



This 4ha experimental area alongside the road frontage of Silverwood farm, on Leaches Road near Hororata, is providing Central Canterbury Farm Forestry with a valuable opportunity to combine social interaction with an opportunity to determine whether European-style continuous mixed forestry, including coppicing, is feasible on a dryland site in New Zealand. The area is also serving as a “proving ground” for “alternative” tree species for shelter on difficult sites.

Frank White, who farmed the 404ha (1000 acres) dryland property for 60 years, was well-known among farm foresters throughout New Zealand. He was a bachelor with no close living relatives. Several years before he died in 2002 at the age of 91 he had placed the farm in trust and handed control to trustees, who in turn leased the farm to Lincoln University but retained control of some elements, including the woodlots and the remarkably diverse shelter belts, in which more than 120 species are growing. At Frank’s express wish, an area of about 4ha adjoining the road frontage was set aside for use as an experimental area by the Central Canterbury Farm Forestry Association, of which Frank was a member for half a century.

The experimental area is managed under a forestry right by a trust set up by the Central Canterbury Farm Forestry Association. It is only a small part of the entire farm, but the CCFFA Trust has developed an excellent relationship with the Silverwood trustees and has advised them on the design, composition, and maintenance of shelter belts, including an experimental belt consisting entirely of indigenous species. The CCFFA Trust has also taken over the management of a private arboretum containing more than 100 tree species planted by Frank. Many of these species began life as seedlings taken home by Frank from farm-forestry annual conferences all over the country. Until his last few years when he was too ill to travel, he attended every annual conference and was known among farm foresters as the man who, in his late seventies, still climbed trees to collect seed.

When Frank White offered the 4ha for experimental forestry three years before he died, he imposed no conditions but privately made it clear that he wanted the block to be used “for experimental purposes” with “alternative species”.

This wish has been observed.

The CCFFA trustees initially concentrated their efforts on some of the so-called “English” deciduous hardwood trees that were among Frank's favourites.

A row of deciduous trees, a chain apart along the entire road frontage of the farm, is a conspicuous feature of Silverwood. Some of these were planted by Frank in the 1930s, some when he was at home on furlough during World War II, and the remainder in the late 1940s after he was demobbed. Captain Frank White served in North Africa, where he was an officer in the Long-Range Desert Group, often working behind enemy lines.

While maintaining his theme, the CCFFA Trust decided to determine whether low-cost, on-farm methods using recycled materials such as balage wrap for mulch could be adapted to enable landowners to establish mixed hardwood plantations on less fertile sites with minimal expense and effort. At Silverwood the dominant soil type is Lismore stony loam, one of the more common but least fertile plains soils. And although the average rainfall is a relatively generous 830mm the trial site is on the high plains, more than 60km inland, 260 metres above sea level,

and subject to frequent early and late frosts, drying winds, and summer drought.

Planting began in 2001, and the establishment phase was completed in four years.

Oaks, chestnut, and walnuts were chosen because:

Little information is available about their establishment as timber trees on exposed sites in New Zealand;

While it is known from the age, form, and size of old existing hardwood stands that hardwoods can be grown successfully on the better soils or more sheltered sites in Canterbury, even on dry land, nothing is known of the establishment techniques used when these stands were planted in the 19th or early 20th centuries;

Oaks, chestnuts, and walnuts are known to be capable of yielding timber of high quality;

All are frost-hardy and capable of growing in both the warmest and the coldest parts of New Zealand provided the site has good air drainage to minimise the risk of damage from late frosts after growth starts in spring;

All have heavy, short-lived seeds and little likelihood of spreading;

Although these species are frequently planted on farms and lifestyle blocks little information is available about suitable provenances for woodlots.

Ashes and sycamores, which have light, wind-dispersed seeds and are able to spread over relatively long distances, were excluded from the trial. Cherries and other rosaceous trees whose seeds are dispersed by frugivorous birds were also excluded, although space was found for a few less risky ornamental species on the periphery of the trial area. A handful of Dutch elm disease-resistant elms was also planted to provide a possible future source of propagating material. Two black cherries (*Prunus serotina*), reputedly the world's most valuable temperate hardwood species, were also planted.

