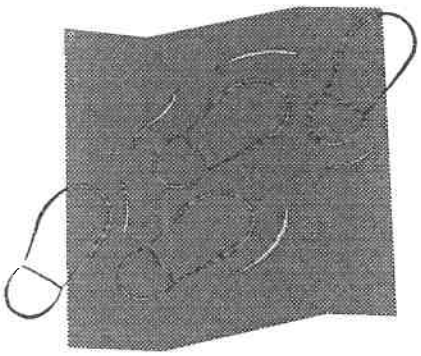
NEWSLETTER

NATIVE PLANT REGENERATION STUDY GROUP
Vol.2 No.1 Date 17/6/96 ISSN 1324-3934

Inside this Newsletter



Remember when in the bush only leave four foot prints behind not your rubbish.

Editorial

Well it's fast approaching that time of year again. Yes the planting out of plants that have been raised in tubes or by other means. Yes I mustn't forget those of you like my self who will be doing some direct seeding this year. I had a look at the results from last year and saw a pretty bad picture before me of around 40% success max. in some places to 0% in others places (mainly due to sandy soils).I hope that this year will be better.

...u can see I have made some ...anges to the format of the newsletter. The changes are in line with some of the ideas that were given through the questionnaires that I did this year and last year.

Some of the information that I got from the questionnaires asked for information on what is happening in other states so if you can lay your hands on a revegetation article out of a newspapers or a journal please feel free to send it in for inclusion in to this newsletter

Another item that was asked to be done by this group is the setting up of a quality assurance program for regeneration and revegetation so in some of your local newsletter you might be seeing a article by the Native Plant Regeneration Study Group requesting for information on what plants you have been trying to grow on you properties. So in the mean time you might like to start sending in this information to me.

All I want to know is

- Soil Type
- Rainfall
- Species of plant
- What type of tree guard use if any
- If a herbicide was used if any
- Was fertiliser used if any
- Burning the area prior to planting
- What method of planting was used.
- Growing conditions e.g. it was dry year on a north facing slope and I had 70% survival of species X and 20% survival of species Y
- And or any other relevant information that will be of help.

In the third edition of this newsletter I might have enough information to publish the result from the information that you have sent me along with others who have contributed.

Those of you who are into technology might find future editions on the internet on the ASGAP home page. Presently I am looking into seeing how one can go about having a page on the internet.

The deadline for the next edition of the newsletter is late August early September with the newsletter in coming out in October.

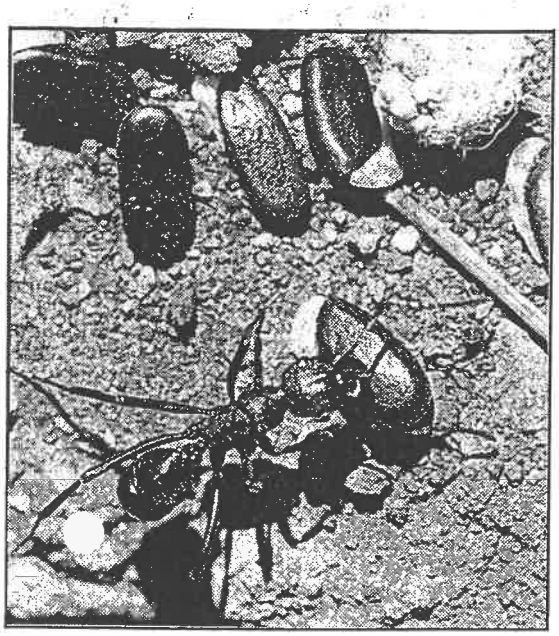
Please feel free to send in a cartoon or article to

P.O. Box 2089
Normanville
SA 5204

Cheers

Matt Pearson

Ants upset tree project



The seed-stealing rhytedoponera ant.

By Environment Writer SYLVIA KRIVEN

Ants have put the bite on research into an SA revegetation programs.

They are stealing thousands of tree seeds scattered in direct seeding trails run by the State Woods and Forests Department.

A single colony can spirit away a kilogram of seeds — about 2500 trees — in less than a week. The seeds are eater · fed to larvae; some ..re stored for winter.

The theft has frustrated the department's revegetation officers, who use the trial plots to teach farmers easy techniques for broadacre tree planting.

It is also expensive. The cost of mechanically spraying seeds on to prepared soil is about $1000 a hectare compared with $5000 for hand planted seedlings.

"Ants are a problem all over Australia," State Woods and Forests Department revegetation officer Mr Leigh Miller said.

