

California's Coast Redwood in New Zealand

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Abstract

New Zealanders are making a significant effort to develop their forest industry to benefit from rapid growth exhibited by *Sequoia sempervirens* on both the North Island and South Island. US and New Zealand forest products companies have established redwood plantations in the past decade, and have found that microclimate, site preparation, soil chemistry, fertilization and precise silvicultural practices are all of utmost importance. Farm foresters have established experimental redwood tree crops alongside *Pinus radiata* and many other western US and NZ native species. The NZ Farm Forestry Association Redwood Working Group has many experimental growth monitoring plots scattered around the country. Nursery producers are testing several California redwood clones that have shown exceptional promise. Researchers have been monitoring plantations of these and other clones here in California and in New Zealand. Genetic traits such as wood density, growth rates, and knot size are known to affect final product quality. Tree growers recognize the importance of investment in improved growing stock. While New Zealand plans to develop domestic and Australian markets for redwood products, growers hope to develop a redwood timber that will be competitive in international forest products markets.

Key words: redwood, New Zealand, plantation, tree improvement, farm forestry

Introduction

As New Zealand farm foresters and forest industry seek to diversify the country's plantation forest, they recognize California's coastal redwood as a key species for plantation forestry. Many New Zealand coastal districts have climatic conditions very similar to California and redwood grows rapidly there. With careful site selection, ongoing research, clonal propagation of improved provenances, and careful timing of silvicultural practices, New Zealanders have no doubt that they can produce a consistent product with desirable qualities. They hope that such timbers will favorably compete with second and third growth California-grown redwood in the global marketplace.

History of coast redwood in New Zealand

During the boom of the 19th and 20th centuries, enormous agricultural industries were developed in the isolated New Zealand economy. Sheep outnumbered people by 30 to 1. As lamb and wood exports declined, a plan in the 1970s projected that timber exports could provide 20 to 25 percent of foreign exchange earnings for the fragile New Zealand economy (O'Neill 1975) by early in the 21st century. *Pinus radiata*, known locally as simply "radiata", had been introduced in the 1860s and was widely planted on old field and volcanic sites by government, industry and farm foresters starting early in the 20th century. Also in the 1860s, coast redwood seed was imported from California. Today the Kaingaroa Forest, in the center of the North Island, is a 240,000 ha plantation almost entirely of radiata. Also, many of the early redwood

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plantations are magnificent groves today. Recognizing its potential and value New Zealand foresters in 1923 imported and planted a ton of redwood seed from California. Though wood quality turned out to be poor, and many trees were lost due to frost damage, weed competition, and inappropriate site selection, generations of redwood trees have been successfully grown at hundreds of New Zealand locations. Little of this redwood, however, was utilized for forest products and the tree was widely viewed as a novelty giant from afar.

As with much change in the world, visionary leadership is vital. Bill Libby, forest genetics professor emeritus of UC Berkeley, has been involved in New Zealand tree improvement since his 1969 sabbatical at the New Zealand Forest Research Institute in Rotorua. In a 1995 address to the New Zealand Farm Forestry Association (NZFFA) Libby urged the membership to establish commercial California redwood plantations. Foresters Wade Cornell, Rob Webster, forest nursery owner Robert Appleton and many others responded enthusiastically to Libby's call for a new New Zealand redwood industry, and the NZFFA established its Sequoia Action Group. On this side of the Pacific, Libby and Kuser selected exemplary redwood trees from native stands in every California county, and established a clonal research trial plantation at University of California's Russell Reservation in the East Bay hills.

New Zealand farm foresters and several US companies started forestry plantations on both the North and South Islands. Even the California forest industry became interested. In 2001 California's Soper-Wheeler company established the New Zealand Redwood Company and purchased a 2500 ha tract, a former sheep station, at Conway River near Kaikoura on the east coast of the South Island. Later the company acquired the adjoining 2500 ha property. Today the New Zealand Redwood Company has 2000 ha of redwood planted on the South Island and 1200 ha on the North Island, the country's largest redwood plantations. Port Blakely Tree Farms of Seattle created Blakely-Pacific Tree Farms and has embarked upon redwood planting on its lands in New Zealand. Though *radiata* remains by far the dominant species planted, scores of New Zealand tree farmers are also actively planting California redwood.

Research, tree improvement, clonal propagation, and product quality

With the goal to expand export timber production in the face of intense competition from Chile and many other southern countries, New Zealanders know they must produce a high quality product that will survive in discerning world marketplaces, particularly Australia, North America and Asia. The NZFFA Sequoia Action Group found that eight clones planted at 34 sites had highly variable performance ranging from 55 to 455 cm height in 4 years (Brown et. al. 2011), so it became clear that careful attention to growth rates, genetic selection, site selection and preparation, fertilization, plantation practice, pruning practices, branch size, wood density are all critical factors in selecting the proper clone to plant.

