

THE AUSTRALIAN TREE SEED CENTRE

A window to the resource*

Bot 9.

INTRODUCTION

The Australian flora is extensive, diverse and demonstrates considerable natural variation. The very foundation to making the best use of this useful, valuable, but variable tree flora is the supply of seed of authenticated botanical identity and representative geographic origin. Without this foundation of high quality seed, the genetic basis of planting programs will always be in question. It costs just as much to establish a plantation with seed of poor quality as it does with seed of the highest genetic potential, but the difference in long-term production, quality and profitability may be great.

The Australian Tree Seed Centre (ATSC), part of CSIRO's Division of Forestry and Forest Products, has acted for 25 years as a national tree seed bank. It supplies seed of Australia's unique woody flora to researchers in Australia and over 100 other countries. It is a national focus for both the import and export of tree seed and a recognized source of considerable knowledge of the practical use of the Australian flora. The Centre provides technical advice on species selection and silviculture and conducts research on seed germination and seed collection, extraction and storage methods. Staff of the Centre have, over the past 10 years, written over 175 papers, written or contributed to the production of 9 books, produced a series of eucalypt and acacia leaflets and provided on-site consultant services to over 20 countries. The Centre also collaborates closely in studies of genetic variation in Australian tree species.

The purpose of this paper is to describe the historical development of the Centre including its national and international role, and to outline current programmes and policies, and future directions.

HISTORICAL DEVELOPMENT OF THE CENTRE

Seed of Australia's unusual tree flora was an early export soon after white contact was made with Australia. A small tree of *Eucalyptus obliqua*, grown from seed collected by the Royal Navy's Tobias Furneaux in 1773, was noted as growing in Kew Gardens in 1789. In 1788, the private English nurserymen Lee and Kennedy had found a ready market for "New Holland" plants and in 1790 dispatched a seed collector of their own to Sydney. Within 40 years of European settlement in Australia eucalypts were growing in Britain, France, Italy, Spain, Portugal, South Africa, Mauritius and Brasil.

*Adapted from a paper presented by S.J. Midgley to the AFDI International Forestry Conference for the Australian Bicentenary, 1988. Albany-Wodonga, 25 April - 1 May 1988

The early French enthusiasm for the Australian flora saw eucalypts planted through the warmer parts of Europe and the French colonies. Ferdinand von Mueller and his enthusiastic French disciple Prosper Ramel (of *E. rameliana* fame) vigorously exported seed of Australian species, particularly eucalypts, in the mid-1800s. By the 1860s eucalypts, acacias and grevilleas were being used in many parts of Europe, Africa, Asia and the Americas. The State forest services of Australia exported seed of many species and large commercial quantities were exported in the early 1900s by suppliers such as A. Murphy of Woy Woy. Much of the early work on the Australian flora was based upon seed collected from single trees and of sometimes confused taxonomy.

The economic and social importance of the Australian trees was quickly established outside Australia, but there remained a need for a reliable supply of certified, authenticated seed for international use. In 1961 the Food and Agricultural Organisation (FAO) of the United Nations requested the Australian Government to set up a centre with three objectives:

- To assemble and disseminate technical information on *Eucalyptus* species, most suitable for maximum wood production and for sheltering field crops, for use in countries outside Australia
- To assist in the procurement of seed of *Eucalyptus* species suitable for use in countries outside Australia.
- To conduct research in genetics of *Eucalyptus* and in tree breeding for improved varieties.

By the late 1960s the economic importance and potential of non-eucalypts were recognized, and with the encouragement of the FAO Panel of Experts on Forest Gene Resources, the charter of the Centre was expanded to include all genera of useful Australian woody plants, from small shrubs to tall trees.

It was envisaged that the newly-formed Forest Research Institute of the Forestry and Timber Bureau would be a logical base for the Centre, and the desirability of a central seed source to reduce duplication of effort was agreed to by the autonomous State forest services. From that time, with a fledgling staff of one professional officer, the Australian Tree Seed Centre has now become a group of 4 professionals and 10 technical staff. Research functions of the Forestry and Timber Bureau were transferred to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 1975 and formed the basis for the current Division of

Forestry and Forest Products. The seed service, now referred to as the Australian Tree Seed Centre, has been maintained as part of this Division.