"I don't think there's going to be any way around using chemical controls," he said.

Mr Miller has trapped and observed thousands of ants in the vain hope of finding a time when seeds can be sown with minimal risk of them disappearing.

"We need to sow when opening rains come (usually late autumn)," he said.

"But unfortunately, that coincides with the time ants are most active."

According to SA myrmecologist (ant expert) Mr Archie McArthur, there are about 30 to 40 species of seed-eating ant in SA including rhytedoponera, a black ant common in metropolitan Adelaide and the Riverland, where many of the tree trial plots are.

"It is a very primitive ant which doesn't have a very developed system within its colony so it works alone," he said.

"Because it is bigger, it can handle big seeds by itself."

Smaller ants, such as monomoriums, are more advanced. They use highly organised teams to drag seeds two to three times their size. Curiously, they are unable to digest tree seeds but their larvae can and regurgitate seeds in a liquid form which the adults drink.

Meanwhile, the department has resigned itself to using a chemical controlling agent.

"It doesn't kill the ants," Mr Miller said.

"It coats the seed and tastes awful. The ant will take a bite and spit it out and pass the information on to the others so they won't touch it," he said.

Water Wise No 1

MANAGING YOUR WATERCOURSE

WHY MANAGE YOUR WATERCOURSE?

There are many reasons to improve watercourse management including:

- stopping soil erosion
- improving water quality
- providing permanent wildlife habitats
- increasing your property value.

The following information will give you a brief introduction to some of the issues involved in improving management of your watercourse.

NATURAL STREAM PROCESSES

When rain falls on a catchment, water that is not absorbed into the soil flows downhill and collects in low lying areas where it forms a stream. Over thousands of years, this runoff process, streambank erosion, stream meandering and flooding have developed the stream systems that we have today. Streams are always changing – or causing change – in response to rainfall and factors affecting runoff from the catchment.

STREAMS AND LAND MANAGEMENT

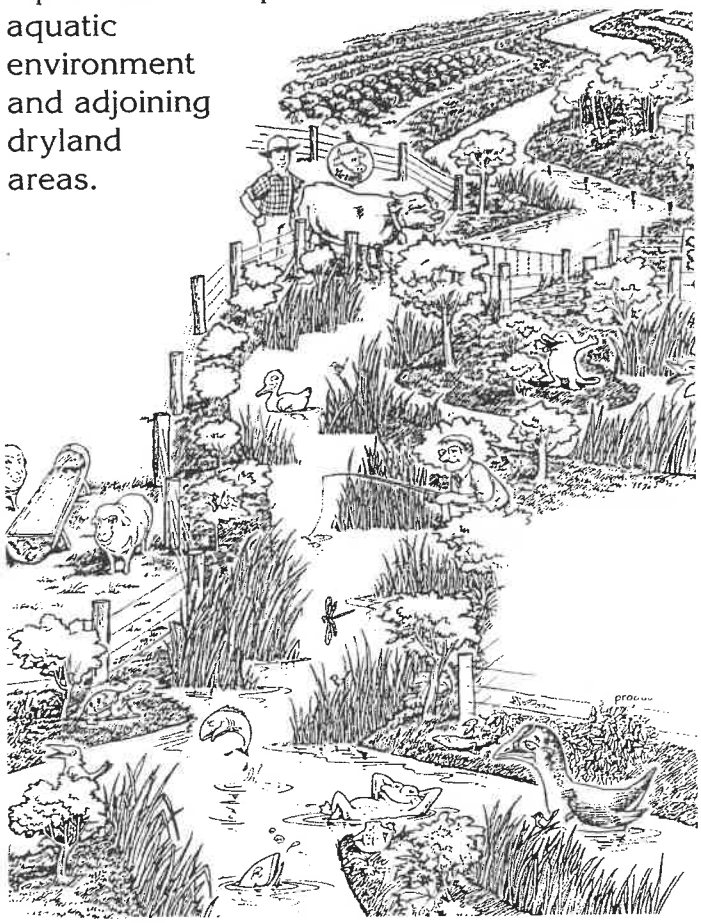
Landuse, and land management within a catchment directly affects:

- the health of a stream
- its ability to recover from flood or pollution
- the maintenance of its aquatic life.

In particular, land development for agriculture, urban or recreational use changes the water runoff pattern and affects the natural stream processes.

