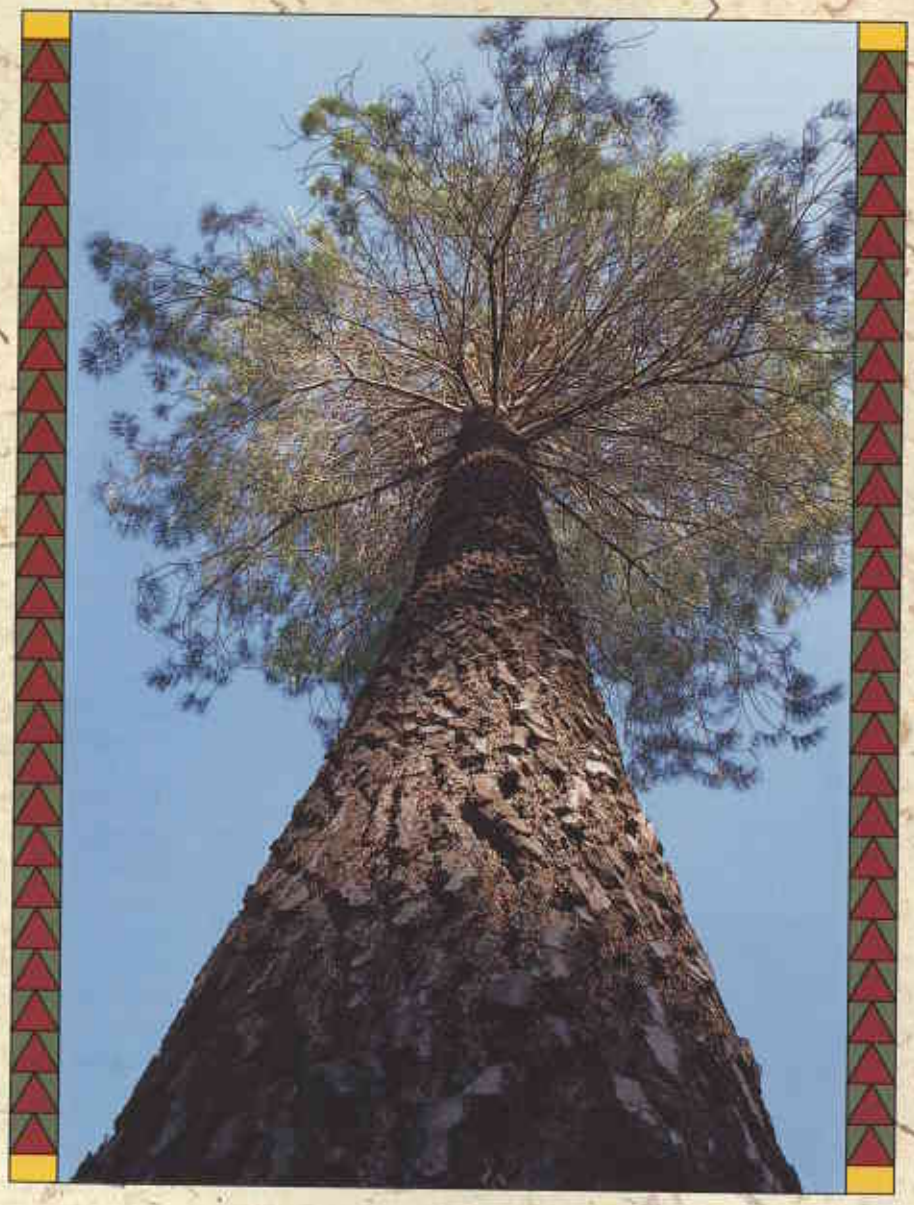
In search of the PERFECT PINE



BY DAVID GOUGH

Some little-known pioneering work began in 1896, when foresters planted the first maritime pine in WA. David Gough describes how innovative WA foresters took this hardy European pine and improved it for harsh WA conditions, with a great deal of trial and error along the way.

When the first Western Australian colonists began to build settlements at Perth and Fremantle, they had problems with the local timber. The native softwood was only good for orange boxes, and the jarrah was so hard that they couldn't drive nails into it. Softwood was used for most European buildings so the carpentry tools of the day weren't designed for working hardwoods like jarrah, and the builders weren't used to working them either.

The immediate problem was resolved by importing 'Oregon pine' (Douglas fir), but this only worsened the colony's balance of payments problem. Importing timber was a serious drain on sparse resources. To avoid costly expenditure, it was decided to employ the apparently useless (from the agricultural and urban viewpoints!) jarrah and banksia woodlands on the Swan Coastal Plain to grow the colony's softwood requirements. The idea stemmed from the success of extensive softwood reforestation programs in the 17th and 18th centuries in western Europe, particularly in the south-east of France. The Cape Colony of South Africa was also actively developing pine plantations at that time.

