72	314	15881	7980	57.73	Grain
291947	46.92	100.93	307	11347	7900	42.73	Knot