THE RIPARIAN ZONE

The riparian zone is the area immediately next to, and influenced by, the watercourse. It includes aquatic and semi-aquatic plants as well as tree and understorey vegetation. It provides an important link between the aquatic environment and adjoining dryland areas.



WHY IS IT SO IMPORTANT?

Riparian vegetation plays a key role in protecting the watercourse from damage by activities carried out on adjacent land.

RIPARIAN RIGHTS

Owners of land in contact with a stream have certain riparian rights. They are entitled to extract water for domestic use and stock use, but not for irrigation.

Produced by the Mount Lofty Ranges Catchment Program and
Water Resources Group Department of Environment and Natural Resources

However, the indiscriminate use of riparian rights can result in degradation of stream banks and water quality.

THE IMPORTANCE OF NATIVE VEGETATION

Native vegetation reduces the speed of water runoff, which reduces the risk of erosion and encourages deposition of soil eroded elsewhere. The roots of vegetation on the banks and floodplains of streams, hold the soil together and protect the area from erosion.

Water plants such as reeds and rushes also trap sediment and protect the banks from erosion by reducing the speed of flow within a stream. They remove nutrients from the water and provide food and habitats for stream animals.

NATIVE HABITAT

Maintenance of natural habitats is necessary to protect native species. A variety of habitats will ensure the existence of a large diversity of organisms. Pool and riffle environments and stream meanders should be retained for natural aquatic animal populations. Indiscriminant clearing, straightening of stream channels and filling in of billabongs should not be undertaken.

STREAM PROTECTION

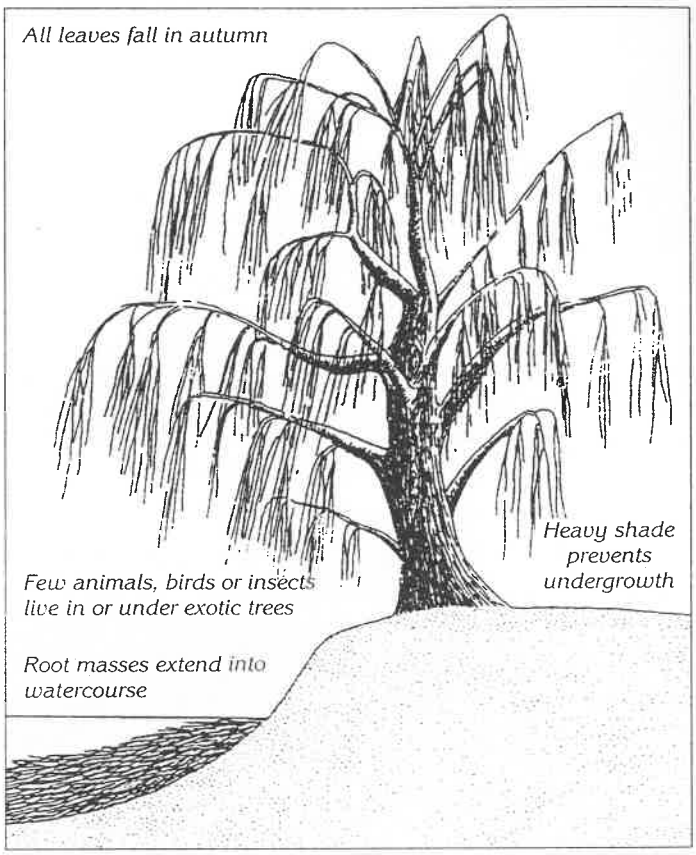
Stream buffer zones

Planting and maintaining a buffer of vegetation between a stream and adjoining cultivated or grazed land, will slow runoff and minimise soil loss. Buffer vegetation also reduces the risk of chemicals and manure entering the watercourse which contaminate the water.

The resulting improvement in water quality provides for a greater diversity of aquatic life.

Vegetated buffer zones on creeks in the Mount Lofty Ranges should be 5 — 10 metres wide, or more if possible.

To maximise the benefits of a buffer zone, your revegetation program should aim to establish a full range of native plant species, including trees, shrubs and groundcovers.



Minor drainage lines

A good groundcover of deep-rooted grasses will minimise erosion along minor drainage lines, and encourage silt to deposit before it reaches larger streams. Drainage lines should not be cultivated.

EXOTIC TREES AND WOODY WEEDS

Exotic trees such as willows, ash and poplars, and woody weeds such as blackberry, briar rose and gorse, are a problem along many watercourses in the Mount Lofty Ranges.

They provide poor habitats for native wildlife and contribute to poor quality water and bank erosion and also exacerbate flooding. It is important plan a control program on properties where exotic species are a problem.

