ANNUAL REVEGETATION NEWSLETTER

VOLUME ONE

June 1988

Produced by the
Department of Conservation and Land Management,
Western Australia.

ANNUAL REVEGETATION NEWSLETTER
VOL I

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TABLE OF CONTENTS

PREFACE

The first volume of the Annual Revegetation newsletter has been an experiment to gauge the interest and response of workers in this field of research. The idea came from a number of people and has proven to be a great success with over 40 articles submitted and about 100 people asking to be placed on the mailing list. We would like to thank those who have responded and apologise to anyone who we did not contact. We hope you will contribute next year! A special thanks to those individuals in each State we "dobbed-in" to organise circulation of our letter to their co-workers. This saved us much time and we believe allowed better circulation of our letter.

A couple of significant changes to the format as set out in our original letter we must mention. The most obvious is that this volume has been retyped and desk top published with the assistance of the Western Australian Department of Conservation and Land Management (C.A.L.M.). This was believed necessary because of the variable standard, typeset etc. of submitted articles and the "quick" publishing facilities now available with computers. However, the machines do cause some delays when you least expect them - we are sorry about the delay in publishing this volume. In addition, it was decided that we would not include the mining industry in this newsletter because it was thought it was adequately covered through the Australian Mining Industry newsletter "Landline" (article 42). However, those articles which have been submitted are included. It is hoped to continue the Newsletter in this format in forthcoming years.

Finally we would like to thank the number of C.A.L.M. staff who aided us in retyping the manuscript and the C.A.L.M. publications personnel. In particular Marg Wilke, Debbie Vickers, Cheryl Tonts and the assistance from Sweton Stewart.

Paul Brown and Penny Hussey.

June, 1988

I RESEARCH PROJECTS

ESTABLISHMENT - GENERAL

1. THE REVEGETATION SCHEME

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The Department of Environment and Planning has recently completed a five year research programme to evaluate and develop broadscale revegetation techniques suitable for local conditions in the agricultural region of South Australia.

Trials were established on private land during 1982 and 1983 in areas representing a wide range of soils, rainfalls and vegetation types. They were run with the generous assistance of the landowners and Departments of Agriculture and Woods and Forests staff.

Direct Seeding

The success of direct seeding was found to be primarily controlled by climatic conditions and weed competition. Both these factors have a significant bearing on soil moisture which is vitally important to germination and early survival in the field. A number of other factors, such as seeding rates and time of seeding, also played an important part in determining the outcome with this method.

Findings of the Department's trials can be briefly summarised as follows:

1. Ground preparation methods that controlled weed reinvasion for 6-9 months after seeding gave the best seedling establishment. For example, grading away the uppermost topsoil which suppressed weed growth at the site well into the first summer after seeding was more effective than cultivation which did not inhibit weed growth for more than a few months.
2. Autumn-early winter sowing was better at the trial sites than spring sowing.
3. Covering the seed improved seedling establishment. This may be due to improved moisture retention around the seed and reduced ant predation and other insect damage.

However some exceptions to the above were found which illustrate the need to adapt the approach to suit the conditions at each site.

Direct seeding was most successful on those sites with a higher and more reliable rainfall and the better moisture-retaining soils.

Natural Regeneration

Only one of the six woodland and mallee species in the exclosures regenerated. This illustrates that exclusion of grazing and weed control are only two of a number of factors which influence the occurrence of natural regeneration.

It is evident from the programme that natural regeneration results from the chance combination of a number of factors. Large falls of viable seed need to coincide with good rainfalls when temperatures are suitable for germination.

Regeneration in drier parts of the agricultural region is sporadic because seedfall, rainfall and optimum germination temperatures do not often coincide. This method is strongly influenced by climatic factors and in areas where rainfall patterns are more reliable it is more predictable.

Planting Seedlings

The programme reviewed planting practices throughout Australia for comparison with direct seeding and natural regeneration techniques.

Publications

The research programme has culminated in the preparation of a handbook "Growing Trees for Farms, Parks and Roadsides", published by Lothian Publishing Company, which covers all technical aspects of seedling planting, direct seeding and natural regeneration.

The following reports were published as part of the programme and are available from the Department:

Sullivan, P.L. and Venning, J. (1982). The Extent and Severity of Tree Decline in Agricultural Regions of South Australia. ($1.00, postage 60 cents)

Copley, P.B. and Venning, J. (1983). Rural Revegetation in South Australia. ($4.00, postage $1.00)

Croft, T.S. and Venning, J. (1983). The Extent and Severity of Tree Decline in Agricultural Regions of South Australia. Supplement. ($1.00, postage 60 cents)

Venning, J. and Croft, T.S. (1983). Natural Regeneration : A Case Study. (N/C, postage $1.00)

Croft, T.S. and Venning, J. (1985). Nutrient Susceptibilities of Some Common South Australian Native Plants: Influence on Direct Seeding ($3.00, postage $1.00)

McMurray, S.K. (1985). Post-emergent Herbicides for Weed Control with Direct-Seeding Native Species. ($3.00, postage $1.00)

Venning, J. (Ed.) (1985). Proceedings of a Workshop on Direct Seeding and Natural Regeneration Techniques. ($5.00, postage $1.50)

Venning, J. (1985). Natural regeneration: Case Study II. (N/C, postage $1.00)

Venning, J. (1986). 1985 Revegetation Trials. ($4.00, postage $1.00)

Bishop, G.C. (1987). Reliability of Natural Regeneration for Broadscale Revegetation. $5.00, postage $2.00)

Copies of these reports can be obtained from Ellen Geyer, Community Information Centre, Department of Environment and Planning, G.P.O. Box 667, Adelaide. 5001

2. RURAL TREE REGENERATION IN THE TASMANIAN MIDLAND

Libby Pinkard, Midlands Tree Project Officer
c/o The Chief Commissioner, Forestry Commission,
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Tree decline on farmland in the Midlands of Tasmania is becoming an increasingly obvious problem. Not only individual paddock trees but whole groups are showing signs of dying back, and their skeletons are becoming a common sight in the area. There is little regrowth establishing to replace these trees, and a real worry is that we will eventually have a treeless landscape, open to erosion, rising water tables and salinity.

The environment in the Midlands, a predominantly sheep growing region, is one of the harshest in Tasmania. The average annual rainfall is 500-600 mm, with mean, maximum and minimum temperatures in summer and winter being 22°C - 8°C and 10°C- 1°C respectively. Hot dry winds are common in summer, and frosts can occur all year round. Approximately 3 years in the past 10 could be considered "good" years climatically in the Midlands, with the remainder being drought or near-drought. Conditions are very difficult for establishing tree seedlings.

From a growing concern within the farming community about the extent of the tree decline problem and the expense and difficulty of re-establishing trees, a research project was initiated in 1984 by the Forestry Commission, in conjunction with the Midlands Tree Committee (MTC). The main objective was to investigate methods of cheaply and effectively establishing trees on farms, with emphasis on the use of native species grown from local stock. This includes researching direct seeding, natural regeneration and planting techniques.

Work has concentrated mainly on developing direct seeding techniques, using seed collected from the Midlands region. Collecting seed from individual trees scattered over a large area is a very slow and expensive process and seed from declining trees is often less viable than that from healthy trees in a forest situation. The problem largely overcome when Greening Australia (Tas) and the MTC successfully applied for a Commonweath Employment Program grant to fund a seed collection gang. Two grants were actually obtained - one in 1985/86 and one in 1986/87 - and over 200kg of mixed species seed, valued at $3-400/kg is stored in the Midlands Seed Bank.

A range of conventional farm sowing equipment was tested, without much success, but giving good indications of methods that do not work. In 1986 a Western Tree Seeder

was purchased. This is a machine designed specifically for sowing tree seed on farmland, and has proven very successful in areas where it has been used in Victoria. Pilot trials with the Seeder in the Midlands have given some very encouraging results, and further seeding trials will centre on its use.

In 1987 funding from the Forestry Commission and National Soil Conservation Program enabled the appointment of a Project Officer for a 2 1/2 year term. This appointment has assured the continuation of this important research.

A number of trial sites have been established throughout the Midlands over the past 3 years, which are monitored for seedling numbers, growth and vigour. Detailed weather monitoring is also undertaken. As well as direct seeding trials, a major planting trial investigating cheap methods of seedling establishment is in progress. A limited trial into the processes of natural regeneration has also commenced.

In conjunction with these trials, the Forestry Commission has undertaken a long-term investigation into the effects of grazing exclusion on remnant woodland in the Midlands. This project will be monitored for at least 10 years.

Future Rural Tree Regeneration work will concentrate on adapting direct seeding techniques; investigating species suitable for the area; looking at cheaper planting techniques; and limited study into methods of encouraging natural regeneration. By mid 1989, a set of guidelines should be available to landholders to assist them in their regeneration efforts.

3. EUCALYPTUS REGENERATION PROGRAM - NEW ENGLAND TABLELANDS (Progress Report No. 7- January 1988)

David Curtin
Botany Department, University of New England,
Armidale 2351.

Aim

To monitor natural regeneration on farmland near Armidale N.S.W. and to initiate a series of eucalypt re-establishment trails.

Introduction

In 1979 the New England Eucalypt Dieback Research Fund was established with donations totalling $80,000 from the local community to fund research into dieback. In 1984, with 3/4 of its funds exhausted it began the Eucalyptus Regeneration Program. 1988 is the final year of the project. In the first half of the year I will be completing my MSc thesis based on the results of the work. This will include sections on dieback and vegetation changes since settlement, phenology of eucalypts, early seedling establishment, lignotuberous regeneration, direct sowing and tree planting. It will be a

synthesis of work completed between 1982-83 as part of a MSc (prelim) project plus the current work (1984-1988).

Broad achievements of the project

1 Natural Regeneration

a) Lignotuberous advanced growth

About 113 ha. over 11 properties have been fenced off by landholders to allow natural regeneration and for tree establishment work. Of this about 81 ha. is regenerating well with (in places) quite dense regeneration. Three years after fencing many of the regenerated seedlings are up to 1-2 m in height. 182 advanced seedlings are being monitored in detail on 5 of the sites, of 4 eucalypt species, 1 acacia and one other native shrub. Measurements are being made on height and density changes after exclusion from stock.

b) Flowering and seed fall patterns

The flowering cycle of 112 trees of 13 eucalypt species has been monitored in detail over 3 years. 26 trees (10 species) have also been fitted with seed traps so that seed fall can be measured.

c) Early Seedling Recruitment

Seedling recruitment was observed over Spring/Summer of 1985. 124 newly established seedlings were monitored and survivorship and height changes measured until 1988. In subsequent seasons recruitment was rare and only a few seedlings were found and monitored.

2. Eucalypt re-establishment trials

a) Planting Trials

Five planting trials were established over 5 sites in 1985 and 1986 with about 1300 seedlings of 24 species and 6 different planting techniques (including mulches, fertilizer, terrasorb and planting times).

In 1987 a further series of trials was established. This time the same two species and planting designs were replicated over 4 sites involving about 1300 trees. The trials were designed to examine:- 4 pre-planting techniques (Roundup, Roundup + Simazine, Ploughed and Chipped); 2 planting techniques (hand planting versus machine planting); 4 tree guard types (milk carton, gro-tubes, Rural Trees Australia guard, none); sawdust mulch and fertilizer combinations; 5 post planting maintenance techniques (Roundup, Fulsilade, nothing, cultivation and hand weeding).

A major planting by the Armidale Tree Group of about 12000 trees around the water supply reservoir of Armidale (Malpas Dam) was also monitored as part of this project. All trees were planted using the same technique i.e. pre-rip, chip by hand, sawdust mulch, milk carton guard, stake, and water in. 33 native species and 6 exotic species were planted. Height and survival changes are measured annually and comparisons will be made between species, soil type, aspect, slope and degree of disturbance. Overall survival after the first year was 97%.

b) Direct Seeding Trials

In 1985-86 about 18 different sowing trials were established on several sites. These trials embraced about 30 different techniques including various soil preparations, sowing rates, sowing times, mulches, species and follow up treatments, pasture and soil types and sowing methods. Some of these trials gave promising results, particularly ones where the site to be sown was first graded to remove top soil and then chisel ploughed or ripped.

On the basis of these, three further trials were established in 1987 to examine in more detail 3 ground preparation techniques i.e. grading and ripping, herbicide applications and ploughing.

Concluding Remarks

The project has been a success in increasing knowledge in the community about dieback and tree establishment. One field day to show the work was well attended - another is planned this year. A number of talks have been given to school groups and two public talks have been given. In addition the project has attracted a number of newspaper articles and has close links with the Armidale Tree Group - a community tree planting group.

After three years of trying many tree establishment techniques the project will be able to recommend to local land holders many techniques which do work, in replacing trees lost to dieback, and warn of many which do not.

Publications

A report for the project will be published in the form of a 100 page book with accompanying brochures, wall charts and video. It will be aimed at landholders, school children and others interested in tree establishment and will emphasize a 'how you can do it' approach. Also to be published this year are three papers based on a trip to Victoria in 1987 a part of this project written jointly be myself and Ian Reeve of the Rural Development Centre:

"Growback in Victoria - Community Responses to Tree Decline". (A report on what's being done in Victoria to correct tree decline, salinity and soil erosion by community groups, individuals and governments.)

"Sowing the Seeds - A guide to nurturing community support for tree planting programmes."

"Planting Trees - How they do it in Victoria." (A report on tree planting and propagation techniques used in Victoria.)

