The WESTERN BLUE GUMS *Are Here!*

By Liz Barbour and Trevor Butcher

The result of years of research, the new Western Blue Gum will grow taller, thicker and faster than its Tasmanian counterparts over a 10-year period. It will also provide tree-farmers with thousands of dollars in extra income.

For years, scientists at the Department of Conservation and Land Management (CALM) have been searching for a tree of the future: one that will grow taller, thicker and faster than its predecessors, and produce more pulpwood for the paper industry.

Now, after 14 years of breeding and trials, the Western Blue Gum is here.

This new breed, developed especially for Western Australian conditions, has powerful benefits. By growing more quickly, the trees will yield more timber than others. They will increase the landowner's income when grown in plantations or integrated onto farms, and will increasingly provide an alternative source of hardwood for the paper industry. The species can also resist dieback caused by *Phytophthora cinnamomi*.

The Western Blue Gum is the product of much research. More than 100 000 trees have been planted in 35 trials, including populations of Tasmanian bluegums (*Eucalyptus globulus*) taken from areas scattered across south-eastern Australia. From this breeding population, orchards of 5.5 hectares of clones and 42 hectares of open-pollinated seedlings have already been planted for seed production. This seed will grow into seedlings of high genetic quality in time for the 1995–96 planting season.

The research started in 1980 when senior CALM scientist Trevor Butcher planted two provenance trials of *Eucalyptus globulus*, a species largely ignored by the Australian pulping trade because mature trees (those more than 20 years old) had shown undesirable pulping characteristics. But after trials in plantations in Portugal and elsewhere, its growth period was reduced to only 10 to 12 years. The Tasmanian bluegum is now one of the most sought-after species for its versatile paper pulp properties.

BEGINNING TO BREED

The original *E. globulus* trials were planted with seed taken from south-eastern Australia by Keith Orme, who worked for the Tasmanian Forestry Commission. This collection was sent all over Australia as well as to Portugal and Chile, which also have climates suitable for this species. In Western Australia, CALM planted the Orme seeds in Busselton, Manjimup and Dwellingup. Several years of assessment produced three key findings: that *E. globulus* thrived in the south-west; that an intensive breeding program would produce good results; and that some areas in eastern Australia produced better seed for tree growth than others. Researchers knew not only the best areas, but also the various populations which produced the best-performing trees. The concept of breeding the Western Blue Gum was born.

To create an *E. globulus* population specifically for Western Australian conditions, the breeding program had to plant families of trees. In 1985 a family trial based on seed collected from individual trees was planted—the first in Australia. The trial program progressed rapidly between 1988 and 1993, with ALCOA and Bunnings Treefarms joining the CALM program to establish a large, robust breeding population on a range of sites.

Two seedlings compared. The one labelled is from the Western Blue Gum population, while the other is from normal *E. globulus* provenance seed stock.
Photo – Liz Barbour

The seed for these trials came from a number of sources, the most famous being the 1988–89 CSIRO collection. Although this *E. globulus* seed has been available to all States, Western Australia has been more committed to breeding the species. As a result, by the end of 1993 the goal of 1 000 families, replicated in 35 trials and with more than 100 000 individuals, was achieved on some 132 hectares, a feat not matched elsewhere in Australia.

These trials are measured regularly, and the data analysed to decide which families and individuals are best for the second generation. To do this efficiently, Trevor Butcher wrote a series of programs for hand-held computers used in the field. Human error is much reduced, as the computer prompts for all measurements and data can then be electronically

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Main: A Western Blue Gum branch showing a bud at the top, an open flower displaying the stamens, and a flower, with its stamens removed, developing into a capsule.
Inset: Pure Western Blue Gum seed ready for use in the nursery.
Photos – Kim Howe

Left: A breeding trial is used to select the Western Blue Gum population.
Photo – Liz Barbour

Mixed Western Blue Gum seed and chaff extracted from native capsules. The chaff has to be removed before it can be used in the nursery.
Photo – Kim Howe

Western Blue Gum seed is given a final clean so it can be used on a mechanical precision seeder machine in the nursery.
Photo – Mark Dalton

transferred to a desktop computer. All of the field and genetic information is integrated by CALM's Tree Breeding Information Management System (TBIMS) to calculate the breeding value of each tree—its volume and density.