REVEGETATING IN CATCHMENTS

Revegetating or maintaining vegetation within catchments, particularly on steep slopes, decreases the amount of runoff and its speed of travel. This in turn reduces bank erosion, silting in channels and channel realignment. Water quality will improve and productive land next to the stream will be maintained.

In areas prone to waterlogging or salinity, vegetation in strategic places can lower the watertable and reduce these problems.

FARM TREES

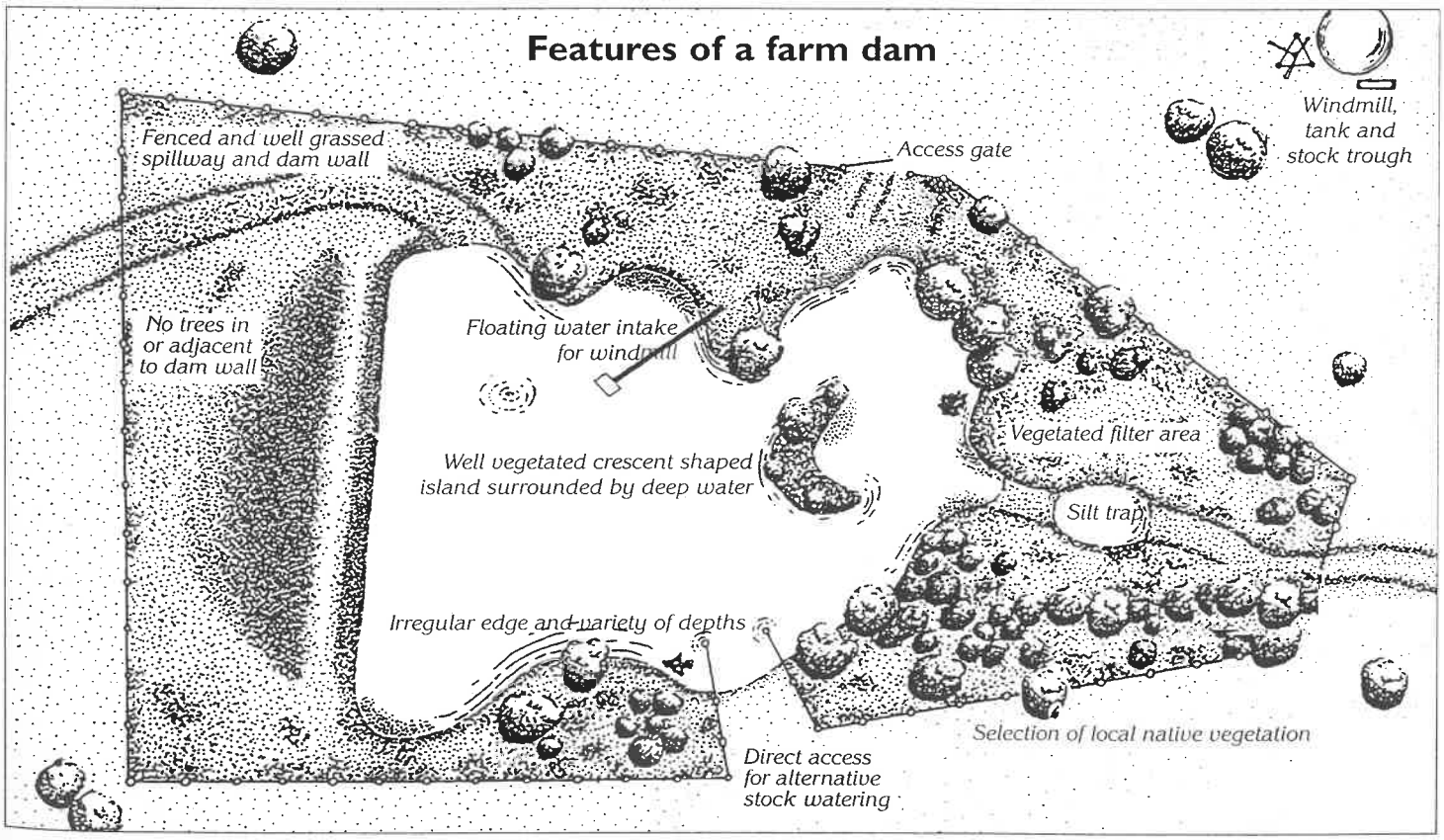
Stream bank vegetation is very important for many reasons. In your farm planning process, it is important to treat streams and riparian land as separate land units and prepare management plans accordingly.