These papers are available on request from the authors.

4. REFORESTATION FOR SALINITY CONTROL

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Commencement : April 1986
Duration : on-going
Research Program :
The overall objective is to improve reforestation techniques for salinity control in water supply catchments in the south-west of WA.

Of immediate concern is the Wellington Reservoir Catchment (WRC). In that catchment over 5000 hectares of cleared land in the eastern low rainfall/high salinity zone have been planted with a variety of species, mostly eucalypts, since 1976. Generally the lower 30-40% of cleared land is planted i.e. in and around saline groundwater discharge sites (referred to as discharge sites). This environment is often harsh for plant establishment. Major environmental stresses in discharge sites, such as those in the WRC, are high soil salinity (typically up to 1.0% by weight salt in the surface 20cm of soil) and waterlogging caused by watertables which are often (especially in winter) less than 0.5 metres deep. Other environmental stresses in and around discharge sites are drought (mostly in summer/autumn) and, possibly, low soil fertility.

Field trials were set up in 1986 and 1987 with the above environmental stresses in mind. They fall into two groups:

1. Establishment trials - to find ways of reducing environmental stresses by modifying the environment or changing planting practices.
2. Species selection trials - to find trees or shrubs which
   (a) are most tolerant of the environmental stress
   (b) and will give maximum depression of saline groundwater tables through increased transpiration.

1. **Establishment trials**
   Separate trials are to investigate
   (a) The best size and shape of ridge mounds to plant seedlings in.
   (b) Drainage (using parallel open ditch drains formed in the ridge mounding process).
   (c) Mulching (as a way of reducing salt accumulation in ridge mounds).
   (d) Seedling containers - Will bigger containers, or those which allow chemical root pruning give more robust seedlings?
   (e) Planting time - Can this be altered to take advantage of seasonal changes in soil salinity and waterlogging conditions?
   (f) Fertilizer - what is the best fertilizer regime for seedlings? Note: Trials (d). (e) and (f) put in both discharge sites and sites with well drained soils.

2. Species selection trials

For harsh sites i.e. discharge sites devoid of even salt and waterlogging tolerant barley grass (Hordeum marinium) or containing only patchy barley grass. The approach, so far. has been to look for any shrub or tree species that will grow. Trials include species from the *Atriplex, Melaleuca, Casuarina, Tamarix* and *Eucalyptus* genera.

For less harsh sites two approaches are being followed.

(a) One study is compare leaf conductance of four eucalypt species so far found to be tolerant of some waterlogging and salinity i.e. grow on sites with a patchy cover of barley grass. The assumption is that species with highest leaf conductance will be the best to plant because they will transpire most causing maximum depression of saline groundwater tables.

(b) In another study species performance trials with 13 species (*Eucalyptus* species and *Casuarina obesa*). selected as being of most interest for reforestation in the WRC, were put in six sites. Those sites were chosen to represent the range of soil types and salinity/waterlogging conditions in the WRC. The aim to evaluate species/site suitability.

5. THE ABATEMENT OF DUST IN THE KALGOORLIE REGION BY THE REVEGETATION OF OVERBURDEN STOCKPILES.

Mary Fletcher, Research Officer
W.A. Department of Agriculture, Kalgoorlie W.A. 6430

The minerals and Energy Research Institute of Western Australia has engaged the Department of Agriculture to conduct a three year research programme. The goal of the project is the abatement of dust in the Kalgoorlie region by the revegetation of overburden stockpiles which have resulted from open-cut mining for gold. The project began in March, 1986 and employs a Research Officer and a Technical Assistant.

Previous work done by the Department on revegetating the tailings material resultant from the processing of the gold bearing ore provided an initial suite of species and an initial establishment technique.

The establishment technique and species list are summarized in the following steps:

Step 1 Control surface run-off i.e. grade absorption banks along contour lines.
Step 2 Apply fertilizer, generally single superphosphate and trace elements at 400kg/ha.

Step 3 Broadcast locally collected shrub seed

Atriplex numularia	4kg/ha
Atriplex stipitata	1
Atriplex vesicaria	1
Atriplex bunburyana	2
Maireana brevifolia	1
Maireana pyramidata	1

Step 4 Spread slag (ex Kalgoorlie Nickel Smelter)
(a small pamphlet on Vegetating Kalgoorlie's slime dumps can be obtaind from the Department of Agriculture at Kalgoorlie).

The waste rock material or overburden, with which this project is primarily concerned is generally highly compacted, highly salime (ECe's generally higher than $16dSm^{-1}$ and up to $50dSm^{-1}$), sodic and has widely varying pHs (4.00 - 8.5).

Work over the last two years has expanded the initial suit of species. As part of the 1986 trial programme, 11 species were direct seeded and in 1987 39 species were direct seeded in the species selection trial. The best species to date are:

Atriplex	- *A. spp. "pintharuka"; A. lentiformis* *A. stipitata; A. vesicaria.*
Acacia	- *A. ligulata: A. tetragonophylla*
Eucalyptus	- *E. brockwayii, E. sargentii,* *E. woodwardii; E. wandoo* (inland)

Atriplex bunburyana showed the most potential at the end of the 1986 trials, however due to poor seed viability in 1987 it didn't perform so well as expected.

Other trials have included:

1) Fertilizer Pot Trials using *Atriplex bunburyana* - good results were obtained from both of these trials.
2) Fertilizer Field Trial - plus or minus fertiliser seeded with a "shotgun" mix of seed. Plots with fertilizer showed good germination and survival. Plots without fertiliser had very poor germination.
3) Fertilizer Field Trial using *Atriplex bunburyana* germination was very poor due to low seed viability and a dry winter.
4) Germination of Species under Different Depths of Slag. A pot trial conducted in Kalgoorlie. Slag depths greater than 1.8 cm reduced germination of all species.
5) Effect of Different Mulches on Germination and Growth of *Atriplex bunburyana*. Germination was poor due to low seed viability.
6) Germination of Four *Atriplex* Species Under Different Salt and Temperature Condition. This trial was conducted in temperature cabinets in South Perth and showed temperature to have a minimal affect on germination of the *Atriplex's bunburyana, vesicaria, numularia* and species "pintharuka".

7) Evaluation of Tree Seedlings Transplanted into Overburden Stockpiles. Seven Eucalyptus species, a Casuarina and seven *Eucalyptus camaldulensis* clones (ex Alcoa) were planted and watered by trickle irrigation. *Eucalyptus loxophleba, dundasii, sargentii* and two *camaldulensis* clones had better than 75% survival rates.
8) Species Selection Trial Planted. Seedlings of Atriplex and Maireana species were transplanted into the waste dump. They were watered at planting and one month after planting. Survival has been good. Grazing by rabbits has caused a large proportion of the losses.

In addition to the trials, a series of "best bet" treatments have been made each year. These include; Hydromulching on 37°, 20° and 0° slopes with and without topsoil, strawmulching on 37° slopes, moonscaping, spreading and seeding of street sweepings on a 20° slope and niche seeding on dump tops. The most succesful of these treatments has been Hydromulching on 20° slopes with topsoil and moonscaping.

Another series of trials and "best bet" treatments are planned for 1988. The trials will include; Species selection - field trials, species selection - pot trial, spoil ameloriants (gypsum, lime and chicken manure), burden, Effect of compaction of the growth of *Atriplex bunburyana* in mine overburden, Effect of different surface mulches on movement of salt in spoil profiles, Effect of different surface mulches on evaporation from mine overburden.

Best bet treatments will include; Hydromulching on a 15° slope with and without topsoil, niche seeding on a 1° slope with and without topsoil and Evaluation of tranplanted tree seedlings.

6. REVEGETATION OF DISTURBED CLIFF-TOP COMMUNITIES

John Morgan
18 Poplar Grove, Murrumbeena, Victoria 3163
Phone No: (03) 568-5330

Location Of Research: Port Campbell National Park

Duration: June/July 1988 - July/August 1889

Outline: The aim of the planned project is to develop techniques for re-establishing indigenous species on eroded or disturbed cliff-top sites. It is hoped that a number of trials will be established to determine - suitable indigenous species for use in this situation :

- the value of various types of mulch
- the effectiveness of site preparation practices such as ripping
- the most suitable means of revegetation
  eg. assessing the success of direct seeding techniques
- seeding rates
- weed control techniques
- fertilizer applications

7. COAL DUMP REHABILITATION USING NATIVE PLANT SPECIES

B.K. Owens,
School of Biology, Curtin University of Technology,
Kent Street, Bentley W.A. 6102

A number of projects were established and are continuing on coal dumps at Collie, W.A. These include surveys of abandoned coal mine dumps to find acid tolerant plant species, pot and field trails on potentially tolerant species (e.g. *Acacia* spp. and *Eucalyptus patens)*, topsoil and mulch trials as well as the effect of a range of lime and fertilizer treatments on selected native plant species. Further details can be obtained from B.K. Owens.

8. REHABILITATION OF A GYPSUM MINE

Curtin University of Technology
Kent Street
BENTLEY W.A. 6102

The rehabilitation of a gypsum mine operated by a wheatbelt farmer has been assessed after the cessation of winter rainfall for the past three years. The mining lease is situated within a salt marsh reserve and in order to maintain the lease, the farmer is required to rehabilitate the mined areas.

Each mining area or pod was surveyed for plant species and transects were made in each area to record plant density, dominance and frequency. A survey of ant species in each pod was also made as ants are often a good indicator of the level of succession.

The results showed that in the two oldest pods (31 months after mining) rehabilitation was progressing well, with increasing species diversity, increasing plant density, a high level of ground cover and increasing ant colonisation. The largest pod (19 months after mining) had been contoured with a ridge and furrow system running across it, as well as having salt bush (Atriplex) seed sown prior to winter rain. These two treatments appear to be very beneficial with the pod having good cover from salt bushes, and

furrows offering a place for water retention and thus plant growth. Forty seven Eucalyptus seedlings were found in this pod, most in the furrows.

Publication

Fox, J.E.D. and D.L. Fletcher. (1988). Rehabilitation at Kondinin Salt Marsh 26905 Mining Lease 70/4. 21st January 1988.

Mulga Research Centre, School of Biology, Curtin University of Technology, Bentley, W.A., 6102.

9. REVEGETATION MACHINERY - AUSTRALIAN REVEGETATION CORPORATION

Australian Revegetation Corporation
51 King Edward Street, Osborne Park, W.A. 6017

Blue Bush Harvester

In a joint venture with the West Australian Department Of Agriculture South Perth Kimseed Machinery has designed and built a suitable machine to harvest bluebush *(Mareana Spp.)*. The *Maireana brevifolia* is known to be a most suitable species for spreading and colonising on the lighter well drained soil types throughout the agricultural area. Due to its popularity the demand for seeds has been far in excess of the supply. The existing method of harvest is not efficient enough to keep up with the demand, therefore a machine has been developed to improve the efficiency of harvesting seed.

The three point linkage machine weighs approximately 1 tonne and has been designed to pass over the bush where the light seed is dislodged from the bush and is drawn up into the collection bag under suction. The machine has been undergoing testing and modification and is expected to be completed prior to the coming season.

Kimseed Klodbuster breaks new ground

Australian Revegetation and Environmental Consultants have recently completed the initial stages of the rehabilitation of the tailings dump at Edjudina Gold Mine.

The dump was steep sloped and sever gullying was evident in two areas. The methods of site modification for revegetation were undertaken:

1. Moonscaping
2. Kimseed Klodbuster

Moonscaping is a common method used to assist in stabilisation of slopes less than 24 degrees, such as haul roads and top of banks.

Kimseed Klodbuster

The Kimseed Klodbuster is the most effective method for use on slopes greater than 24 degrees which are inaccessible to graders or other machinery used for moonscaping.

It is composed of a long heavy duty chain with intermittent spikes and swivels with a weighted disc at one end and a towhitch attachment at the other enabling it to be dragged along the edge of a slope by a tractor (or other suitable machiner).

The aim of the Kimseed Klodbuster is to gouge out intermittent holes in the slope which create microclimate areas for seed and water catchment.

It does not create continuous trenches along the slope and therefore reduces the risk of gullying and washing away of seed. Another advantage of the Kimseed Klodbuster is that it breaks up the hard pan clay layer that is often found on compacted mine slopes allowing water to penetrate, creating a more favourable environment for seeds to germinate and establish.

The results found using the Kimseed Klodbuster at the Edjudina mine have been favourable and would appear to be the only cost-effective alternative in situations where slope angle is greater than 24 degrees, and, as in this particular mine, where there was no possibility of creating bund walls to reduce the slope angle because of the extremely limited lease size.

Kimseed Camel Pitter

The Kimseed Camel Pitter was a result of a joint venture between West Australian Department of Agriculture, Western Australian Product Innovation Centre Pty Ltd, and Kimseed Machinery and it is a low cost, low maintenance rangeland seeder designed to be trailed behind small tractors, utilities, and 4wd vehicles. The Kimseed Camel Pitter is suited to a wide range of seeding operations and soil types and is designed so that the full weight of the frame acts through the disc to give pits that are 1 m long, 15 - 20 cm wide and up to 15cm deep, without the use of hydraulics.

Seeds are released within these pits which provides the best possible conditions for germination.