In the early years of the *radiata* industry most questions were answered by trial and error, but it was soon evident that continuing research and education programs are necessary in order to assure measured and successful development of the New Zealand plantation forest industry. The NZ Forest Service established the Forest

Research Institute at Rotorua in 1947 at the site of 1901 experimental plantations, including the Whakarewarewa Redwood Grove. Though the FRI facility was created primarily to support the radiata plantation industry, the fine plantations of redwood and Douglas-fir (*Pseudotsuga menziesii*), macrocarpa (*Cupressus macrocarpa*) and other species are of continuing interest. Today the research campus is operated for Crown Forest Research by Scion, a private organization with over 350 researchers and staff. Interestingly, the Whakarewarewa Redwood Grove is protected as a memorial grove and a site of historic trees.

The NZFFA has a membership of over 300 farm foresters from around the country, all with intense interest in forests and trees of the world. Almost 50 members have voluntarily established test plots on their farms throughout the country. The NZFFA Sequoia Action Group has field days, collects data, does provenance testing, and tracks the performance of selected clones. Farm foresters, the industry and researchers are working together on their common interest in redwood research.

Today virtually all redwood planting stock is clonally produced via tissue culture. The genetic material is obtained from the most outstanding provenances. Many new clones have been imported from California while other proven trees derived from the early historic plantings were also selected for development. Fifty new clones, derived from the 1923 seed import project, are tested each year by NZ Redwood Company. The California clones, originally selected from all the counties in California where redwood is native, are being tested for a variety of qualities on the NZFFA membership test plots. The original clones were selected either by complete chance, or because the parent trees seemed to possess desirable traits for New Zealand plantations. Meanwhile foresters have recognized that redwoods grown rapidly with very wide rings often do not produce the most desirable wood products. Clonal sources for tissue culture are being selected for moderate growth rates, smaller knot size and desirable heart color. Redwood clones are also selected to represent the average of natural range densities of 330 to 350 kg/m³. Genetic testing is ongoing, but early results show that some of the California-sourced clones, with names such as R2 and R52, outperform their peers in growth and uniform small knot size², while some of the naturalized New Zealand clones are more adapted to varying New Zealand climatic conditions and growing sites³. Further wood density, durability, and structural tests are now underway to assure that the selected clones possess desirable market characteristics. Nicholas, Silcock and Webster of NZFFA, have calculated that investments in redwood plantations that can produce timber with these desirable traits show an internal rate of return of 9.3 percent net of land costs (Nicholas 2011, Chapter 9).

Redwood growers and silviculture

New Zealanders expect to produce redwood timbers from the selected genotypes that compete very handsomely with second and third growth redwood on the market in California. Trees are planted on frost-free or low frost prepared sites below 700 m elevation with medium to good quality soils in areas of moderate rainfall that are naturally sheltered from prevailing winds. High soil moisture capacity is important

² R. Appleton, Appleton Nurseries, Brightwater. 2010. Personal communication.

³ R. Coker, New Zealand Redwood Company. 2011. Personal communication.

but fog drip is not essential. Sites require suitable redwood mycorrhizal inoculation to perform well. Weed control is critical for establishment. NZ Redwood Company originally used mechanical site preparation methods to clear weeds, mostly gorse, bracken and broom, on abandoned sheep paddocks. This method has been replaced with a combination of herbicide application and burning, which is cheaper and preserves soil structure (see footnote 3). Redwoods have performed adequately on clay soils on the North Island. As in California, New Zealand redwood plantations have been relatively pest free. Fungicide applications are in some locations necessary for establishment. There are enormous brushtail possum (*Trichosurus vulpecula*) populations in some areas, and they have damaged redwood leaders, so possum control is necessary. In wet areas drywood termites are sometimes problematic. Minor problems with leaf rollers and cankers have been reported. There has been some branch node dieback that may be attributable to soil boron deficiencies (see footnote 2). Minute boron applications on such sites seem to cure the problem. Robert Appleton has imported natural boron from Africa and South America and applied it in the Tasman Region using aerial dusting.

Plantings increase each year. Trees are planted at 500 to 600 stems per ha. After 9 years trees are generally about 8 to 9 m in height. Pruning would be necessary to produce the clear heart redwood prized by the market. However the species responds to moderate or heavy pruning by producing epicormic branches. Therefore pruning trials, which field test pruning of varying intensity and stages of development, are ongoing. Ideally trees would be pruned to about 4 m so that a clear log is produced in each tree.

Trees are planted with the intent of production of clear saw logs within 25 to 40 years. New Zealanders recognize that consistent quality is going to be vital when it comes time to develop an export market. If the clones selected today produce timber with traits such as durability, high specific density, good heart color, and small knot size, the market return should dramatically exceed that from radiata pine, and this group of creative researchers and land managers will have developed yet another valuable forest product and a source of foreign exchange for New Zealand.

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