Previous page:
Maritime pine
Photo - Jon Green
Bark
Photo - Bill Bachman

Mature and immature maritime pine cones.
Photo - Jon Green

Dick Perry, the officer responsible for plus tree selection in Portugal, beside a 20-year-old tree grafted from one of the buds he forwarded to Australia.
Photo - Jon Green

WOODY IMMIGRANTS

The WA Lands Department, and later the Forests Department, began a worldwide search for a conifer that suited local conditions. Trials of many species were planted at the department's tree nursery at Hamel, near Waroona, in 1896. Monterey pine (*Pinus radiata*) did well on the better soils, but on the poorer sandy soils maritime pine (*Pinus pinaster*) gave the best results. Maritime pine occurs naturally on the northern and southern coasts of the Mediterranean sea and the Atlantic coasts of France and Portugal. Its common name is derived from its preference for coastal or maritime environments, although in recent times it has been grown in the inland parts of the countries concerned. After these early trials established that maritime pine was suitable for growing in sandy soils, it was decided to establish plantations on the poor sandy soils of the northern parts of the Swan coastal plain, to the north and east of Lake Gnangara.

It was first thought that seed from the French forests in the Landes region near Bordeaux would be best for the project, and a nursery of this variety was established by forester Dick Perry at Gnangara in 1926. This was real pioneering work - in the early 1920s the only way to reach the area from Perth was by walking, riding a horse or, if something had to be transported, driving a horse and iron-tyred cart many kilometres along a deeply rutted, sandy track winding its way between the banksia trees.

Despite the early optimism, it was soon obvious that there was something seriously wrong. Seed that had been sown in September produced plants that were only two inches high and a bright yellow colour by the following July, when they should have been 10 to 12 inches high and deep green in colour. After much trial and error, it was discovered that the little seedlings needed the cooperation of a special fungus known as a mycorrhizal fungi, which attaches itself to roots and helps them to take up nutrients from the soil. Once the fungus was introduced to the nursery, the trees began to thrive.

By 1929, foresters were finally growing healthy pines in the Gnangara

CALM researcher Trevor Butcher, who has worked on maritime pine improvement for almost 30 years, with Dick Perry, now retired.
Photo - Jon Green

Considerable variation in tree form and vigour required the planting of many trees for adequate selection of crop trees.
Photo - Jon Green

Orchard seed produced straight trees and uniform stands. This enabled the planting of fewer trees and more efficient management.
Photo - Jon Green

nursery and began to plant them out in the field. The transplanted trees stayed green, but only grew very slowly, except in areas where the forest workers had heaped the banksias up and burnt them. The problem appeared to be a nutritional one, but foresters in those days were hesitant about using fertilisers to grow trees.

'The assumption was that if you had to use fertilisers you'd have to apply them every year for the whole rotation,' recalls Dick Perry. 'Anyway, I requisitioned half a ton of superphosphate and a quarter of a ton of blood and bone to use for trials, but my request was knocked back by Treasury - they were just plain horrified.'

Eventually, Dick got his fertiliser and the results were excellent. Later research by scientist Eric Hopkins showed that it should be applied at the time of planting and then every seven years or so.

But the problems were not yet over. The native vegetation had to be completely removed if the trees were to thrive, as it competed with the pines for moisture and scarce nutrients in the coarse, sandy soils. It was back-breaking work just to clear the area for planting. The stump-jump mould board ploughs available at the time kept getting caught under the roots still in the ground and, in most of the early plantations, the scrub kept growing back.

'When the Depression came we had 100 men out there hand-grubbing the scrub, and during World War II people imprisoned because of their foreign connections, and conscientious objectors worked on it as well. Eventually

disc ploughs came in, and we were able to purchase heavy stump jump disc ploughs that were much more effective,' said Dick.

At this early stage, most of the seed was from the Forest of Landes in France, but seed was also purchased from Portugal, Corsica, Italy and South Africa. The seed from each of these regions produced trees that were so different they appeared to be different species.

Dick Perry established seed provenance trials of maritime pine in plantations at Gnangara and Sommerville (now the suburb of Karinya) in 1926. These pines conclusively showed that pines from Leiria in Portugal had the fastest growth rate and had reasonable form, Later research proved that the Leiran race had the best wood properties for sawn timber use. As a result, all seed imported since 1940 for extending the

plantations came from the Forest of Leiria, Portugal.

Despite the improvements that resulted, the department still had to plant about 1 200 trees per acre from which to select the best 80 for the final crop and it was necessary to grow them close together to keep the branches small. Maritime pines were also subject to 'butt sweep' and 'pistol butt', which means that the tree's butt logs were bent to varying degrees. As these were always the biggest logs that the trees produced, a lot of wood was wasted when they were cut up in a sawmill or peeled into thin sheets to make plywood.