ESTABLISHMENT - PLANTING SEEDLINGS

10 EFFECT OF TREE SHELTERS ON THE GROWTH OF RAINFOREST TREE SPECIES

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P.O. Box 210, Atherton. Qld. 4883. Telephone (070) 911 844

Duration: February 1987 - February 1988

Introduction

The use of designed individual tree shelters for improving the establishment and initial growth of trees began with Graham Tuley in 1979 in the United Kingdom. Since then, research has been undertaken into the design and performance of these shelters, resulting in a variety of materials and structures now being marketed at the rate of 2 million per annum.

Although tree shelters provide the following benefits to the young trees, very little information is available on which factors contribute most to tree growth:

- forms a greenhouse in the field
- increases the humidity around the plant
- prevents the risk of exposure from wind
- concentrates CO_2 at the base of the shelter if the base is sealed at ground level
- protects against predators such as rabbits and wallabies
- allows weedicides to be applied around the tree quickly and safely

Research into tree shelters in north Queensland began in 1987 as part of our agroforestry research programme. The shelters used, are made of 130 um thick UV stabilised plastic tubing, registered under the name Growtube. These shelters with cuff folded inwards at the base are placed over the trees and supported by three wooden stakes, 30 cm apart in a triangular arrangement. The cost of the stakes plus a 1 m Growtube is about $3.00.

Red cedar was the first rainforest species chosen because it is one of the most valuable and popular native rainforest trees in north Queensland. Although it is shade intolerant, it has not always grown quickly when planted for agroforestry in highly modified and exposed environments.

Aim

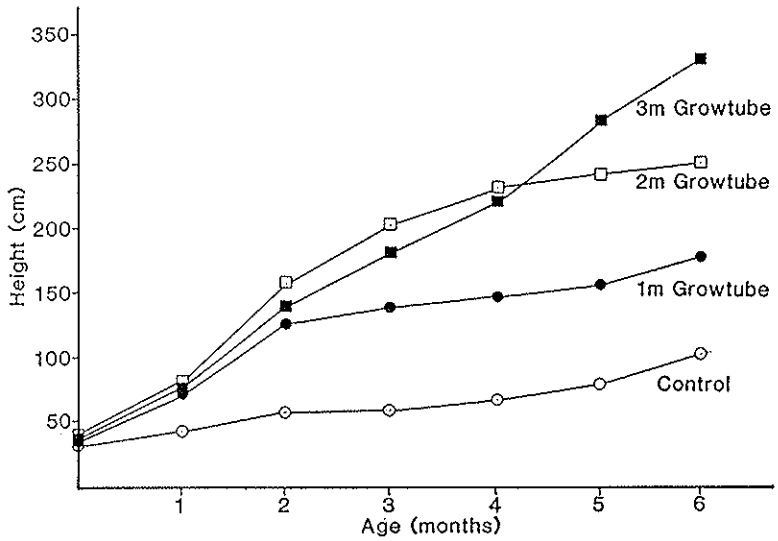
To observe the early growth and development of red cedar inside Growtubes and to compare this growth with red cedar grown without Growtubes.

Method

The experiment is a completely randomised block consisting of four treatments, nil Growtube (control), 1 m, 2 m and 3 m lengths of Growtube with three replications. Each plot comprises 5 single trees at a spacing of 4 m. A weed cover of less than 10% was maintained around each tree using a guarded Roundup spray at 4 litres/ha.

Results

The height development of the red cedar up to age 6 months as shown in the figure below for the control, 1 m, 2 m, and 3 m Growtubes are 0.96 m, 1.75 m, 2.54 m and 3.04 m respectively.



Height growth of red cedar to age 6 months

Conclusion

The Growtubes reduced the exposure of the young trees to wind. The enhanced tree growth would be consistent with a lower evapotranspiration and improved water status.

Although this is the first trial we have established with the Growtube, the results are dramatic enough to warrant further testing using other valuable rainforest species. The Growtubes have shown that they could be a valuable, cheap and easily constructed tool for agroforestry systems such as farm timber lots, shelter belts, rehabilitation and enrichment of rainforest in north Queensland.

11 TUART STUDIES IN THE KWINANA INDUSTRIAL AREA

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BENTLEY W.A. 6102

A study commenced in 1985 aimed firstly to re-establish Tuart *(Eucalyptus gomphocephala)* seedlings in the Kwinana industrial strip because of the poor success of natural regeneration, and secondly to determine and assess the relative success of planting on different sites. This was to take into account proximity to potential pollution sources and other factors on the growth of Tuart seedlings.

Some 50 five month old Tuart seedlings were planted at six sites in the Kwinana industrial strip. Height and observations on survival and health have been recorded.

Survival to June 1986 was good at all sites excluding plants lost due to vandalism. Insect damage was greatest in the August-October period in 1985 and reduced the overall growth rates at all sites. However, by the end of 1985 most plants were recovering and during 1986 the damage from insects was not as severe or as widespread.

Some of the best growth responses occurred in the main industrial belt where plants were more likely to be exposed to pollution. Some plants were watered over summer and it would seem that water availability is a more important factor than air pollution in determining early Tuart performance.

Publication

K.A. Meney and J.E.D. Fox. Tuart studies in the Kwinana industrial area. Final Report 1985-1986. 10th November 1986.

12 RESTORATION OF A FLY ASH POND, SOUTH FREMANTLE

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BENTLEY W.A. 6102

In June 1986 work commenced to restore vegetation on the South Fremantle Power Station fly ash pond to that of the surrounding lands (i.e. tuart woodland) and to determine the response of native plant species to growth in fly ash material.

Approximately 1300 container grown trees and shrubs were planted on site in June 1986. this was followed by seed sowing and fertilization of half the plants with superphosphate in July 1986. Heights of plants have been recorded since August 1986.

So far the fertilizer has had little effect. Tuart of South African origin showed best overall growth and a possible early response to fertilizer. Tuart was susceptible to insect damage particularly from leaf blister sawfly.

Some pot trials and seed germination trials in various concentrations of fly ash have been undertaken to complement the field work.
Further details can be obtained from an Interim Report:

J.E.D. Fox. Restoration of Fly Ash Material, South Fremantle. Report to the State Energy Commission of W.A. 19th January 1987.

DIRECT SEEDING

13. BROADSCALE DIRECT SEEDING ON ESTABLISHED FARMLAND IN THE W.A. WHEATBELT

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Through closely monitored field trials and specifically designed glasshouse experiments over the past two years we have been developing methods of broadscale direct seeding for use on established farmland in the W.A. Wheatbelt (400-700mm rainfall in zone). Many of our results complement those found by J. Venning in South Australia and the techniques used by farmers such as Geoff Grewer at Esperance. The following article briefly summarises the current recommendations arising from our experience and trial results over the past two years. Writing up of results is in progress and will be submitted for publication by the end of the year.

Weed Control

The elimination of competition from weeds is the most important factor in establishing trees by direct seeding. The aim is to have the ground to be sown absolutely weed free prior to sowing and to control all weeds at least into the first summer after sowing.

This is best achieved on medium and heavy soils by multiple cultivation using a scarifier. This will need to be repeated at least three times so that successive germination from the weed seed bank are killed. On sandy surfaced soils this continued cultivation will leave the prepared land susceptible to erosion. The risk can be lessened by sowing rows of a suitable cover crop to protect the seeded area.

Scalping off the top 5-7cm of soil with a blade or road grader just prior to direct seeding provides very effective weed control into the first summer by removing the weed seed bank altogether. Do not scalp shallow duplex soils where clay will be exposed once the overlying sand is removed, as very poor results have been achieved on exposed heavy soil types.

Chemical Weed Control - Cultivation or scalping can be supplemented with applications of contact herbicides such as glyphosate or paraquat/diquat PRIOR to sowing. All residual herbicides appear to have a detrimental effect on thee germination of tree seed.

Late germinating grasses can be, and must be, controlled with a selective grass herbicide (such as "Fusilade" or "Sertin"), sprayed at the recommended rates, over the top of germinating tree seedlings. Keep a close watch on grass weeds, particularly during the first eight weeks after sowing, and spray as soon as the problem is noticed.

Difficult Sites

It is advisable to begin with the sites which are easiest to establish i.e. well drained, sand or loam soils which are not salt affected. The following site types are currently NOT recommended for direct seeding, at least until further research is carried out:

* Sites with late germinating, aggressive broadleaf weeds. Scalping can be used on such sites prior to sowing to remove the seed store, however, cultivation and chemical weed control have not proven successful. Fortunately, however, on most sites broadleaf weeds germinate early and can be controlled prior to sowing.
* Heavy textured soils - due to 'surface-sealing' of clay soils, direct seeding has proven very poor.
* Deep sands - Seedlings must be protected from strong winds and species selections are crutial. Non-wetting sands present additional problems and these sands must be scalped off prior to sowing.
* Waterlogged/saline sites - not recommended.

Sowing

Established farmland should be seeded when good weed control has been achieved usually in June or July. Trials have shown Spring sowing (August or September) results in very poor germination. Most eucalypt seed will germinate two to six weeks after sowing. However during Winter the small seedlings will remain dormant until soil temperatures increase, so seedlings often remain unobserved until as late as October or November.

Seed should be sown at 350g/ha for new land and between 500 and 1000 g/ha for old country. This is mixed with super in a combine and applied at rate of 150-200 kg/ha going over the area twice to ensure complete coverage. Other 'bulking-up' agents used have been Grade 2 vermiculite, graded sand, bran flakes and chicken pellets. The area to be sown must be scarified prior to sowing. When sowing the combine tynes are set just above ground level so the seed drops onto the rough ground surface and the hoses should preferably be disconnected from the boots.

For small seeded species such as most eucalypts, melaleucas and casuarinas the seed may be either left uncovered on the soil surface or very lightly covered by dragging wheat bags, a chain, brush or even a piece of carpet behind the combine. If the seed is buried even 1cm below the surface, germination is severely affected. However, large seeded species such as Marri *(E. calophylla)*, Coastal Blackbutt *(E. todtiana)* and all legume species (acacias, native pea flowers, tagasaste) germinate best when buried to a depth of about 1cm below the soil surface. This can be achieved by pulling harrows behind the combine. If a mix of both small and large seeded species are to be sown on the one site we suggest either they are sown separately (the large seeded species sown first) or if sown together the best compromise would be surface sowing and lightly covering the seed using wheat bags or a chain pulled behind the combine.

Sometimes vibration will separate the seed and super, so it is advisable to have someone agitating the mix during sowing.

Germination can be significantly improved on sandy textured soils by compacting the site with the tractor tyres or a roller, immediately after sowing . Heavy textured soils should not be compacted.

Seedlings must be protected from stock, wind and rabbits.

Observation Plots

Due to the small seedling size of many of our native species we suggest 'observation plots' be established i.e. two to three 50cm square plots per site be permanently pegged, seeded by hand and carefully observed for germination seedlings. Regular and close observations of the observation plots will enable identification of seeded species and of pest problems such as red legged earth mite, lucerne flea, rutherglen bugs or grasshoppers. Seeded areas should be sprayed with insecticide when the pests are seen in large numbers.

Species Selection

Use a mixture of at least 4 or 5 species to create a mixed windbreak of trees of various forms. Select species native to the area, soil type and topographic position that are growing well in your district. If you wish to extend the range choose species from similar soil types and the same or lower rainfall. Understorey plants as well as trees may be sown, however, all seed should be germination tested prior to sowing.

14.DIRECT SEEDING TRIALS OF NATIVE PLANTS IN GIPPSLAND

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13 Waratah St., Walkerville Vic., 3959

Following the completion of the Gippsland tree seeder in October 1987 a series of trial seedlings were carried out at 5 sites in the Yarram Woodside area, 3 sites in the Walkerville area and one site at Lang Lang.

In the Yarram area sites had been prepared by cultivation many times through the winter. One site had had gypsum incorporated into the light sandy loam. All were shelter belts from 6-10 m wide and 0.5 to 2 km long. All seed was coated with "Austrasorb" and finely divided clay after mixing with mucilage. The eucalypts, acacias,

melaleucas and casuarinas of local provenance and as supplied by the Department of Conservation Forests and Lands. Sowing took place from 20 October to 11 November.

At Walkerville in two sites the topsoil was graded off the row positions to a depth of about 7 cm and a width of about 50 cm. The machine sowed directly into this bed. Sowing took place from 19 November to 22 November.

At the third site the surface was sprayed with "Roundup" after heavy grazing in July, cultivated with a chisel plough several times, resprayed with "Roundup" and further cultivated before sowing. Sowing took place on 19 November.

At the Lang Lang site "Atrazine" had been applied to the surface before cultivation; gypsum had been cultivated into the heavy clay soil. Sowing took place on December.

Results to date (29 January 88)

Some germination occurred at all Yarram sites. Most results are unsatisfactory. Good rains occurred within 7 days of sowing. A hot spell in January and lack of follow up rains resulted in little growth and some loss by dehydration. weeds were a large problem in all cultivated sites. General results were better in areas of unimproved pasture. It is considered that sowing should take place earlier in the spring as the area has a history of unreliable late spring rain.