FARM DAMS

Natural seasonal variations in the volume and quality of water in watercourses are important for maintaining healthy and diverse plant and animal communities. Stream flow should not be impounded, and farm dams should be offstream storages, filled at periods of high flow. Farm dams can also provide water for bushfire protection, wildlife habitats, recreation, aesthetics and a sediment basin for soil eroded from the catchment.

STOCK WATERING

Unrestricted stock access can cause stream banks to become destabilised and increase erosion. Stock watering facilities should be located well away from streams. If stock access to streams is necessary, it should be restricted to areas where the banks are stable and not prone to collapse.



RABBITS

Rabbit populations near streams can cause increased erosion and banks collapse. They should be eliminated.

WASTEWATER DISPOSAL

Concentrations of organic waste, such as septic tank overflow and wastes from fruit and vegetation processing and animal keeping, also pollutes watercourses. There are several methods of safe disposal; the most appropriate for your property will depend on factors such as the available disposal area, soil type or the slope of the land.

STORMWATER DISPOSAL

Stormwater from roads, paved areas and roofs is most often discharged into streams. Increased flow rates can cause severe erosion, and the stream environment can be degraded by pollutants entering stormwater drains. By creating retention ponds or grassed swales, you can reduce the amount of pollutants reaching streams via stormwater and reduce the flow rates in receiving streams.

TOTAL CATCHMENT MANAGEMENT

Appropriate landuses and associated land management practices, undertaken within the constraints of site conditions, will provide sustainable agriculture and also generate good quality runoff.

Stream protection involves the whole catchment and an understanding between the different land users and water resources. The water, the land and the community within the catchment are inseparable.

FURTHER INFORMATION

General information on watercourse management is found in the following publications:

WATERCOURSE MANAGEMENT: A field guide, prepared by the Upper River Torrens Landcare Group

Native Plants of Watercourses, Bob Myers

Watercourse processes: A guide for watercourse managers in the Mount Lofty Ranges, Jason Carter

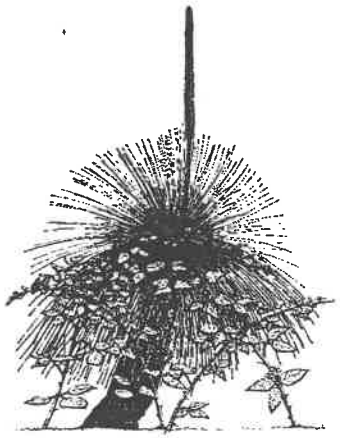
A guide to erosion control measures for small watercourses in the Mount Lofty Ranges, Jason Carter and Ed Collingham

For more information contact:

Mount Lofty Ranges Catchment Program
5C Cameron Street
MOUNT BARKER SA 5251
Telephone (08) 391 7500
Facsimile (08) 391 7524

or

Water Resources Group
84 Mount Barker Road
STIRLING SA 5152
Telephone (08) 339 7111
Facsimile (08) 339 7115



SAVE THE BUSH from WEEDS

HERBICIDES FOR BUSHLAND WEED CONTROL

By Richard J Carter, Senior Adviser (Plants)

Herbicides are useful when managing weeds in bushland. They reduce the cost of control and are easy to apply. Often herbicides are integrated with other techniques. In many cases herbicides are preferable to slashing, bulldozing or digging. Herbicides do not disturb the soil, reducing weed regrowth.

Do not use herbicides that have a long soil life, or that are readily taken up by plant roots as these may damage desirable vegetation.

A wetter or surfactant helps the spray droplets penetrate the plant. Only use surfactants recommended on herbicide labels.

BEFORE USING ANY HERBICIDE READ AND HEED THE LABEL

Glyphosate
Glyphosate is available in a wide range of pack sizes and is suitable for control of a wide range of bushland weeds. It is not selective and may damage or kill any plant that spray droplets contact. It can be applied as a spray or wiped on to green foliage of weeds. It is inactivated and rapidly broken down by in the soil. It is carried through the plant from foliage to the root system. It may take up to two weeks before you see the effects so it is best to add a dye to avoid double treatment or missing plants.

Triclopyr
Triclopyr (Garlon®), is effective on a wide range of bushland weeds. It is sprayed on leaves and stems and moves in the sap throughout the plant. It can be selective. Triclopyr does not affect grasses.