THE IDEAL TREE

Tree improvement by breeding was a new science in the 1950s. Forests Department scientist Eric Hopkins argued strongly for a breeding program to improve the stem form of the tree. He argued that this could be justified on the basis of reduced nursery, planting and tending costs, as fewer trees would be planted. He gained approval and the tree breeding centre at Wanneroo was set up in 1957. Considerable capital was invested into glasshouses, a laboratory, shadehouses and a general nursery. More

importantly, specialist technical staff were appointed to carry out the breeding program. It was these highly skilled technicians, in particular Alex Malajczuk and Joe Stritof, who guaranteed the success of the program.

Eric decided that they needed a set of 'plus phenotypes' - trees vastly superior to the others in the plantation. These trees had to be straight, with few branches, and the branches had to be at right angles to the trunk. They also had to be dominant trees, with a fast growth rate and superior height. At least 50 trees were needed to provide a wide enough genetic base to work from to avoid the dangers of in-breeding.

As a result, Departmental officers embarked on a thorough search of the WA plantations to find the superior trees. They located several that were suitable. However, local plantations could not supply all of the parents required for a comprehensive breeding program and in 1964 Dick Perry travelled to Portugal, where he was based for two years. After many months systematically walking through the Forest of Leiria, he found a further 85 superior trees. Once they were found, each tree had to be climbed about five times - right to the top. They had to be accurately measured by tape, from top to bottom, and two core samples had to be taken to measure the density of the wood. When the trees were flowering, the buds were collected and sent back to Australia for grafting. Seeds and pollen were collected at other times. Cones were also collected and the seed extracted and sent home to WA.

All this material was sent back for testing in Western Australian conditions. In all, 51 local and 85 Portuguese trees were tested for parental qualities. The buds were used to clone the parents. This involved taking a bud from a superior tree - which may be up to 130 feet high and perhaps 80 years old - and grafting it to another small seedling. The resulting plant is effectively an 80 year old tree that is genetically identical to the parent tree and only a few inches high. Instead of having to wait 15 years for it to develop pollen and female flowers, it is already sexually mature.

The grafts were pollinated each spring, to a planned mating design, to provide families for testing in the field. During the main program, about 1 000 grafts were pollinated each year. To protect the cones from cockatoos (who love to eat pine seed), the successfully pollinated conelets had to be covered with calico bags.

But when the buds from Portugal were grafted in the Australian spring, they showed no signs of growth until autumn, because of the differing seasons of the northern and southern hemispheres. It was decided to try some grafts in the Australian autumn. These took immediately, and the seasonal problem was overcome by forcing new buds in a glasshouse during the dormant period. No such problems were encountered with growth from seed.

The first maritime pine progeny trials in WA were planted in 1965, with seedlings raised from the 1961 pollinations, and were expanded each year as more seed became available. By 1978, 85 trial plots were planted over 195 hectares.

However, testing the suitability of a potential parent takes at least eight years. The department wanted to use the gains that had been made immediately. So, in the meantime, the first maritime pine seed orchard, containing 16 local clones, was planted with 2 462 grafts over a 10.5 ha area at Joondalup between 1963 and 1964. The first commercial seeds were collected from the orchard in 1968.

A second seed orchard, designed to take advantage of the imported clones, was established between 1969 and 1972, at Mullaloo. It occupied 10.1 hectares of fertile sands near Wanneroo. Up to 96 clones were planted and these were culled to the best 40 as progeny test data became available. These 40 parents are now used for all seed produced for WA plantations.

A third seed orchard, incorporating

Maritime pine seed is a favourite food of the white-tailed black cockatoo.
Photo - Jiri Lochman

the best original clones and outstanding second generation selections from the controlled crossing program, was completed by Trevor Butcher at Manjimup in 1989. This will eventually replace the Mullaloo orchard and should meet all plantation requirements after 1994. The Mullaloo orchard now forms part of the Joondalup Campus of the Edith Cowan University. It will be retained as a recreational park while continuing to serve as a genetic resource bank of maritime pine.