One Walkerville site was in loose sand and wind scour prevented any results. The other two sites showed good germination. The best result was in the graded area where seedlings are present at intervals of from 10 to 100 cm. All species sown are represented ie eucalypts, acacias, melaleucas and casuarina. The seedlings are up to 5cm high. Weed growth is small compared to the cultivated sites. Excellent rain occurred immediately after sowing; follow up rains were received at intervals of about 14 days; the latter part of January had heatwave conditions which have curled up leaves of eucalypts in the cultivated site particularly. The other Walkerville site shows good results with eucalypt seedlings up to 10 cm high at intervals of about 1 m. There are some melaleuca and a few casuarina seedlings. The best results appear where seed was coated with clay; results from coating with nutrients and "Austrasorb" are at present inconclusive. Weed growth particularly clovers is a large problem. A small area sown with Tagasaste into a section ripped, sprayed with "Roundup" one week before sowing produced a large number of seedlings showing good growth up to 20 cm high. This seed was presoaked in boiling water and coated with "Austrasorb" and clay.

At Lang Lang germination was good and the best results appear where gypsum had been incorporated into the soil.

Some hothouse trials have been carried out testing the effect on germination of eucalypts of using "Atrazine" as a pre-emergent herbicide. Results are not yet fully collated.

Further trials will be carried out in the autumn and spring of 1988, concentrating on grading the surface before sowing. Attempts will be made to build a grading module into the seeder. The search for a postemergent herbicide which will kill broadleafed weeds but not the species sown will continue.

15.REVEGETATING A ROAD VERGE BY DIRECT SEEDING: WONGAN HILLS-CALINGIRI ROAD, W.A.

Alex Hart
CALM, Hayman Road, Como WA

Sowing 1983 and 1984 - Results evaluated 1987.

This work involved direct seeding of 2.5km of roadside virtually denuded of all vegetation during roadworks. The road runs approximately east-west, and both northern and southern verges are 2.5 - 3m wide. The topography is a gentle slope of $1^{o}15'$ to 2^{o} 0', with soil changes from shallow sandy clay gravels at the crest to loamy sands in the saline area of the valley. Rainfall in this area occurs in winter and averages about 400mm/year.

The whole site was ripped. Weed control included the spreading of surplus road gravel onto the verge and the use of pre-sow, contact herbicide sprays. Two seed mixes with two fertilizer treatments were used.

Some establishment of sown species, particularly acacias, has occurred. Volunteer species are also prominent; the major species being *Acacia lasiocalyx* and *Acacia leptospermoides*. However, in some areas there has been no response to the seeding.

Conclusions from the trial include:

a) Greater use of local species, especially acacias.
b) More effective weed control during early growth period.
c) Sandblasting of unprotected seedlings by soil from adjoining paddocks caused high initial losses.

16. DIRECT SEEDING OF ROADSIDES

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Date Commenced: 1988

Expected Completion Date : 1992

Aim:
To establish a technique of direct seeding which allows the development of a broad spectrum of vegetation species in roadside areas.

Site Preparations
Two basic techniques are being investigated.

1. Topsoil Removal
   It is considered the removal of the top 50 - 100 mm of topsoil in degraded areas will reduce the impact, on germinating native species, caused by weed competition and the build up of artificial nutrients.
   This topsoil layer is being localised in windrows or removed from the site.

2. Herbicide Control
   The control of grass growth can be achieved by use of foliar absorbed or root absorbed herbicides.

   The trial is investigating the impact on germination of site treatments prior to seeding with amitrole, atrazine, glyphosate and glyphosate/simazine mixtures.

   All sites are then deep ripped to a minimum of 300 mm then scarified to a fine tilth immediately prior to seeding.

   Seeding is carried out using a blended mix of local native species spread with a hand broadcaster.

Post Seeding Site Treatments

Sites treated with herbicide prior to seeding will be oversprayed with a range of selective herbicides from 1988 to remove narrow leaved grass species.

Monitoring

Seed species are being checked for viability/germination potential.

The field trials are being duplicated under laboratory conditions to delineate field responses.

Field trials are being monitored using a series of random $4m^2$ quadrats, and analysis of species diversity and abundance is determined within the quadrats. This monitoring is repeated four times in year one with further monitoring dependent on success of each site.

Monitoring is being carried out by staff and research assistants from Murdoch University in Western Australia.

Further research requirements of specific problems arising from the trials are being assessed annually.

17.OBSERVATIONS ON SEED GERMINATION OF SCLEROPHYLLOUS LOW SHRUBLAND HEATH SPECIES FROM ENEABBA.
Curtin University of Technology

Joan M Osborne
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Box 1987 GPO, Perth W.A. 6000
and Mark Jefferies
Associated Minerals Consolidated Limited, Eneabba WA 6518

Studies commenced 1984 and ongoing.

Overview

The most numerous native vegetation elements of the Eneabba region are species of Myrtaceae, Proteaceae and Leguminosae, with a ground cover of sedges (Cyperaceae) and the rush-like Restionaceae.

At Eneabba, Associated Minerals Consolidated Limited (AMC) carries out opencut mining for mineral sands. Rehabilitation techniques include direct seeding onto the topsoil of locally collected seed. Seed quality and viability and pre-sowing treatments are aspects which must be considered before seed of a particular species is selected for large scale collection.

Laboratory germination studies at Curtin University have ascertained dormancy breaking factors and germination requirements for seed from more than 80 species. A range of pre-treatments and temperatures have been trialled. The importance of identification of non-viable seed has been confirmed.

Publications

Davies, G., J.E.D. Fox and B.B. Lamont. 1984. Observations on seed germination for some species of the northern sand plain heath. Mulga Research Centre Report 7,17-33

Unpublished Reports

Chesson, K. 1986. Germination characteristics of selected native species from the kwongan heathland region, Eneabba, Western Australia. Biology Project Report, School of Biology, Curtin University.

Francis, M. 1987. Germination requirements of selected species from Eneabba, W.A. Biology Project Report, School of Biology, Curtin University.

Lloyd, S. 1986. Mine site rehabilitation: presowing treatments of seed collected from the Eneabba region (W.A.). Neville Stanley Scholarship Report.

Randall, R. 1984. Germination studies of native Eneabba plant species with special consideration to dormancy factors. Biology Project Report, School of Biology, Curtin University.

Stomber, T. 1985. Seed germination characteristics of twenty native plant species of Eneabba, Western Australia. Biology Project Report, School of Biology, Curtin University.

18.MINESITE REVEGETATION: OPTIMUM SOWING TIME TRIALS AT ENEABBA, W.A.

Curtin University of Technology

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Commenced 1982, ongoing studies.

Overview

Vegetation re-establishment by direct seeding is a standard rehabilitation technique applied on former mine-sites.

Since 1982 Curtin University undergraduate students complete applied rehabilitation projects at Associated Minerals Consolidated Mineral sand mining sites at Eneabba, W.A. One set of field investigations has considered the relative merits of different sowing times on germination and growth rates of native plant species.

Field sowings have been at regular monthly intervals through the 1982 to 1987 growing seasons, with up to twelve species studied each year. At each sowing time, and during an end of year recording, counts have been made of the germinated seedlings and established plants. Plant growth parameters have been recorded at the end of each growing season.

At Eneabba, early March sowings of a few species, e.g. *Hakea corymbosa* and *Xanthorrhoea reflexa* were most successful. Sown seed remained dormant but viable, and germinated when favourable combinations of soil moisture and temperature were met. Seedlings had an adequate cooler, wet period for growth and establishment, and survived the summer months. *Acacia blakelyi* is another species that can be sown early in the year, with good results. April would be the earliest recommended sowing month on the basis that follow-up rains are required to ensure survival of germinants.

May is the best month for sowing many species, e.g. *Allocasuarina humilis, Eucalyptus tetragona, Jacksonia floribunda.* Cooler summers optimise survival of seedlings, especially for the small *E. tetragona* germinants.

Although May was an optimum time for sowing some species of banksias (e.g. *Banksia attenuata* and *B. menziesii*), the resulting good field germinations only survived to the end of the first growing season. High mortality rates over summer indicate these species are possibly unsuitable for direct sowing.

August and September sowings have been unsuccessful. Germinations were low, and there was generally insufficient time for seedling establishment before the hot drier months. The late July sowing has also resulted in overall fewer germinations. The lower growth rates again reflect a shorter period conducive to plant growth.

Some species studied appear to show evidence of staggered dormancy periods, extending at least 12 months after sowing, e.g. *Allocasuarina humilis, Eucalyptus tetragona, Hakea corymbosa* and *Jacksonia floribunda*. As a consequence, seedlings of a given species emerging at different times, will be exposed to a range of environmental conditions, ultimately increasing the likelihood of survivals. However, these listed species all were found to have an optimum sowing time.

The plant species quoted above were drawn from a subset of the collected data (1984 field trial). Details of the 1982 to 1987 trials is contained in the following listed publications and unpublished reports.

Publications

Bywaters, T.K., J.M. Osborne and J.E.D. Fox. 1983. Observations on direct sowing of four native plant species at Eneabba, Western Australia. Mulga Research Centre Ann. Rep. 7, 1-17.

Osborne, J.M., S.G. Lloyd and D.R. Brooks. 1986. Sowing time and climatic influences on establishment of native plant species at Eneabba, Western Australia. AMIC Conference, Launceston, Tasmania. Working papers pp. (Ed. D. Brooks).

Unpublished Reports.

Bowyer, J. 1985. The optimum sowing time of eleven native species at Eneabba, Western Australia. Biology Project Report, School of Biology, Curtin University.

Clingan, V. 1983. The optimum sowing time of eight native species at Eneabba, Western Australia. Biology Project Report, School of Biology, Curtin University.

Lloyd, S. 1984. The optimum sowing time of eight native species at Eneabba, Western Australia. Biology Project Report, School of Biology, Curtin University.

Elliott, J. 1986. Minesite revegetation at Eneabba, W.A.: time and depth of sowing trials of native plant species. Biology Project Report, School of Biology, Curtin University.

Harris, C. 1987. Minesite rehabilitation: effect of sowing time, fertilizer application and climate on establishment of native plant species, Eneabba, W.A. Biology Project Report, School of Biology, Curtin University.

19. SEED PRODUCTION OF AUSTRALIAN NATIVE PLANT SPECIES

W.A. Wildflower Society, Eastern Hills Branch.
CONTACT PERSON: Mrs J Seabrook, 15 Rabone Way, Boya 6056.
Phone: 09 2996816.

Aim:

To establish a seed orchard for the production of seed of Australian plants which may be harvested and used in revegetation projects. The production of wildflower shrub seed is fast becoming a necessity. There are already many areas where the local vegetation has become too scarce to obtain enough seed for revegetation.

As long as wild seed is being collected in large quantities the supply needed for natural purposes, such as food for insects and animals and for natural regeneration, is being depleted.

The seed orchard is near Darlington in the Shire of Mundaring. It was first planted in May 1979. The area used is a small disused gravel pit, which was ripped as a preparation for planting. The original planting consisted of 18 species of local shrubs. The seed was scattered on the surface of the ground in rows of each species. Germination of all species was very good and by the spring of 1981 the first seeds of Acacia spp. were harvested. As the success of the original sowings became apparent more species were added, always with success in germination. The seed was never covered and no water was ever used. The plantings were carried out as soon as possible after the first winter rains.

It should be noted that the original seed orchard is very small in area occupying less than 1/8 ha and growing on ground from which the topsoil had been removed. It was grown as an experimental operation - a prototype - the success of which indicates unlimited possibilities.

In the 1984-85 season during the fifth year from planting seed harvested amounted to:

Acacia dentifera	1520g
Acacia drummondii var. *drummondii*	180g
Acacia drummondii var. *elegans*	700g
Calothamnus quadrifidus	140g
Eucalyptus caesia var. *caesia*	30g
Isopogon dubius	25g
Kunzea recurva	30g
Labichea lanceolata	40g
Petrophile biloba	70g
Trymalium floribundum	290g

Each year the seed harvested from the seed orchard has been donated to the Shire of Mundaring for revegetation work which has been carried out in the Beechina borrow pits. The seed has been broadcast in these gravel pits by the use of a superspreader. The results have been so good that the Eastern Hills Branch of the W.A. Wildflower Society has been motivated to produce a handbook detailing the methods used, mistakes made, and experience gained. The booklet is called "Seeds of the Future" and may be obtained by writing to Mrs J Seabrook at the address as above. The present charge for the book is $2.00 per copy, plus $1.50 postage and packing. Cheques should be made payable to the Eastern Hills Branch, W.A. Wildflower Society.

ESTABLISHMENT - NATURAL REGENERATION

20.CONSERVATION REQUIREMENTS OF THE GAZETTED RARE SPECIES, *BANKSIA CUNEATA* A.S. George along the Quairading-Bruce Rock Road, Western Australia.

Byron Lamont, Stephen Bergl, Stephen Connell
School of Biology, Curtin University of Technology
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This project has been funded by the W.A. Roadside Conservation Committee for a two year period which commenced in February 1987.

Background

Banksia cuneata, the Matchstick Banksia, is one ot he rarest species of banksias. It is confined to remnant vegetation in the wheatbelt area of Western Australia; occurring within a 50km radius of the town of Quairading. Four populations are currently known; three occur on roadside verges and one is located in a small nature reserve. Fewer than 300 plants exist in the wild.

Project Aim and Constraints

The aim of this study is to explore ways of maintaining present populations and establishing new populations by manipulation of the environment. The project is constrained by:

1) the need to ensure that suitable methods require limited effort and maintenance; and

2) that the surrounding native vegetation be considered in evaluating the success and utility of such methods.

Project status

Banksia cuneata is serotinous (retaining its seeds in woody follicles on the plant) and is killed by fire. It relies upon post-fire seedling establishment for population regeneration. The size and nature of the seed crop on plants of known ages was assessed in 1987.