The Centre provided the high quality seed for provenance trials of *E. camaldulensis* established in the early 1960s under the auspices of the FAO Mediterranean Forestry Research Committee. These trials provided positive and definitive demonstrations of the differences in growth rate between provenances and support for the high standards of collection the Centre follows. Intensive and systematic seed sampling has subsequently been carried out on many species including *E. cloeziana*, *E. delegatensis*, *E. grandis*, *E. globulus* ssp *globulus*, *E. leucoxyton*, *E. microtheca*, *E. nitens*, *E. obliqua*, *E. saligna*, *E. tereticornis*, *E. viminalis*, *Acacia aneura*, *A. auriculiformis*, *A. crassicarpa* and *A. mangium*. In collaboration with local forest authorities, the Centre has participated in seed collections of eucalypts and acacias occurring naturally in Indonesia and Papua New Guinea. These collections complement those made in Australia and have been used mainly for international provenance trials.

National and international interest in the work of the Centre has resulted in many government and corporate bodies providing support and the Centre is currently 80% self-financed. However, as a result, the operational role has expanded greatly. Figure 1 shows the geographic origin of seed orders processed by the Centre in 1987.

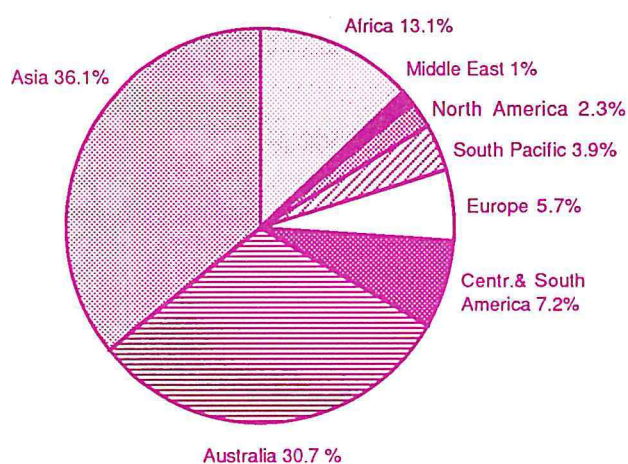


Figure 1. Seed orders processed 1987; by geographic origin.

Past and current supporters of the Centre's work include such diverse groups as FAO, the Australian International Development Assistance Bureau (AIDAB), the Australian Centre for International Agricultural Research (ACIAR), the Brazilian Agricultural Research Corporation (EMBRAPA), the French Centre Technique Forestier Tropical (CTFT), ALCOA of Australia, the US Department of Agriculture, aid bodies from Denmark, Canada and the USA, and a number of large international forestry companies. Without such support the service of high quality seed and advice from the Centre could not be

provided. The AIDAB support is especially valuable as it supports services in addition to seed collection and distribution, allowing for training programs, advisory visits and supply of literature. The Centre encourages overseas foresters to visit Australia to collect their own seed as this provides a better understanding of the resource with which they are dealing.

The main aims of the Centre are to provide authenticated and representative samples of seed and to provide professional advice on species selection and silviculture to international and Australian researchers. Where research leads to greater quantities of seed being required, the seed may be secured through commercial seed suppliers or State forest services. The Centre distributes a brochure of "Suppliers of Australian Tree Seed" and, by acting as a "shop window" to Australia's flora, assists a commercial seed export industry valued at over A\$7 million annually.

CSIRO's standards for seed collection are very strict. Parent trees are selected at a minimum distance apart to minimise the number of closely related individuals included in a seedlot. Precise records including parent tree description, botanical identity, collection location, habitat description, basic soil description, date of collection and number of parent trees are maintained.

All seed distributed by the Centre is provided with a seed certificate which provides information on geographic origin and viability, and the number of trees sampled. This information is computerised to minimise transcription errors and improve handling efficiency. Researchers requiring additional seed origin information can request copies of the original provenance record sheets completed during the collection. Recipients of CSIRO seed are urged to use and record the unique 5-figure seedlot number which accompanies the seed. This number is the key to the record-keeping system of the Centre and is now commonly used for exchanging information in international research on Australian species.