HARD TO MULTIPLY, SLOW TO FLOWER

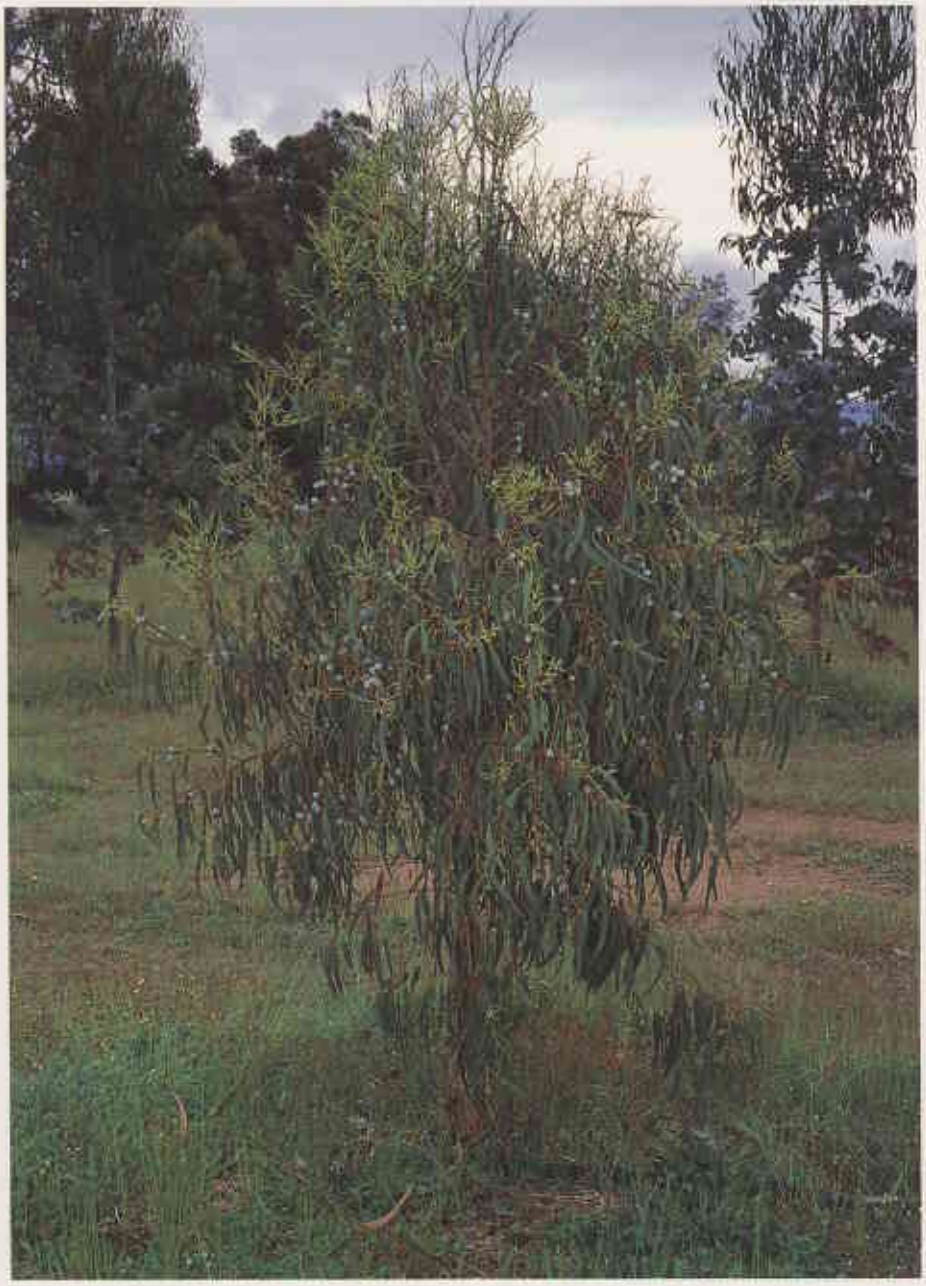
New challenges arose. Although CALM was experienced in the breeding of pines for seed production (see 'In Search of the Perfect Pine', *LANDSCOPE*, Autumn 1992), the Western Blue Gum offered a different set of problems. This hardwood species is both slow to flower and difficult to vegetatively propagate, or clone. Both are necessary to gain the greatest breeding improvement and to produce seed.