In late autumn 1987, a controlled fire was placed over a portion of one roadside population. Seed release and seedling establishment in control and experimental plots within the burnt and unburnt areas is currently being examined. Experimental plots have been designed to examine the effects of microtopography, weed control, rabbit

and insect exclusion, direct hand sowing, and seedling transplanting on the success of seedling survivorship and growth.

Studies in 1988

Glasshouse investigations of the growth of *B. cuneata* seedlings on different soil types from the wheatbelt area will commence. Field monitoring will continue and a comprehensive census of all known populations will be undertaken. The census will determine population sizes, age structures, the nature of the surrounding native and weed vegetation, substrate relationships and possible threats.

Publications

Connell, S.W., Lamont, B.B., and Bergl, S.M. 1988. Matchstick Banksia. Australian Natural History Magazine (in press).

Lamont, B.B., Connell, S.W., and Bergl, S.M. Seed bank dynamics of *Banksia cuneata* (in preparation).

FACTORS LIMITING ESTABLISHMENT

21.VELDGRASS CONTROL IN KINGS PARK BUSHLAND

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West Perth W.A. 6005. Phone: 09 3215065

Introduction

Veldgrass *Ehrharta calycina* is a South African perennial grass which has naturalised itself in Kings Park bushland. It quickly establishes itself in disturbed areas, favouring partial to full sun conditions and high nutrient levels, conditions which are provided by regular bush fires. Unfortunately very little is know about its biology such as life span, how long seed remains viable in the soil etc., however under favourable conditions plants can flower and seed in autumn as well as spring.

General Effects of Veldgrass in Kings Park Bushland

1. Suppresses the native flora by crowding out and competing for available nutrients and moisture
2. Creates a fire hazard, a heavy stand of Veldgrass will provide enough fuel to burn every year, whereas it may take 3 to 4 years before the natural bushland would carry a fire.
3. Produces a dry harsh looking environment, unacceptable to visitors who expect to see a good display of wildflowers.

"Fusilade" (Fluazifop)

"Fusilade" is a selective, post emergent, translocate herbicide used for the control of certain grass species. Grasses which are not controlled include Annual Winter Grass and Silver Grass. This chemical is fairly safe to use having an L.D. 504000 mg/kg of body weight oral and 2000 mg/kg dermal acute, which compares favourably with other chemicals in common use, especially when diluted for field use. The concentrate should be handled with care, not least because it is highly flammable. As with all herbicides/insecticides protective clothing should be worn when using them eg P.V.C. gloves, respirator etc.

The mode of action is not fully understood, however, once in the tissue the chemical moves actively in the phloem and passively in the xylem.

"Fusilade" is translocated to the growing points of the plant, the initial effects are to inhibit growth followed by necrosis of the meristems. The signs of the chemical working on Veldgrass are a reddening of the leaves, this may take 2 to 3 weeks during cold weather or 2 to 3 days when hot. "Fusilade" must be applied when the grass is actively growing, not when under drought stress, and should not be used when rain is

expected, though 60% of the chemical is absorbed into the leaf within 1 hour of application. It is important to use a wetting agent or spreader eg "Agral 60", as this can improve the effectivenss of the "Fusilade" by up to 40%. The cost of "Fusilade" varies considerably depending on how much you buy and where you purchase it, eg $78 - $86 per litre (retail but tax exempt).

"Fusilade" Trials

"Fusilade" was first used in Kings Park in 1985. The first basic trials were designed to establish:-

(a) whether Veldgrass could be controlled
(b) whether the native flora was adversely affected
(c) best time to spray
(d) concentration required for effective control
(e) number of applications required
(f) the best conditions for effective control

Further trials in 1986 were aimed primarily at refining the best time for spraying. A 1 ha plot was also sprayed to assess the effect of a field scale operation.

Conclusions from the trials

"Fusilade" is a relatively safe herbicide to use a blanket spray over native plants for the control of Veldgrass in Kings Park bushland, at the rate of 2 to 4 litres per ha in 300-400 litres of water plus wetting agent, eg Agral 60 @ 1:1000. Two applications between late May and late August may be necessary or one application and a mop up spray the following year. Over 80 species of native plants have now been recorded in the sprayed areas, with no apparent damage (the exception being the native grass *Microlaena stipoides*). Other people trying out "Fusilade" have recorded damage on native plants especially *Eucalyptus,* but no deaths, when applied to seedlings grown on pots and in nurseries, perhaps causing lush growth more liable to damage. Before embarking on a full scale eradication programme we advise users to spray small trial plots and monitor the effect of "Fusilade" on local native plant species.

The use of selective herbicides to control grasses in the bushland situation is only a tool in the overall management of these areas. When badly degraded with virtually no seed bank in the soil a revegetation programme is necessary, eg sowing seed in situ or planting up with tube stock. If left alone these large bare areas will be colonised by resistant grasses and road leaved weeds which cannot be controlled by selective herbicides. Removal of Veldgrass appears to improve the overall vigour of the bushland species and reduces the recurrent fire risk. Regular bush fires must be kept out of these areas as they encourage the reintroduction of Veldgrass. However, fuel levels should be monitored to take into account public liability from wild bush fires.

22.EFFECTS OF ANNUAL PLANTS ON THE ESTABLISHMENT OF SHRUB SEEDLINGS ON A NATURE RESERVE IN THE WEST AUSTRALIAN WHEATBELT

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Summary

We carried out an experiment in which seeds of the shrub *Allocasuarina campestris* were planted into a disturbed area on Durokoppin Reserve, 20km north of Kellerberrin. Seeds were planted into quadrats which were either left without further manipulation, weeded to remove all seedlings of annual species, or planted with seeds of an introduced annual, *Ursinia anthemoides*. Significantly fewer *Allocasuarina* seedlings established in the "annuals added" treatment. Heavy mortality of seedlings occurred in early summer when the winter rains ceased, and by the following autumn virtually all seedlings in the control and "annuals added" treatments had died. Seedlings in the "annuals removed" treatment were significantly larger at the start of the summer than survivors in the other treatments, and approximately 30% survived until rains commenced again in autumn. We suggest that annuals significantly reduce the growth of shrub seedlings and prevent them from reaching an adequate size and root length to allow them to survive the summer rain-free period. This has important implications for attempts to re-establish natural vegetation in disturbed areas with high cover of annual species.

(This work commenced in May 1988 and was completed in Nov 1987. A manuscript on this work has been submitted to OECOLOGIA).

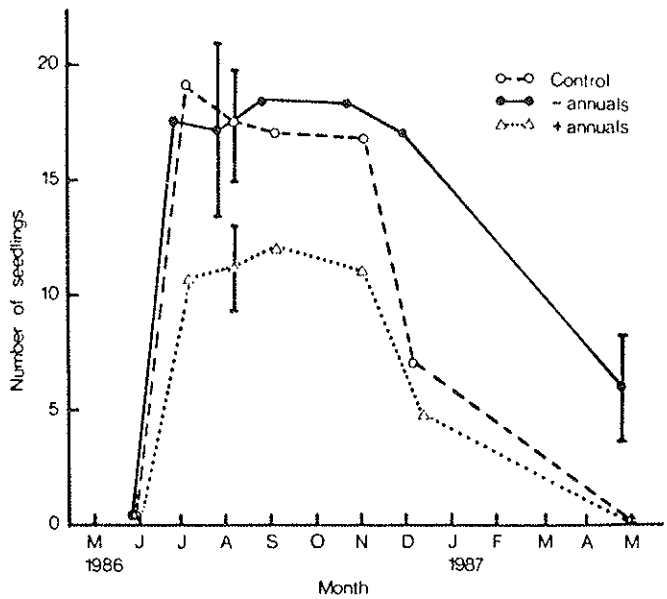

Fig 1. Numbers of live seedlings of *Allocasuarina campestris* present in experimental quadrats from May 1988 to May 1987 (mean + 1 S.E., n = 4). Open circles, control; closed circles, annuals removed; open triangles, annuals added.

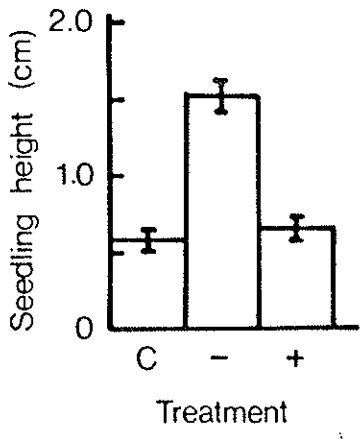

Fig 2.
Height (cm) of surviving seedlings of *Allocasuarina campestris* in control (C), annuals removed (-) and annuals added (+) quadrats (Mean + 1 S.E., totals from 4 replicates).

Publications

Beckmann, R. 1987 Preserving nature amid the wheat fields. Ecos 53: 29-31.

Hobbs, R.J. and Atkins, L. 1987 The effect of disturbance and nutrient addition on native and introduced annuals in plant communities in the Western Australian wheatbelt. Journal of Ecology, (In press).

23. A NEW APPROACH TO THE STUDY OF RURAL DIEBACK OF EUCALYPTS: A REPORT ON THE INITIATIVE BY CSIRO DIVISION OF ENTOMOLOGY.

R.A. Farrow and P.B. Edwards, CSIRO Division of Entomology,
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Introduction

Repeated defoliations by herbivorous insects, particularly by pasture breeding Christmas beetles (Scarabaeidae) are reported to be the prime cause of dieback of eucalypts in partially cleared savannah woodlands of south-east Australia (Carter *et al.* 1981). It has been proposed that outbreaks of such herbivores are caused by the lack of natural enemies in parkland and cleared areas, compared with woodlands, where a more complex plant and insect community is present (Davidson 1982).

With these problems in mind, the CSIRO Division of Entomology in 1983 initiated a programme to study the impact of insects on the establishment of eucalypts in plantations in pastures of the Southern Tablelands. The programme aims to understand the three following processes: 1) immigration and colonisation of experimental trees by herbivorous insects and their natural enemies, including the formation of insect guilds; 2) factors regulating the numbers of herbivorous insects including weather, natural enemies, food quality and movement, and 3) impact of insect feeding on eucalypt growth and survival in terms of biomass removed and compensatory regrowth. These studies will in turn provide answers to the two questions posed earlier on the role of herbivorous insects in dieback and the role of natural enemies in the control of herbivores.

Application to Primary Industry

The project aims at:

1. Identifying the criteria that should be used in the selection of eucalypt species for establishing shelter belts and woodlots with reference to resistance or tolerance to insect attack and other stress inducing factors. Although primarily applicable to the harsh Southern Tablelands habitat of south eastern Australia, the principles should have wide application to many agricultural areas of temperate Australia.
2. Producing appropriate designs of shelerbelts and woodlots in terms of species composition and location to minimise insect attack.
3. Identifying key pests and providing information on the most appropriate way of managing such pests.

Establishment of the Trial

A preliminary planting in 1984 indicated that several of the chosen species were unsuitable due to susceptibility to severe cold. Species with a greater tolerance to cold replaced these in the main plantings in 1985 and 1987. Final plantings will occur in 1989 and 1991 by which time the oldest trees will be six years old and vary betweeen two and ten metres in height

Concluding Remarks

The experimental plots are rapidly acquiring a natural insect community which is superficially similar to the communities observed in natural regrowth nearby. Numbers of herbivores are highly regulated by natural enemies even in the absence of ground and shrub cover. Some trees are showing poor growth and these are less able to recover from insect damage when attacked. Major damage on healthy trees is rapidly compensated for by regrowth.

ESTABLISHMENT OF GRASSES AND RANGELAND SHRUBS

24.NATIVE GRASSES AS A BASIS FOR DIRECT-SEEDING

Andrew N Paget [1] and Ian R Shimmen [2]

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Aim

To develop techniques for re-establishing pure stands of native grasses, as a nurse-crop for the overseeding of herbaceous, shrubs, and tree species in the revegetation of indigenous plant communities.

Background

Direct-seeding of indigenous tree and shrub species has often only been successful on poor or degraded sites due to the intense competition from exotic grasses. We aim to evolve techniques for replacing these exotic grasses with stands of native grasses with which indigenous herb, shrub, and tree seedlings will face less competition.

Outline

The following process is to be applied to a wide range of grass species:

1. Locate wild populations of each native grass species,
2. Collect ecological information,
3. Collect seed from wild populations (record yields),
4. Conduct propagation trials (determine dormancies, germination rates),
5. Plant row crops of each native grass species,
6. Monitor establishment and management of row crops (costs. methods),
7. Monitor growth periods (to determine best times for establishment),
8. Use crops to trial herbicides (for selectivity, tolerances),
9. Use crops to trial management with mowing.(timing, intensity)
10. Use crops to trial management with burning.
11. Use crops to trial management with fertilizers
12. Use crops to trial management with water
13. Use crops to trial seed harvesting (equipment, yields),
14. Use crop-produced seed with information on herbicides and management regimes to establish pure swards by direct-seeding.