The experiment was seen as complementary to walnut and chestnut research done by the New Zealand Tree Crops Association, Lincoln University, HortResearch, and other agencies into nut production and clonal propagation. In the 2001 block the primary aim was high-value timber production from seedling trees. In October, 2012, its scope was widened through coppicing of three rows of the block with the aim of producing a range of different forest products, including chestnut stakes, which are in demand by grapegrowers. A small number of well-formed trees was left in each row to grow on as "standards" through several coppicing cycles to yield hardwood sawlogs. However, the main aim of the coppice trial now is to create a sustainable supply of durable chestnut vineyard posts. Some posts from this first cut contained up to 85 per cent heartwood despite being only 10 to 12 years old. These are now part of a post trial in a local vineyard. An adjoining block of hazels planted in 2005 will, if all goes well, become an integral part of the coppice and broaden the product range by providing straight stems that can be harvested for sale as tomato or runner bean stakes, for which there is a steady demand. Properly handled and stored, hazel stakes can be reused for up to four seasons, whereas untreated pine stakes are usually good for only one season. For those who enjoy tramping, coppiced hazel also produces light but strong hill sticks.

In the main trial block the initial species mixture was about 50 per cent oaks, 10 per cent walnuts, and 40 per cent chestnuts. Most of the latter were well-grown surplus rootstocks up to 1.8m tall, donated by the Quality Tree Company. Seedlings were planted at two-metre spacings, with either three or four metres between rows.

As the planted area expanded to 2ha over the next few years, trees of known provenance were secured from Allenton Nursery (Ashburton) and Southern Woods (Templeton). Chestnuts and oaks from what were regarded as superior provenances located in Ashburton and Hanmer Springs were raised for the trial at Allenton Nursery. A short row of Turkey oaks (*Quercus cerris*) was included for its drought resistance and strong growth, although its timber is usually considered to be of lesser quality. Southern Woods grew on our behalf a line of *Quercus frainetto*, Hungarian oak, from seed collected by the trustees from well-formed trees in an isolated group

at Lake Coleridge. About 15 of these were planted at Silverwood early in August, 2010.

The best of the Silverwood oak trees, now aged between six and nine years, have exceptionally good form with light branching. Their growth rates have exceeded expectations and many of them are already seeding.

The first, and so far only, independent research project at the area began in 2001 and was completed in the following year. Tembo Chenyanga, a graduate student at the Canterbury University School of Forestry, completed his thesis under the supervision of Professor Roger Sands with a study of the effectiveness of different mulching techniques, including straw, herbicide with no mulching, recycled plastic balage wrap, and combinations of mulch and herbicides. His report is available for study.

The 4ha is divided by a median fence into two more-or-less equal areas. The unplanted block was initially cultivated and used to help finance the experiments by growing kale to be sold for winter fodder. Since 2008, however, the experimental area has been extended into this section, initially by an indigenous planting that was, unfortunately, largely unsuccessful because of a spring drought immediately after planting. The only survivors were a handful of black beech, ribbonwood, coprosma, and kanuka. In due course the fact that these survived will tell us something. Since then a wider range of indigenous species, including shrubs, has been planted with more encouraging results. The experiment was broadened further in 2009 by a range of cypress clones, including one found in a Silverwood woodlot. The purpose of this trial, which includes several replicates of each clone, is to test for canker resistance, growth rates, and form on a dry site.

In 2011 the experiment was extended to include a hardiness test of a group of eucalyptus species known to yield ground-durable timber. Unfortunately, these species, planted in November, suffered severe checks from unseasonable weather soon after planting and again in June, 2012, when many were killed in an unusually severe early-winter snowstorm that caused widespread damage to Australian trees all over the lower Canterbury Plains. These were replaced in late October, 2012, with provenances reputed to be more cold-tolerant. A spacing and silviculture trial of selected silver wattle (*Acacia dealbata*) strains was also planted in October, 2012, with the assistance of a grant from the Neil Barr Farm Forestry Foundation. These will dovetail with the hardwood coppice because the species is known to be capable of producing high-quality timber and like the chestnuts is expected to produce coppice shoots after the initial harvest.