Seed distributed by the Centre is priced according to the cost of collection, processing and storage and is more expensive than seed from commercial suppliers. This reflects the cost of collection from widely spaced trees, the cost of collecting detailed site information, the cost of record maintenance and the cost of dispatching seed in grams rather than kilograms. Prospective purchasers should be aware, however, that excessive economy in obtaining seed may jeopardise the results of costly research programs or the value of resulting plantations. There is a long-standing policy of exchanging seed whenever an appropriate arrangement can be made.

To Australia's lasting credit the export of seed of Australian tree species has been mostly free of government restriction. From 1944 until 1953 the export of seed of *Eucalyptus polybractea*, a species rich in essential oils, was prohibited. There have been suggestions at different times since then that the export of seed of other species be prohibited. Examples include *Melaleuca alternifolia* which has a foliar oil of strong anti-bacterial

quality, *Castanospermum australe* the seed of which contains an alkaloid reported to be of high potential for AIDS and cancer treatment and *Duboisia* ssp. which produces atropine. Apart from the moral issues of laying proprietary claim to a wild species, the simple problem of adequately policing such regulations make prohibition impractical.

CURRENT PROGRAMS

Seed Collection and Distribution.

The seed collection program of the ATSC is formulated every 2 years and is strongly influenced by the priorities of funding/sponsoring bodies, anticipated research needs within Australia and the FAO Panel of Experts in Forest Gene Resources. There is an increasing demand for a wider range of species and this has meant the development of new techniques for the collection, handling and storage of those new species. Collaborative, carefully focused seed collections are now preferred. Over 70 person-months were spent in the field seed collecting in 1987.

Table 1 demonstrates the growth in seed collection and distribution in the 10 years, 1976-1986 and Table 2 reflects the current demand for species of different genera. The technical challenges of collecting, handling and testing such a range of species are great.

Figure 2 shows the geographic origins of seedlots dispatched in 1987 and demonstrates the breadth of the stocks maintained by the Centre.

Table 1: Growth in seed collection and distribution 1976-1986

Numbers of Seedlots	1976	1986
Accessions to store	700	2600
Dispatches from store	1500	6000

Table 2: Breakdown by genera of seedlots dispatched over 2 years, 1986-1987

Genera	Number of Species	Number of Seedlots
Eucalyptus	331	6526
Acacia	83	3893
Casuarina	9	758
Melaleuca	31	282
Allocasuarina	23	194
Sesbania	1	74
Grevillea	9	46
Other	84	320

Whilst there has been a strong increase in the demand for species suitable for agroforestry and arid and semi-arid land planting over the past 8 years, the most-requested species remain *E. camaldulensis*, *E. tereticornis*, *E. grandis*, *E. globulus* ssp. *globulus*, *E. nitens*, *A. mangium* and, more recently, *A. auriculiformis*. This is demonstrated by the steady demand for the popular *E. camaldulensis*, the most favoured provenance of which is Petford in north Queensland; in the 30 months after January 1985 the Centre sent over 72 kg of seed to 348 researchers in 79 countries — a total of 1700 seedlots, 30% of which went to India, Nepal and Zimbabwe.

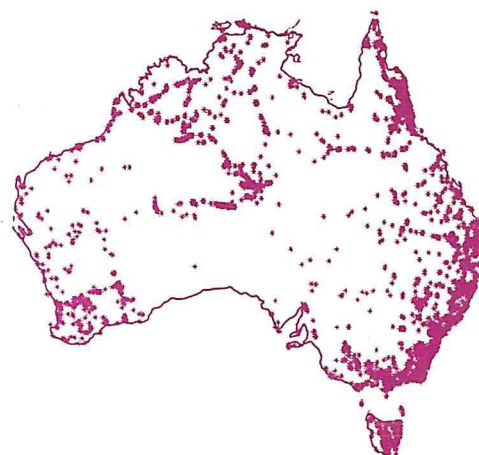


Figure 2. Geographic origins of seedlots dispatched, 1987.

Research.

Research aimed at optimising methods for collecting, processing, storing and germinating Australian tree seed so as to obtain maximum longevity and germinative capacity is an essential function of the Centre and information from this work has been published.

The Centre initiates and contributes to research within the Division of Forestry and Forest Products on genetic variation and breeding systems on eucalypts, acacias and casuarinas. Complementary research within the Division includes eucalypt taxonomy, breeding strategies, quantitative genetics, isozyme studies and advanced investigations of a range of physiological attributes such as frost resistance, salt tolerance, nutritional requirements and water relations. At many Universities and other research laboratories in Australia work is in progress on microbiological associates, nutritional value of foliage and wood properties, using seed and information from the Centre.