Progress

To date we have established crops of the following native grasses:

Agropyron scabrum	Common Wheat-grass
Amphibromus neesii	Swamp Wallaby-grass
Danthonia caesnitosa	Common Wallaby-grass
D. geniculata	Kneed Wallaby-grass
D. pallida	Silvertop Wallaby-grass
D. racemosa	Clustered Wallaby-grass
Deyeuxia quadriseta	Common Reed Bent-grass
Dichelachne aequilateralis	Weeping Plume-grass
Echinopogon ovatus	Common Hedgehog-grass
Eragrostis brownii	Common Love Grass
Microlaena stipoides	Weeping Grass
Pentapogon quadrifidus	Five-awned Spear-grass
Poa labillardieri	Large Tussock-grass
Poa morrisii	Velvet Tussock-grass
Poa sieberana	Wiry Tussock-grass
Stipa semibarbata	Fibrous Spear-grass

During 1988 we are planning to establish crops of about another 30 species. We have also found *Themeda australis* (Kangaroo Grass) to be resistant to "Roundup" 250ml/15L during winter, and will be spraying other summer growing species during this winter to see if they are also resistant while dormant.

Results

As we finalize techniques we will be promoting them along with the supply of seed. We hope to begin promoting the revegetation of Kangaroo Grass *(Themeda australis)* this year based on a composite of available research.

25.RANGELAND REGENERATION RESEARCH

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Meekatharra, W.A. 6642 Phone: (099) 811 105

Interest in pasture rehabilitation has increased quite significantly over the last few years. At present there are fourteen Soil Conservation Districts (SCDs) in the pastoral zone.

The winter rainfall region of Western Australia, comprising about 600 000 sq. km. of land, has districts covering most of the area. In March 1986 a professional officer was

appointed to assist the development of these SCDs - a project funded by the National Soil Conservation Programme. The primary duty has been to determine problem areas in the SCDs, and to establish projects that demonstrate remedial approaches to these problems. A focal point of most of the SCDs has been the investigation of cultivation techniques to rehabilitate severely degraded areas.

A number of cultivation demonstrations have been established with pastoralists. Waterponding (a technique developed in western New South Wales) has been examined. The success of the work at Sturt Meadows Station (Leonora) and Wooramel Station (Canarvon) suggests that waterponding will be a valuable tool for regenerating severely scalded plains.

A 14 week regeneration programme in the southern shrublands last year by the Department of Agricultures Rangeland Regeneration Team has provided valuable information. Equipment evaluated in the programme included a Agrowplow with two opposed discs, a disc pitter designed by the Department of Agriculture, and an opposed disc implement.

Techniques employed were a series of contour lines forming a brick wall pattern, elliptical waterponding banks, circular ponding banks and a spiralling bank design. Early observations indicate that the most appropriate equipment for large scale work is a ripping implement (eg. Agrowplow) with either opposed disc or disc pitting attachments. Research into the required design features is continuing. In addition, the two ponding techniques have shown promise and warrant further investigation.

In conjunction with the demonstration programmes a series of research projects have been developed. These include saltbush screening and adaptation trials on Sturt Meadows and Belele Stations, cultivation systems trials (comparing four cultivation techniques) on Bidgemia, Mt Phillips, Mt Gould and Moorarie Stations, a waterponding trial on Wooramel Station; and Caesium 137 soil loss investigation on Belele, Boolardy and Barnong stations. This research has provided necessary information on plant species that are suitable for rehabilitation programmes and the soil types that are responsive to cultivation. Future research will be aimed at determining the suitability of cultivation techniques for a number of dominant land systems, and to investigate mechanisms that deposit seed where the probability of germination and establishment is maximised.

Details of the above projects are available. It is planned to present the results of the rangeland research in subsequent newsletters.

26. SCREENING ATRIPLEX SPECIES AND ECOTYPES FOR IMPROVED FORAGE PRODUCTION

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Carnarvon Regional Office, Department of Agriculture,
P.O. Box 522, CARNARVON W.A. 6701 PHONE: (099) 41 8103

Duration: May 1984 - May 1987

Outline of project:

Halophytes are plants that can tolerate high levels of soil salinity and occur naturally on salt affected soils the world over. In the agricultural areas of Western Australia halophytes (particularly saltbushes and bluebushes) have an important role in improving production from salt affected land.

1987 saw the completion of a three year project aimed at screening a number of saltbushes to improve forage production from salt affected land. The project was funded by R.C.D.F. and assessed saltbushes on their ability to establish from seed in the field, to survive and produce adequate forage and to recover from grazing.

The survival and growth of saltbushes at a number of trial sites from Bedford Harbour in the south, to Holleton in the east and Merkanooka in the north, demonstrated their adaptation to a wide range of salinity levels and soil types. Most of the species flowered and set seed within their first year and in some instances volunteer seedlings were also evident.

Valuable information on sheep diet preferences and the ability of shrubs to recover from heavy grazing was gained from a grazing trial at Brookton. Initially the sheep ate the plants they were most familiar with, which were mainly annual ground cover species. Once the sheep began grazing the shrubs, distinct preferences were observed. The three River Saltbush ecotypes (*Atriplex amnicola*) were grazed almost exclusively to begin with, followed by Wavy Leaf Saltbush *(A. undulata),* Quailbrush *(A.lentiformis)* and Marsh Saltbush *(A. paludosa).* In general, the species which were most palatable (preferentially grazed) recovered the fastest, attaining 80-90% of their original leaf cover within five months.

The results of this project indicate that it is possible to screen species for some forage shrub attributes within a three year period. The project has also demonstrated the ability of a number of halophytic shrubs to adapt to a wide range of soil salinity and soil types, to improve production from salt affected soils substantially and to be palatable to sheep and recover quickly from grazing.

The extension of these results by radio talks, field days and press releases has enabled the farming community to recognize and understand the role of halophytic shrubs in improving production from salt affected soils. As a result, saltbushes are now being integrated into farming systems which are attempting to cope with increasing soil salinization.

27.SELECTION AND ESTABLISHMENT OF FORAGE SHRUBS FOR REGENERATION OF DEGRADED RANGELAND

B.H.R. Ward
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Duration: January 1987 - December 1988

Objectives of project:

1. To collect and test rangeland forage species and ecotypes especially adapted for arid rangeland regeneration.

2. To devise direct seeding methods for introducing the selected species to degraded rangelands.

Progress in relation to objectives:

Project planning began in early February 1987, following consultations with Carnarvon Regional Office and Meekatharra District Office staff. Study sites were surveyed and species for testing were selected.

Trial sites were chosen to be representative of the major degraded landsystems in the Gascoyne area. The trials are located on alluvial plain elements of the Beringarra, Delta, Durlacher and Jimba landsystems.

The original vegetation of these elements was composed mainly of saltbush (Atriplex) and bluebush (Maireana) species, forming highly productive pasture. Sixteen perennial shrub species, including several of these bluebushes and saltbushes were chosen for inclusion in the screening programme (Table 1). Many of the species are known to be adapted to varying degrees, to the degraded landsystems of this study. Others are not endemic to the trial areas, but are known from other regions and previous work (RCDF project WADA 5784) to have potential.

Table 1: Species included in screening programme.

Scientific name	Ecotype	Common name
Acacia victoriae		Bardee bush
Atriplex amnicola	573 Wongan Hills	River saltbush
Atriplex amnicola	949 Bencubbin	River saltbush
Atriplex amnicola	971 Gutha	River saltbush
Atriplex bunburyana	Kalgoorlie	Silver saltbush
Atriplex lentiformis		Quail bush
Atriplex vesicaria		Bladder saltbush
Enchylaena tomentosa		Ruby saltbush
Maireana aphylla		Spiney bluebush
Maireana brevifolia		Small leaved bluebush
Maireana platycarpa		Low bluebush
Maireana polypterygia		Gascoyne bluebush
Maireana pyramidata		Black bluebush
Maireana tomentosa		Silky bluebush
Maireana triptera		Three winged bluebush
Ptilotus polakii		Gascoyne mulla mulla
Rhagodia eremae		Tall saltbush
Scaevola spinescens		Currant bush

Evaluating these species for arid rangeland regeneration will include studying their emergence in the field, and their survival and growth in adaptation trials. Methods tested and expertise gained from RCDF project WADA 5784 (Screening Atriplex species and ecotypes for forage production from salt affected land) will form the basis of this trial work.

Experimental work to investigate direct seeding methods for introducing selected species into degraded rangelands will occur mainly during the winter months of 1988. At present a range of cultivation techniques designed to regenerate degraded rangelands are being assessed in conjunction with staff from the Meekatharra District Office.

This project is funded by the Rural Credits Development Fund of the Reserve Bank of Australia.

28.PERENNIAL PASTURE ESTABLISHMENT ON A LEVEE BACK SLOPE SOIL OF THE DJADA LAND SYSTEM.

A.R. Williams, J.S. Addison, M. Revell and T. Bell.
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P.O. Box 278, Derby W.A. 6728. (091) 911 555.

Duration: 1986 - 1988

Trial A: Effect Of Soil Ameliorants

Objectives

To assess the benefits to plant establishment on a Djada levee back slope site accruing from the application of gypsum, mulch, a slow release compound fertiliser, and polyvinyl alcohol, individually and in combinations.

Method

Five treatments were applied in all possible combinations in 2m x 0.5m planting niches on banks formed by an opposed disc machine. Annual weed growth was previously controlled by "Gramoxone" spray. Six strips of niched banks formed six blocks. The treatments were:

1. Gypsum	at 1 kg/niche.
2. Magamp K fertiliser	at 20 g/niche.
3. Polyvinyl alcohol	at 60 g/niche.
4. Hay mulch	at 0.25 kg/niche,sprayed with white emulsion.
5 Nil treatment control.	

The six pasture species sown as indicators of the effectiveness of treatments were:-

1. *Astrebla elymoides*	1.0 g/niche	=	60 Pure Live Seeds/m2
2. *Cenchrus ciliaris* cv Biloela	0.4 g/niche	=	"
3. *C. setiger*	0.4 g/niche	=	"
4. *Centrosema pascuorum* cv Cavalcade	3.2 g/niche	=	"
5. *Dichanthium sericeum*	0.1 g/niche	=	"
6. *Panicum coloratum* cv Bambatsi	0.1 g/niche	=	"

Results

Plants of *Centrosema pascuorum* cv Cavalcade were counted on February 19, 1987; plants of all species were counted on March 16, 1987. Plant counts of *Centrosema pascuorum, Astrebla elymoides* and *Cenchrus setiger,* recorded on a "per niche" basis, were submitted for statistical analysis. Plant counts of the other species were judged to be too low for analysis.

The results indicate that gypsum and mulch have a significant beneficial effect on plant establishment of *Centrosema pascuorum* cv Cavalcade, *Astrebla elymoides and Cenchrus setiger.* Also polyvinyl alcohol in combination with mulch had a significant effect on the establishment of *Astrebla elymoiles.*

Trial B: Effect Of Mulching Treatments

Objectives

1) To assess the effect of various mulch treatments on the establishment and persistence of a mixture of six perennial pasture grasses and one introduced legume.
2) To compare mulching treatments on cultivated and uncultivated soil.

Method

Eight treatments are randomly allocated to strip plots of chisel/nil cultivation in 4 blocks following control of annual weed growth in January 1987. The treatments are:

1. Nil control.	
2. Curasol (R) (P.V.A.)	at 135g per plot.
3. Hay mulch	at 0.45kg per plot (2 tonnes/ha).
4. " "	" 0.9 kg " " (4 tonnes/ha).
5.Verano mulch	at 0.45kg per plot (2 tonnes/ha).
6. " "	" 0.9 kg " " (4 tonnes/ha).
7.Vermiculite	at 160 g per plot.
8. "	" 320 g " " .

Hay and mulch were sprayed with white emulsion.

Seven pasture species are used as indicators of treatment effects:-

1. *Astrebla squarrosa*	2.0 g/plot giving	40 PLS/m2
2. *Cenchrus ciliaris* cv Gayndah	0.6 g/plot giving	40 PLS/m2
3. *C. setiger*	0.5 g/plot giving	40 PLS/m2
4. *Centrosema pascuorum* cv Cavalcade	3.7 g/plot giving	40 PLS/m2
5. *Dichanthium sericeum*	0.2 g/plot giving	40 PLS/m2
6. *Diplachne parviflora*	0.1 g/plot giving	130 PLS/m2
7. *Panicum coloratum* cv Bambatsi	0.1 g/plot giving	40 PLS/m2

Results

Plants of *Centrosema pascuorum* cv Cavalcade were counted in six 0.25m2 quadrats per plot on February 19, 1987. Plants of all species were counted on March 17, 1987. Plant counts of *Dichanthium sericeum, Diplachne parviflora* and *Panicum coloratum* cv Bambatsi were too low to be statistically analysed.

The plant counts revealed that the hay and verano mulch treatments are generally better at promoting plant establishment than the other treatments tested. This is most obvious in the cases of *Astrebla squarrosa* and *Centrosema pascuorum* cv Cavalcade. Plant count differences between the rates of mulch application were only recorded for *Centrosema pascuorum* cv Cavalcade, indicating that the relatively low mulching rate is sufficient to promote pasture establishment on these sodic (E.S.P. 6), occasionally saline clay soils.

Annual pasture production on degraded frontage areas is typically around 0.5 tonne/ha, compared to the lower mulching rate used in the trial of 2.0 tonne/ha. It would therefore be feasible to attempt pasture establishment enhancement on frontage sites by gathering in situ annual pasture mulch material onto strips of seeding.

The effect of cultivation has not been significant to date for all species tested in the trial. This indicates that cultivation has been of lesser importance to plant establishment than the mulching treatments. Further experimentation with mulches at a range of sites has been established.

Publications:

Williams,A (1987), Recent Pasture Regeneration Research Findings, Pastoral Memo Vol 7, No 4, Kununurra.