BREEDING SUCCESS

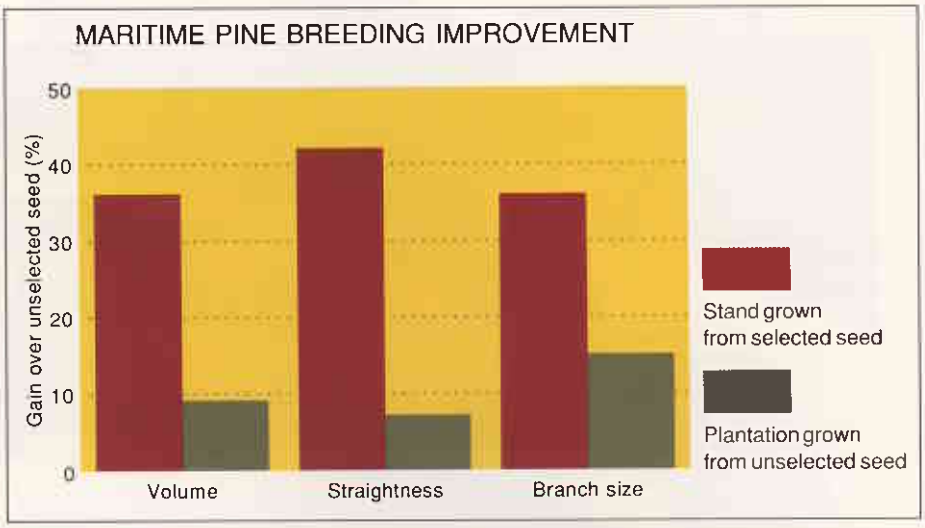
The maritime pine improvement program has been a major success. Gains from the first stage have been very large; the pedigree tree is straight, has smaller branches and is more vigorous, and the stands are notable for their uniformity.

Results from the yield trials, planted at Gnangara and Yanchep in 1973 with the first Joondalup orchard collection, are impressive (see graph). The 18-year-old pedigree stock pines are 36 per cent larger than trees grown from ordinary seed and the timber is of better quality. Added to this, a much higher recovery of timber can be sawn from the straighter trees with smaller limbs. The more even quality of the trees allows for greater efficiency in management and future harvesting.

Stem straightness was the most sought-after characteristic. Orchard seed produced 20 per cent of trees that were classed as very straight and suitable for the final sawlog crop, compared with only three per cent for the routine seed. This meant that the number of seedlings planted to produce the sawlog crop could be drastically reduced. Similar results had been achieved from assessment of progeny trials in 1971.

A new management regime for maritime pine was formulated in 1971. This takes the improved form into account by increasing plantation spacing, and takes advantage of improved growth rates by adopting a shorter rotation length. Stocking was reduced from 2 500 to 1 000 seedlings planted per hectare. Immediate benefits include large savings in seed, nursery, planting, pruning and early tending costs.

Since 1972, over 13 000 ha of maritime plantations have been planted with improved seed. The tree



Graph:
These benefits have been transferred to 13 000 ha of plantation since improved seed became available in 1972.

A developing cone flower. These must be covered to avoid foreign pollen during controlled crossing. The bud scales open and are receptive to applied pollen for 3 to 5 days in September.
Photo - Eric Hopkins

Aerial view of the Gnangara pine plantation.
Photo - Jiri Lochman

improvements, due to the additional growth rate alone, are returning an extra million dollars in income each year to the State. What is more, these gains will be magnified at the sawmill as a result of the greater volume that can be utilised because of the straighter stems and the smaller branching.

Seed from the genetically superior Mullaloo orchard was available from 1976. Progressive culling has further increased the seed quality and the expected growth rates of plantations.

CALM's new second generation seed orchard at Manjimup should produce an extra 20 per cent gain in tree volume while maintaining the current level of improved tree form.

With the foresight and hard work of early foresters like Dick Perry, today's foresters and scientists can continue to build a thriving maritime pine industry in WA. But advanced generation breeding can no longer rely on simple selection. Mathematical index procedures are now used to compute breeding values for individuals and families based on genetic parameters and economic weights of traits. Selection has to be efficient; it is the tool of the tree breeder and the key to maximising genetic gain.

Maritime pine is a secondary and minor species for pine wood production in the southern States of Australia. Nevertheless, there is potential for the improved breed of trees to be used in drought-susceptible areas and on infertile soils.

Who knows? One day maritime may even be exported back to Portugal - with our home grown improvements. ⊡

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LANDSCOPE

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Each year more people seek wilderness experiences, but many are unprepared for the difficulties they might encounter. Learn about the basics of outback safety and bushcraft on page 35.

Will the honey possum become a secondary victim of dieback disease? See page 22.

Australia is a land of lizards - tough competitors evolving amid spinifex and wildfires in the Great Victoria Desert. Turn to page 10.

Botanists search for a eucalypt last seen by Giles in his expedition across WA deserts 115 years ago. See page 28.

Straight and vigorous pines don't grow by accident. Years of research and breeding have gone into producing the perfect pine. See page 49.

COVER

*The tiny honey possum (*Tarsipes rostratus*), seen in our cover illustration by Philippa Nikulinsky, feeds almost exclusively on nectar and pollen. However, most of its important food plants are threatened by dieback disease caused by the* Phytopthora *fungi. The endangered scarlet banksia (*Banksia coccinea*) is one plant species used by the possums that is highly susceptible to the dieback disease. See story on page 22.*

FEATURES

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