Support and coordination of international provenance trials of *E. microtheca*, *E. urophylla*, *A. aneura* and *A. mangium* have recently been provided under FAO auspices. The inability to make a larger input into international species and provenance trials has long been a source of frustration, but the problem is now being addressed by ACIAR whose forestry program aims to identify, and assist in the introduction and domestication of, Australian species of trees and shrubs suited to the

specific needs of developing countries. The major activities of the ACIAR program have focused on the exploration of the potential of Australian trees and shrubs to meet the fuelwood, agroforestry and industrial needs of developing countries and many field trials have been successfully established in Australia and overseas to determine their productivity and adaptability in a range of tropical environments.

Training, Extension and Consultancy Services.

The Centre has provided in-service training in seed technology to foresters from fourteen countries over the past 10 years and this remains an integral part of the "Seeds of Australian Trees Project" sponsored by AIDAB. Apart from basic training in techniques of seed collection, handling and testing, this training provides a valuable opportunity for overseas foresters to become familiar with the ecology of Australian species in their native occurrence.

Staff of the Centre respond to over 1500 requests for seed or information a year. Advice is provided on an *ad hoc* basis to tree growers on the selection of appropriate tree species and provenances to meet stated objectives. To support this service, information on the ecology, propagation, silviculture, harvesting and utilisation of selected species is collated and disseminated.

The Centre regularly participates in international workshops to provide information and advice on the use of Australian trees and seed handling. As part of this activity the Centre played a major role in organising an international workshop on casuarina ecology, management and utilisation in 1981. The Centre will organise a IUFRO meeting on seed problems to be held in Australia in 1989 and is assisting with the forthcoming IUFRO meeting on casuarina to be held in Egypt in 1990.

Since 1980 Centre staff have undertaken on-site consultancies and advisory visits to 20 countries. As greater international use is made of the Australian flora, this activity will increase. Such visits are of value to Australia as they provide feedback on the overseas use and silviculture of Australian trees.

THE FUTURE

With the high national and international interest in planting and improving Australian tree species it is inevitable that demand for the service of the Australian Tree Seed Centre will continue. Natural populations will remain important sources of germplasm of Australian trees. Many widely planted species such as *E. grandis* and *E. globulus ssp globulus* remain inadequately sampled, partly due to an incomplete knowledge of their population structure and breeding systems. The recognition of superior provenances, the progressive identification of the potential of previously little-known species and wider recognition of inbreeding problems in many overseas plantations all point towards the need for continued intensive and systematic sampling of native populations of Australian tree species. There will be a

continuing need for high quality seed for research and development of commercially important species such as *Eucalyptus grandis*, *E. globulus ssp. globulus*, *E. camaldulensis*, *E. tereticornis*, *Acacia mangium*, *A. auriculiformis* and *A. mearnsii*. Research programs will undoubtedly identify a further suite of species useful for agroforestry and small-scale village afforestation. Two species which will receive increased attention are *Grevillea robusta*, a species widely used in the tropical highlands for high shade, agroforestry and lumber, and *Macadamia integrifolia* which has considerable potential as a high value tree crop for crowded village garden situations. There is evidence to suggest that the extensive international plantings of *Grevillea robusta* have a narrow genetic base.

Essential research to improve handling techniques for seed of high value species will continue. This will be of particular importance should afforestation using a broader range of high-value rainforest species become a reality.

Seed supply of important provenances of priority species such as *A. auriculiformis* and *A. mangium* will be assured through the establishment of seed orchards by State forest services and private organisations in Australia.

Service activities of the ATSC such as the advisory service, consultancies and training will continue under outside sponsorship. An exciting innovation will be the further development of a new tree crops data base, TREDAT, which will permit the results of field trials of species, provenances and other sub-specific taxa to be stored and selectively retrieved. The accumulated records will be used to assist in the choice of planting material for nominated localities and end uses.

Australia has an obligation to contribute to reforestation efforts in a world of shrinking forest resources. No other organisation maintains such a diverse and publicly-accessible collection of source-identified, authenticated tree seed. The Australian Tree Seed Centre represents a uniquely Australian contribution to international forestry.

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