Note: National Soil Conservation Programme (NSCP) supports the Fitzroy Pasture Regeneration Project.

AGROFORESTRY SYSTEMS AND CASH CROPS

29.SHELTERBELT RESEARCH IN VICTORIA

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In Australia, shelterbelts as a source of timber have generally been overlooked. There is considerable scope for examining combinations of tree species, planting density and tree arrangement in shelterbelts designed to produce timber, whist simultaneously providing protection for livestock, pasture or crops.

Two major windbreak research trials are being conducted in the state of Victoria. These form a part of a much wider agroforestry research program.

Near Hamilton in south-west Victoria, timber production from shelterbelts is being investigated. Several shelterbelt systems are being tested. These are:

- Two-row system - windward row of shelter species, plus leeward row of taller, timber-producing species
- Three-row system - windward row of shelter species, plus two rows of timber-producing species
- Three-row coppice system - three rows of species that coppice. Timber is produced and shelter maintained, by coppicing each row in turn
- Multi-row system - five rows of trees with the central row of a timber-producing species being nursed by two rows either side of fast-growing shelter species

A second trial in northeast Victoria aims to evaluate the effect of shelterbelt orientation and design on cereal crop production. Very little is known about the effect of shelter on crop yields in Australia.

Crop production will be measured at permanent sampling points along transects that bisect and extend 120m either side of each shelterbelt. Baseline information on crop yield will be collected before the shelterbelt is tall enough to have any significant influence. When trees are about 8m tall, the height of the shelterbelt will be controlled at this level by annual trimming. At this stage, permanent sampling points will be established, these being at multiples of tree height from the edge of the shelterbelt. By keeping the height constant, repeated measurements of crop yield (at 10 times tree

height from the edge of the shelterbelt, for example) can then be made at the same sampling point over several successive crops.

Once sufficient information is obtained, the shelterbelt may be manipulated by thinning to alter its structure and permeability, and another cycle of measurements commenced. The affect on crop yield of deep ripping close to the outermost tree line will also be studied.

At the same time, amongst farmers, there is increasing interest in the production of sawn timber from farm trees, especially timber for construction and fencing. Sugar gum, red gum, radiata pine and Monterey cypress are all being utilised by landowners at present.

30.RESEARCH ACTIVITIES IN THE SCHOOL OF BIOLOGY

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Sandalwood Research

A permanent collection of sandalwood (*Santalum spicatum*) representing different provenances within the State which can be used as a resource for demonstration, teaching and experimentation is being established at Muresk Institute of Agriculture near Northam. Other trials to assess the growth performance of sandalwood have been established at Eneabba, Jarrahdale and Bentley. Further planting trials are planned at Boddington and New Norcia.

A number of host, fertilizer and shade tolerance trials are in progress on potted plants and mature trees.

Flowering and fruiting are being examined in detail at the Curtin University campus. This involves studying flowering from bud initiation through to fruit maturation. Palatability and nutritional content of the fruit has been assessed in conjunction with the School of Home and Consumer Studies at Curtin University.

Publications

Barrett, D.R. (1986). Shade requirements of young sandalwood plants and initial consumer studies on fruit. Sandalwood Seminars, WAIT. October 1986.

Barrett, D.R. (1987). Germination and planting out techniques for the Western Australian sandalwood (Santalum spicatum). Mulga Research Centre Journal 9, 31-32.

Barrett, D.R. (1987). Initial studies on flowering and fruiting in Santalum spicatum (R.Br.) A.DC. the Western Australian sandalwood. Mulga Research Centre Journal 9, 33-37.

Barrett, D.R., Wijesuriya, S.R. and Fox, J.E.D. (1985). Observations foliar nutrient content of sandalwood (Santalum spicatum R.Br.DC.). Mulga Research Centre Journal 8,81-91.

31.EUCALYPTUS OIL AND AGROFORESTRY RESEARCH

Allan F.M. Barton
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At Murdoch University in Western Australia research into eucalyptus oil has been continuing since 1981 under the direction of Associate Professor Allan Barton.

A major aim of the research is to look at the possibility of establishing a eucalyptus oil plantation in the southern half of Western Australia.

Eucalypt agroforestry has the appeal of being able to grow trees of commercial value in areas that have previously been cleared for different farming practises. With the increasing problem of soil salinity and erosion, farmers are keen to experiment in a venture that has the long term potential of relieving the problems created by extensive land clearing.

To date around 240 species from the southern half of Western Australia have been analysed using solvent extraction and gas chromatography. Remaining species are gradually being added to the data bank.

Selected high yielding species have been planted in trial plots located on farming properties in the south-west of Western Australia. In establishing such plots the vigour and oil yield of each species under varying soil types and climatic conditions will be determined.

The high oil yielding species exist mainly as mallees which is advantageous for commercial production as it facilitates easy mechanical harvesting. A hectare plot has recently been established on Murdoch campus to enable the experimentation of various methods of mechanical harvesting; interrelated with this is plant and row spacings and biomass production.

Cineole is the major compound found in the Western Australian oil mallees that is important to the essential oil industry.

Oil yield varies considerably not only between species but also within species, therefore it appears desirable to obtain a high yielding mallee and clone it. Tissue culture of oil mallees and the lignotuber development from the cloned material are presently being researched.

Other areas of study at Murdoch include the effects of fertilizer application on oil yield and use of chemical analysis of eucalypts as a taxonomic tool.

The West Australian Department of Agriculture is also using the oil mallees in trials aimed at assessing the potential for salinity reclamation of land used for oil and fodder production.

Currently, with the aid of a Special Rural Research Grant a research assistant is investigating further uses of cineole.

II DEMONSTRATION PROJECTS AND EXTENSION

32. THE POTTER FARMLAND PLAN

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The Potter Farmland Plan commenced in the Hamilton area late in 1984. The project has established demonstration farms which aim to show farmers and the wider community how a whole farm planning approach which integrates agricultural and ecological principles can be applied on real farms. Briefly the project can be outlined as follows:

Design: Fifteen demonstration farms:

- 6 at Glenthompson: 60km east of Hamilton, rolling treeless plains, Ordovician sediments, severe gully erosion, dryland salinity and tree decline.
- 5 at Melville Forest: 35km north of Hamilton, former redgum (E. camaldulensis) woodland on soils derived from Rhyolite, severe tree decline, emerging gully salinity and erosion.
- 4 at Wando Vale: 80km west of Hamilton, steeply dissected lateritised tableland, severe gully, and tunnel erosion, slumping and hillside seeps, severe tree decline and emerging salinity.

Whole Farm Plans have been prepared for each farm. Substantial implementation of the plan was carried out from 1985-1987 with Potter Foundation assistance, completion of the plan will be carried out by the landholder from 1988 onwards, but at a reduced rate.

Funding:

Ian Potter Foundation	Landholders
$800,000 1985-1988	$200,000 1985-1987

Works 1985-1987:

150 kilometres of fencing	60,000 trees in shelter belts
200 hectares of direct-drilled perennial pasture	44,000 trees in woodlots
5 new water supply systems	54,000 trees in clumps and gullies
50 hectares direct seeded trees	2,000 trees in stock-proof guards

Assessment, documentation and monitoring:

Revegetation works were assessed by forestry students from the University of Melbourne from December 1985 to May 1987. The assessment showed that 78% of the 216 separate planting operations assessed had survival rates greater than 90%, 1 to 2 years after planting. Of the failures, most were due to insufficient protection allowing stock entry. In other words, the establishment techniques used were successful, and variations in herbicides used, soil disturbance, time of planting, and degree of watering and fertilising, did not significantly influence survival rates.

With minor variations, the establishment technique used was: Autumn deep ripping of planting lines, heavy grazing in August, spraying with combination knockdown and residual herbicides in late August/early September (e.g. "Weedzol"/"Gesatop" @ 61/31 per ha, applied along riplines with a "micron herbi"), follow up spray if necessary in late September, and planting using the "Hamilton Treeplanter" hand planter, with community groups. Usually no watering.

Assessment of direct-seeded areas was difficult, due to problems locating seedlings where weeds were prolific, and stocking rates (assessed using $1m^2$ plots at 200 plots/ha) varied from zero to 40,000 seedlings per hectare, using a seeding rate designed to achieve about 2000 trees/ha of 6-8 indigenous species, assuming a 1% germination rate. Although the assessment was inconclusive, it is worth mentioning that many of the sites which appeared to be unsuccessful 6-12 months after seeding, now have quite satisfactory stocking rates 2-3 years after seeding. We have used a range of site preparation techniques, but cannot draw firm conclusions, as all have been successful on some sites, and all have failed on some sites. One technique which does appear promising however, is as follows: early spring knockdown spray to prevent weed seed set, mouldboard ploughing in late Spring to a depth of 4-6 inches, leaving the site rough, followed by broadcasting seed by hand, usually in mid November. Possible follow-up spray with "Fusilade" if grass competition is a problem.

A study of landholder attitudes to the type of activities embodied in the project was commissioned, and was carried out in 1986, comparing the attitudes of the PFP participants with those of 40 farmers randomly selected from within the Shire of Dundas (roughly in the centre of the PFP area of influence), and forty farmers randomly selected from the Shire of Charlton (in the Mallee, well away from the PFP, with very different types of arms and land). The study used a quantitative method of attitude analysis called multidimensional scaling, and was designed so that it can be replicated at a later date to determine the impact of the Potter Farmland Plan on landholder attitudes over time.

The Potter Foundation-funded operational period of the Potter Farmland Plan winds down during 1988, after which landholders have agreed to complete the implementation of their whole farm plans at their own pace. Andrew Campbell's secondment to the project ends in March 1988, and John Marriott's term of employment ends in September 1988. It is hoped that there will be a permanent position established in Hamilton with a combination of government and private support, to continue the monitoring, public relations and extension activities of the project.

Publications:

Bail, I.R. (1987) "Tree Survival on Demonstration Farms of the Potter Farmland Plan in Victoria's Western Districts: a Preliminary Assessment". Special project submission, fourth year B. For. Sci. Faculty of Agriculture and Forestry, University of Melbourne.

Cary, J., Beel, A., and Hawkins S. (1986) "Farmers' Attitudes Towards Land Management for Conservation". School of Agriculture and Forestry, University of Melbourne. (Copies can be obtained from the University of Melbourne.)

33. ROADSIDE CONSERVATION COMMITTEE (RCC)

Penny Hussey, Executive Officer
C/- P.O. Box 104, Como W.A. 6152.

The RCC was set up in November 1985 to co-ordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and people of Western Australia. Its funds, provided by the State Government, include $20,000 for research in the financial year 1987/1988.

Revegetation of degraded areas falls within the ambit of the RCC, therefore projects involving revegetation along rail and roadside would be eligible for RCC funding. Interested researchers should apply to the Executive Officer at the above address.

Projects funded during 1987/1988 include:

1. Regeneration of *Banksia cuneata.* Use of fire to rejuvenate a senescent stand of a rare Banksia. Dr. Byron Lamont, Curtin University of Technology, WA.
2. Investigation of a method for eradication of spot infection of *Phytophthora cinnamomi.* Dieback is often spread along roads. If caught early enough, perhaps it can economically be destroyed. Dr. Joanna Tippett, Department of Conservation and Land Management, Perth.
3. Effects of fire on roadsides in kwongan vegetation. An attempt to develop management guidelines for fire on roadsides. Mr. Ted Griffin, 47 Macmillan St., Victoria Park WA
4. Effects of herbicide, used for roadside weed control, on native vegetation. An attempt to quantify whether herbicides applied by corridor managers are contributing to tree decline. Mr. Simon Whitehouse, Murdoch University, WA.

34. TREES ON FARMS PROGRAM

Sue Wakefield
Co-ordinator, Trees on Farms Program, Department of Agriculture P.O. Box 143, BATHURST N.S.W. 2795 Phone: (063) 33-4377

In response to a growing awareness of the problem of rural tree decline, in 1983 the N.S.W. Department of Agriculture initiated an advisory program aimed at encouraging landowners to establish trees on their farms. The program is being conducted jointly by the N.S.W. Department of Agriculture, Forestry Commission and Soil Conservation Service.

The Trees on Farms program promotes the use of trees for purposes such as shade and shelter for livestock, soil protection, wildlife habitat, timber production and aesthetics.

The objectives of the program are:

1) To increase farmers' knowledge of the benefits of strategically located trees on farms and thus encourage them to establish trees on their own properties.
2) To provide information to farmers to enable them to successfully carry out whole farm tree establishment programs.
3) To demonstrate recommended tree establishment techniques and tree species by establishing demonstration plantings on co-operating farms, Research Stations and public land.
4) To provide information and resource material to Advisory Officers to increase their level of expertise and confidence in dealing with Trees on Farms enquiries.
5) To carry out research to solve tree establishment problems and improve tree establishment techniques.

Group advisory methods such as field days, seminars, farm walks and farmer meetings are the main techniques used to deliver information to landholders. In addition, a series of publications on tree establishment and care is being produced.

Although this is predominantly an advisory program, research is being carried out into specific tree establishment problems such as weed control, protection of trees from vermin, species selection and direct seeding.

35. TREDAT (MODULE 5, THE PROJECTS MODULE)

The Director
National Tree Program, GPO Box 787, CANBERRA ACT 2601

What is TREDAT?

TREDAT is a computerised system for gathering information on tree projects and the performance of tree species in a wide range of situations. TREDAT was developed by the CSIRO Division of Forest Research, the Queensland Forestry Department and the Department of the Arts, Sport, the Environment, Tourism and Territories, Canberra. It has five modules:

- Botanical identity,
- Site,
- Management,
- Results,
- Projects.