However, the main long-term aim remains: to test whether a European-style, mixed-species, continuous-canopy forest model incorporating coppicing is feasible on a dry New Zealand site.

This perpetually renewable model is becoming more attractive than conventional plantation forestry to many landowners since the introduction of the ETS system. However, while European data on mixed forests assembled over several centuries are readily available, they cannot provide detailed and definitive guides for New Zealand conditions. And while existing old hardwood stands in New Zealand indicate that the species can be grown here, they do not provide information on the kind of low-cost, "home-grown" methods of propagation and establishment used at Silverwood.

Some lessons have been learned already from the trial. The first is that the three most important elements in establishment are weed control, more weed control, and even more weed control. Without protection from weeds, of which the widespread grasses browntop (*Agrostis tenuis*) and fescue (*Festuca rubra*) are the most competitive, planted trees will not thrive on a marginal site such as this one. An area of clean dirt or weed-free mulch must be maintained for a radius of at least one metre around the base of the tree for at least three years, and preferably for up to five years, after planting. If the trees grow well, their own root systems will be sufficient to deter competition after that time.

At Silverwood, where browntop is a dominant species in the old pasture (Frank liked it for its tolerance of drought) in which the trees were planted, attempts at chemical-free weed control were ineffective. Even where mulches were used, it proved to be essential to destroy the browntop with haloxyfop (Galant) or glyphosate (Roundup) before mulching. Often this entailed repeated sprayings over three years or longer. In the unsprayed

control area, browntop growth continued even underneath a heavy plastic mulch, and eventually pushed the plastic aside.

This Godfather factor (The key to success is the elimination of competition) should never be underestimated. Dramatic examples can be seen in rows of walnuts and oaks which were control rows in the original planting and received no weed control during establishment.

Ten years after planting, these control rows remain both smaller and inferior in form to the trees that were initially sprayed and mulched and were thus never exposed to competition from weeds. Although all the rows of trees received an annual release spray after the initial establishment trial was completed at the end of the third year, the differences in form and size between the control trees and the remainder persist and show no indication of closing.

Regularly replenished pea straw proved to be the most satisfactory mulch at Silverwood. Pea straw breaks down into humus relatively quickly and has an open texture that inhibits transpiration but permits rainfall and air to reach the soil. Wheat and barley straw are stiff and very slow to break down. Oat straw is an acceptable substitute if pea straw is not available. Sawdust is not recommended as a mulch because it tends to cake and create an impermeable surface layer, through which neither rain nor air can penetrate.

Whatever material is used, placing it correctly is important. A mulch which is too deep and too close to the base of the young tree may inhibit rather than encourage growth and will probably damage the base of the tree by providing habitat for moulds and rot. One useful test is to fork up and shake out a sheaf of mulch after it has been in place a few months. If the material is full of tree roots the mulch is probably too deep. Root proliferation in the mulch can also indicate that the ground was too dry when the mulch was spread.

Another lesson learned from Silverwood is that when establishing hardwood species it is essential to start with vigorous, well grown, large specimens. This means open-ground planting stocks three to five years old, at least 1.5 metres tall, with a stout root collar and well-spaced roots. Leave any trees less than 1.2 metres tall in the nursery rows for another year. Trees that were smaller than this size at planting were invariably slower to establish and even after up to eight years are still trailing well behind. Life in the exposed open ground, without irrigation, is difficult for infant hardwoods and they do not thrive on it.

Among the less obvious benefits of the trial have been increases in bird and insect life and in the number of small animals, such as skinks, which thanks to intensive dairy farming and predators are rapidly losing most of their habitat on the plains. One of the items on our wish list is to persuade a graduate student to make a comparative study of animal and invertebrate life in the experimental area, on the dairy farm next door, and on nearby extensively grazed grassland.

Pruning in the hardwood trial has been confined to light form pruning in midsummer. Usually this is done by farm-forestry members and combined with a Christmas barbeque, so that the area is performing a significant social role within Central Canterbury Farm Forestry as well as serving as a model hardwood forest that may provide a significant renewable source of income in the future. Numerous groups of Tree Crops Association members and farm foresters from other branches have been hosted at Silverwood. Is this what people mean when they talk about multiple-use forests?