To solve the cloning problems of the species, micropropagation using tissue culture methods was investigated. Although this woody species is relatively easy to initiate from both seed and adult material in sterile culture, with good shoot multiplication rates, it has poor rooting ability. As a result, very few plantlets have been established in the field to allow the technique to be critically assessed. This rooting difficulty hampered progress to such a degree that other cloning methods were sought and, as a security, alternative ways to establish seed orchards tried.

One of the cheapest ways to make an orchard that provides improved seed is to use seedlings. Seedling orchards for improved volume production can be established in two ways. The first will produce *E. globulus* seed with a volume improvement of between eight and 12 per cent. The orchard seedlings are planted at the same time as a series of progeny trials. As the trials grow and are measured and analysed, the information is used to remove the poorly growing families from the orchard, so that eventually the most vigorous trees with the best genes remain for seed production. Alternatively, seedling orchards can be planted with seed from the best families available, identified from extensive trials. The gains of 15–20 per cent in volume from the seed produced from these orchards are greater than those from the first method, though they are delayed because of the need to wait until the parents are first tested before the seedlings can be planted.

Right: Joe Stritof inspecting the Western Blue Gum grafts at the Wanneroo Grafting Centre.
Photo – Liz Barbour

Left: A bud on an *E. globulus* seedling with juvenile foliage. This was the breakthrough which indicated that pachobutrazol would stimulate flowering on *E. globulus* in Western Australia.
Photo – Liz Barbour



Below left: The flowering effect of pachobutrazol applied to a graft at the Manjimup Plant Propagation Centre.
Photo – Kim Howe

These orchards are of no value unless they flower and cross-pollinate to mix the genes and produce seed. However, *E. globulus* is slow to flower. Initially, therefore, CALM planted *E. globulus* orchards in sites from Albany to Gnangara, in the hope of finding perfect environmental conditions to stimulate flowering. Although some sites have been slightly better than others, there has so far been no marked difference. The trigger for early flowering did not seem to be possible in Western Australia.

The answer came from an unexpected source—the use of growth retardants as a means of stunting a tree to reduce street pruning costs. It was noted that trees treated with pachobutrazol flowered copiously, so much so that it was drawn to the attention of Dr Rod Griffin, then working for the CSIRO. Working with a eucalypt species closely related to *E. globulus*, he showed that it could be used to increase seed crops. Liz Barbour tried this chemical on the Western Blue Gum, with startling results. Not only did the seed crop increase, but it accelerated the flowering of some clones to such a degree that, whereas flowering was usually expected after seven years, a seed crop could now be produced after only three. This chemical had made the orchards productive.

ORCHARDS OF CLONES

The best way to achieve volume gain is to establish orchards of cloned trees. Exact copies of the best-known performers in the field are brought together at one site for cross-pollination. This type of orchard will give a volume improvement of about 40 per cent over the entire bluegum population.

A vegetative propagation method was needed to make the clones. Because of the rooting difficulty of *E. globulus*, neither tissue culture nor rooted cuttings was considered. An old horticultural technique, grafting, was used.