The first four modules allow detailed information on species and their performance to be gathered from an extensive range of projects. The Projects module is designed to serve as a record of tree projects, to provide some statistical information, and to provide a reference point for tree-growers and researchers.

Who administers TREDAT?

Information in the first four modules is stored on Queensland Department of Forestry and CSIRO computers. Information on tree plantings throughout Queensland is stored by the Queensland Department of Forestry, while the CSIRO is storing information on the performance of Australian species in overseas countries. Once the system has been fully developed, it is hoped that other states will adopt TREDAT to provide a national TREDAT network.

The Project component will be stored on computer in the Department of the Arts, Sport, the Environment, Tourism and Territories which administers the National Tree Program.

What benefits will TREDAT provide?

Collecting and sharing information about tree-growing will allow more accurate advice to be provided on species selection and establishment techniques, and will lead to improved management decisions in tree-growing. The time, energy and money spent by tree-growers will therefore be used more effectively.

Statistical information will be used in developing and reviewing the effectiveness of government policies and programs.

Who can use TREDAT?

Project (Module 5) information covering the whole of Australia will be accessible to organisations and individuals through published reports and computer facilities. However, detailed tree performance information will be available for Queensland conditions only.

The information will be provided free of charge to people involved in developing and managing tree projects -- including farmers, community groups, researchers and government agencies.

What sorts of tree projects?

All kinds of tree projects are of interest whether they involve conservation or management of existing trees, natural regeneration, planting, direct seeding, or transplanting naturally sown seedlings. Projects may be aimed, for example, at reducing soil erosion, providing shelter, controlling salinity, providing logs or fence posts, improving wildlife habitat, or restoring or improving the natural beauty of urban and rural landscapes. All may provide information which may assist other tree growers.

Can information be provided on a confidential basis?

Yes. In general, TREDAT information stored by Commonwealth Government agencies will be made available to any interested party, as under the Freedom of Information Act the Commonwealth is generally required to make information available on request. However, persons who provide TREDAT information may request the Commonwealth not to pass on certain information -- for example, information affecting their personal privacy, business affairs , trade secrets -- as under the Act, the Commonwealth may not be required to release such information. If desired, all information which would enable a TREDAT user to identify your project can be withheld from users. Information held by the Queensland Department of Forestry is not accessible through the Freedom of Information Act.

How is information provided for Module 5?

Project information is provided by answering 14 simple question: on a green TREDAT questionnaire which can be obtained from Greening Australia or the National Tree Program secretariat.

36. DRAFT PROPOSAL FOR AN AUSTRALIAN TREE RESEARCH FUND

Research Working Group
National Tree Program Co-ordination Committee
c/- National Tree Program Secretariat
GPO Box 787 CANBERRA ACT 2601

The draft proposal was prepared in association with the non-government organisation Greening Australia.

Background

Research in Australia on trees and shrubs of value in agricultural land management has been limited, and most tree related research has been confined to trees of commercial value such as forestry species. Yet the rural areas of Australia are the priority areas for re-vegetation as trees can have a major role in land management for sustained productivity.

The draft proposal

It is proposed that an Australian Tree Research Fund be established to play a major role in defining applied research projects and disseminating research results on the role and use of trees in Australia.

It is proposed that the Fund be established jointly by the National Tree Program and Greening Australia. The Fund would support applied research in a number of areas including:

- role and significance of trees in land management and restoration,
- agroforestry,
- fuelwood,
- effluent disposal,
- tree establishment methods including direct seeding,
- tree management,
- genetics,
- tree phenology,
- community and land-owner attitudes to trees,
- economic costs and benefits of trees,
- the extent of tree cover in Australia.

Monies for establishment of the fund would be sought from the private and public sector.

Response to the draft proposal

Early in 1987, the draft proposal was circulated widely for comment. A range of responses were received and nearly all were supportive. The National Co-ordination Committee of the National Tree Program is now considering the proposal in the light of comments received, and has requested a detailed prospectus from Greening Australia Ltd on how that organisation could administer such a fund. A final recommendation is expected to be forwarded to the Commonwealth Minister early in 1988.

Additional information
Additional information including copies of the draft proposal are available from Greening Australia in each state and territory, or from the Director, National Tree Program at the above address.

37. COMMUNITY INVOLVEMENT IN REVEGETATION

Steve Burke, Kevin Ritchie and Rob Youl
Land Protection Division
250 Victoria Parade, East Melbourne 3002
(Telephone 03 651 4667)

Benalla Region - December 1987
Landholder/Community Treegrowing Groups

GROUP NAME	NO. OF MEMBERS OR LANHOLDERS (APPROX)
A. Tree Groups	
Benalla Tree Action Group	30
Cobram Tree Group	20
Goulburn Valley Tree Group	40
Molyullah-Tatong Tree & Land Protection Group	200
Nathalia Tree Group	20
B. Land Protection Action Groups	
Burnt Creek Landholder Group	20
Creightons Creek Land Protection Assoc	100
Longwood East Landholder Group	40
Seven Creeks Catchment Group	200
Warrenbayne Boho Land Protection Group	180
Dookie Land Management Group	50
Sheep Pen Creek Landholder Group	60
Sheep Pen Creek West Group	20
C. Irrigation Landholders Groups	
Girgarre Salinity Study Group	100
Mooroopna NW Group	40
Undera Landholder Group	40

Benalla Region, one of the sixteen regions within the Victorian Department of Conservation, Forests and Lands, is notable for the number of groups of landowners and others from the community working to combat land degradation.

REVEGETATION PUBLICATIONS

38. "GROWING TREES FOR FARMS, PARKS AND ROADSIDES"

Venning, J. 1988 Growing trees for farms, parks and roadsides. Lothian Books. Available from: Lothian Books, 11 Munro Street, Port Melbourne, Vic. 3207 ($19.95 plus $2.50 packing & postage)

This newly released book aims to promote tree planting by providing practical advice on a wide range of techniques. Trees have been traditionally established by planting seedlings, but direct seeding and natural regeneration can also be cost-effective alternatives. All three methods are discussed and compared, with case studies to illustrate the most appropriate method for particular situations.

- Provides step-by-step procedures for:
  Planning Preparing the site
  Selected species Site maintenance
  Collecting seed
- Extensive case studies
- Primary concern is the ecological issues involved

Dr Julianne Venning is a botanist and Scientific Officer for the South Australian Department of Environment and Planning. Dr Venning has an Australia wide reputation as an authority in direct seeding and revegetation of broadacre sites.

39."VICTORIA FELIX: IMPROVING RURAL LAND WITH TREES"

BY	Robert Campbell, Ross Chandler and Graham Thomas
EDITED BY	Andrea Lindsay and Robin Youl (1987)
ORDER FROM	Publications, Graduate School of Environmental Science, Monash University, CLAYTON Vic. 3168
	$13.70 plus $1.50 postage
	(Cheques to "Environmental Science, Monash")

Liberal new illustrations and diagrams with 124 pages of text.

This book aims to provide Victorian farmers and landholders uptodate information and practical ideas for the integration of trees into their land management systems. Information is provided on the value of trees, where trees should be planted, how to plant them, what sort to plant, how to look after them, further ideas on other types of revegetation techniques. Topics covered include:

- benefits of trees for animal, crop and pasture production
- benefits of trees for soil conservation
- trees and farm layout
- growing your own plants
- successful planting
- managing remnant vegetation
- natural regeneration and direct seeding
- wildlife conservation
- trees, fire and farm production
- reasons for tree decline and how to reverse it
- commercial opportunities

There is also a special section for hobby farmers (the first of its kind) and an extensive list of other helpful books and publications. Finally the section on fire protection may save lives.

The authors and editors are with Monash University Graduate School of Environmental Science. The Department of Conservation, Forests and Lands, Victoria has sponsored this book and assisted in its preparation.

40. PREPARATION OF A BOOK ABOUT THE ROLE OF FAUNA IN RECLAIMED LANDS

Edited by J.D. Majer, School of Biology, Curtin University of Technology, P.O. Box 1987, Perth 6001 Phone (09) 350 7368

Animals in Primary Succession - the Role of Fauna in Reclaimed Land
Cambridge University Press: Cambridge

The compilation of a book about the ways in which animals affect the outcome of land reclamation and how land reclamation can be carried out to benefit animals was commenced in early 1985. A contract was drawn up with Cambridge University Press and it is anticipated that the final manuscript will be submitted to the publishers in February 1988. This book brings together the information on animals in reclaimed lands.

The types of land reclamation covered in the book are those where a succession is involved. For instance, where plants and animals have been removed from an area by mining, where the community has been destroyed by extreme pollution, where land has been claimed from the sea, or where wetlands have been created in previously terrestrial habitats. It does not cover examples where land has been changed from one type of vegetation to another such as farmland to forest or native forest to plantation.

Undoubtedly, the book will contain information of relevance to those involved with such changes.

Coverage of the material in this book has been designed with two types of reader in mind. It is aimed at practitioners such as mine rehabilitation officers, soil conservation officers, urban and regional planners and other such staff. In addition, the chapters highlight the ecological aspects of reclamation so the book should be of value to students, lecturers, research workers and other professional ecologists.

The title of the chapters and their authors are as follows:-

10 The reclamation of lands for agricultural grazing
W. Laycock
11 Wetland habitat development on mined land
J.R. Nawrot and W.D. Klimstra
12 The reclamation of lands for outdoor recreation
David E. Samuel

Part 4 Case Studies

13 The return of soil fauna to coal mined areas in the German Democratic Republic
W. Dunger
14 Sixteen years of fauna development in the Lauwersmeer, a Dutch polder
Jan Meijer
15 The return of vertebrate fauna to surface coal mined areas in Tennessee
Dale K. Fowler
16 The return of vertebrate and invertebrate fauna to bauxite mined areas in south western Australia
O. Nichols, B.J. Wykes and J.D. Majer
17 Synthesis of fauna work in reclaimed areas - an ecologist's and a soil scientist's viewpoint
H. Recher and C.A. Parker

Part 5 Bibliography

18 Bibliography of fauna studies in reclaimed lands
J. Butcher, J.D. Majer and P. Unsworth

41. RESEARCH INTO RURAL TREE DECLINE ANNUAL NEWLETTER - VOLUME FOUR

J. Landsberg (Ed.)
CSIRO Division of Forest Research
PO Box 4008, Queen Victoria Terrace, CANBERRA ACT 2600 TEL 062 818211

A similar styled publication to the Revegetation Newsletter consisting totally of readers' contributions. The theme is of course Rural Tree Decline related research. Items consist of brief reports of recent research, research-in-progress or planned research, abstracts of recent publications, notifications of meetings or visits, technical innovations, sources of funding, etc. The newsletter is only distributed to those people who provide a written request to be on the mailing list from the above address. Contributions are called for during December/January each year.

42. AUSTRALIAN SALINITY NEWSLETTER (ASNL)

The ASNL is issued annually and contributions are in the form of short notes, generally less than two pages in length. Its aim is to improve communication and provide a medium for the interchange of information and ideas between workers concerned with aspects of salinity. Requests for inclusion on the mailing list for the Newsletter should be sent to; Editorial and Publishing Unit, P.O. Box 89, East Melbourne, Victoria. The main subject headings are:

- Salinity - general
- Salinity - Community Involvement and Education
- Water Salinity (excluding irrigation)
- Soil Salinity
- Plants and Salinity
- Animals and Salinity
- Irrigation Salinity Problems
- Land Use Salinity Problems

43. 'LANDLINE' - A LAND REHABILITATION NEWSLETTER FOR THE AUSTRALIAN MINING INDUSTRY.

'Landline' has ben established as a vehicle for the exchange of observations and practical details between people working on mining rehabilitation. contributions are generally in the form of brief reports on some aspect of active work. however other articles relevent to mining rehabilitation are also included, e.g. letters expressing a particular view; reports on aspects of overseas visits; advice of recent theses published; and news items such as advice of conferences to be held and overseas visitors.

Issues of the newsletter are published as sufficient material becomes available. However, it is expected that three issues a year will be published. Copies of 'Landline' are distributed throughout the mining industry and also to people working in this field in government agencies and universities, both in Australia and overseas

Editors
Tom Farrell, Manager - Health & Environment, BHAS Ltd
David Whitrow, Executive Officer - Environment & Services,
Australian Mining Industry Council.

Material for publication should be sent to;
The Editors,
'Landline', Australian Mining Industry Council,
P.O. Box 363, Dickson ACT 2602.

44. AGROFORESTRY UPDATE

Richard Moore
Department of Conservation and Land Management
Queen Street
BUSSELTON W.A. 6280

Agroforestry Update is a newsletter for agroforestry practitioners, research workers and extension specialists. The national Corresponding Working Group on Agroforestry, which produces the newsletter (2 to 3 editions per year), accepts a broad definition of agroforestry. That is, "Agroforestry is the management of land for increased nett social benefit by simultaneous production of farm and forest products." So articles about the deliberate integration of trees and farming to reduce land degradation and to improve production are eagerly sought. The current issue (No. 7), for example, has articles ranging from "New Agroforestry Demonstration in Victoria" to "Growing Tagasaste as a Fodder Crop in the Esperance Region". Anybody who wishes to be on the mailing list or who wishes to make a contribution should contact the above address.

III MAILING LIST

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