Right: The removal of the stamens and pollen from the flower. This exposes the stigma, which will receive pollen from another Western Blue Gum a week later. Photo – Kim Howe

Grafting is the splicing of a piece of branch material on to a young plant for vigorous growth. In the Western Blue Gum program, it has been used with great success to capture the best selections. Perfecting the technique took a number of years, but with young, vigorous rootstock and clean material from the parent tree, grafting success can now average 80 per cent in the spring season.

A program was then set up to graft the best trees scattered around the South West so that they could be brought together at a single site. For the seed demands of the growing bluegum industry, it was calculated that initially 8 000 grafts were needed, which would cover 20 hectares. To complete such a large grafting program, and to meet the demands of other species-breeding programs, CALM's Wanneroo nursery has been remodelled into a specialised grafting centre.

The grafts are established in the orchard either in autumn or spring, treated with the growth retardant, and fertilised and irrigated through the year. The first buds start appearing around Christmas and are observed rigorously from July onwards for signs of flowering.

To ensure cross-pollination, a number of trees must be flowering at the same time. If this does not happen, the pollination has to be done artificially. Pollen is collected and specific pollens are carefully placed onto the female flower part, the stigma. The stigma has to be 'ripe' for successful pollination; this is detected by a droplet of liquid forming at the tip of the stigma. If the stigma is reddening, the pollination period has been missed. This entire sequence (the flower opening, the anthers offering their pollen, and the stigma becoming receptive) happens within a week.

The flower then slowly transforms into a capsule. As it ripens, the seed begins to develop inside. This process can take anything from six to nine months, depending on the dryness of the weather. When the capsule is brown and woody, it is ready to be harvested. Capsules are then passed to the CALM nursery at Manjimup for extraction of the seed, cleaning, and planting.

FUTURE PERFECT

The Western Blue Gum is a major step in CALM's program to 'domesticate' an Australian tree species, improving prospects for tree-cropping and pulpwood production. Future breeding will concentrate on desirable characteristics, such as increased density, pulp yield, and speed of growth. The genetic make-up will also be refined, combining genes to make the new species more resilient to insect pests, pathogens, and environmental extremes. The purpose is to produce a tree which is resilient as well as productive, opening up a better future for farmers, wood-producers, and the Western Australian environment.

Liz Barbour is technical adviser in tree propagation and genetics. Trevor Butcher is a senior research scientist responsible for CALM's tree-breeding programs. Both can be contacted at CALM's Science and Information Division on (09) 334 0299.

Inspect an *E. globulus* seedling for quality. Check the stem diameter, look for a pruned fibrous root system and notice if the foliage has a red tinge to show the seedling is hardy. All these aspects will help in the survival of the seedling. To be confident that the seedling will give you extra profit from its volume production in 10 years' time, look for the Western Blue Gum label.

LANDSCOPE

VOLUME TEN NO. 2 SUMMER ISSUE 1994–95

The golden whistler is a common forest bird. 'Forest Focus' (on page 10) discusses a five-year study into the effects of timber harvesting on forest birds, insects and mammals.

The 10th Light Horse Memorial Trail is one of two walktrails in Neerabup National Park. The story on page 22 takes you inside this little-known park in Perth's northern suburbs.

In the closing days of 1991, heavy downpours of rain flooded Rowles Lagoon in WA's Goldfields; and so began an unusual year of floods, frogs, flowers and fires (see page 42).

Aboriginal people of the northern deserts call the black-headed python 'warrurungkalpa', which roughly translates as 'grinder or crusher of rock wallabies'. See the story on page 17.

Radio collars are fitted to feral cats to help scientists track their movements. 'Hunting the Hunter', on page 36, focuses on research into the habits of these supreme desert hunters.

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The majestic and graceful whale shark visits the north-west of Western Australia each year and is fast becoming a major tourist attraction. What does the future hold for the world's largest fish? See page 28.

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