It may drift from treated areas and damage tomatoes, vines, fruit-trees and vegetable crops. This can happen at the time of spraying or up to three days later. The danger of damage is greatest during warm weather.

Triclopyr is more effective than glyphosate on old woody weed growth. It is faster acting than glyphosate. It has low toxicity, similar to glyphosate, but has a strong odour.

Metsulfuron-methyl
Metsulfuron-methyl (Brushoff®) cannot be used over the root-zone of native vegetation, especially in the drier areas. Use it prior to re-establishing vegetation, or on the margins of areas of native vegetation. The residues may persist for many months.

It is very safe for users. It is non-toxic and odourless.

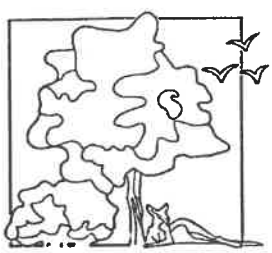
2,4-D amine
The hormone herbicide 2,4-D amine is non-volatile. It works much like triclopyr, but is not as effective on woody weeds. It is sprayed onto the stem and leaves, moving in the sap throughout the plant. It can be selective, and does not affect grasses.

The residues in the soil degrade rapidly.

It is safe for users and has low toxicity. The odour of solvents in the formulation may be unpleasant to some users.

Produced by the
SA ANIMAL & PLANT CONTROL COMMISSION
GPO Box 1671, Adelaide 5001
With assistance from the
SAVE THE BUSH - REMNANT VEGETATION PROGRAM

For further information contact your local Animal and Plant Control Board or telephone 08 2264888



October 1991

HERBICIDES FOR CONTROL OF THE MAJOR BUSHLAND WEEDS

PLANTS	Method	HERBICIDES Garlon 600 (triclopyr 600g/L)	Brush
African boxthorn	Overall spray: High volume		
	Basal bark or cut and swab	1L/30L diesel distillate	
Blackberry	Overall spray: High volume	170ml/ 100L water	10g/1
	Low volume (Gas gun)	28ml/L water	1g/L w
Boneseed	Overall spray: High volume		10g/1
	Low volume (Gas gun)		1g/L w
	Cut and swab		
Bridal creeper			10g/ 1
Broom		Overall spray 170ml/100L water	
Gorse	Overall spray: high volume	170 to 340 ml /100L water	15g /1 surfac
Hawthorn			10g/1
Olive	Basal bark or cut and swab:	1L/ 30L diesel distillate	
	Seedlings to 6 months: Overall spray		
Myrtleleaf milkwort	Overall spray: high volume		10g/1
Watsonia (Bulbil)			10g/1
ENVIRONMENTAL EFFECTS	Herbicide residues	Residues in the soil are degraded fairly rapidly.	Resid Some uptak
	Safety	A low toxicity product slightly more toxic than table salt. Livestock can remain in the paddock during and after treatment as no withholding period applies.	A low Livest area.
COMMENTS		Volatile plant hormone type herbicide. Do not use near vines, horticultural areas or home gardens. Residues in the soil degrade fairly quickly. To avoid damaging desirable, susceptible plants, the label directions should be followed exactly. Initial symptoms will show within 48 hours. Plants may take several weeks to die.	DO N plants where conta Alway otherv Weed after s Do nc

Treatme

READ AND HEED THE HERBICIDE LABEL

ff (metsulfuron-methyl 750g/kg)	Glyphosate Products (360g/L)	2,4-D amine products (500g/L)
	1L/100L water	
	neat (cut stump)	neat (cut stump)
)L water plus 100ml surfactant	1L/100L water	
ıter plus 1ml surfactant		
)L water plus 100ml surfactant	1L/100L water	1L/100L water
ıter plus 1ml surfactant		
		neat
0L ter plus 100ml surfactant	1L/100L water add organosilicone surfactant	
0L water plus 200ml organosilicone ınt (eg Freeway, Pulse)		
)L plus 100ml surfactant		
	1L plus 100ml surfactant to 100L water	1L/200L water add wetter
)L plus 100ml surfactant		
)L plus 100ml surfactant		
ıs in soil are degraded fairly rapidly. hallow rooted species may be affected by by ıts. Refer to warnings on label	Glyphosate is inactivated on contact with the soil.	Residues in soil rapidly degrade.
›xicity product less toxic than table salt. ık do not need to be removed from treated	A low toxicity product less toxic than table salt	A low toxicity herbicide.
T apply on or near native or other desirable ır on areas where their roots may extend or ıe chemical may be washed or moved into with their roots. Refer to product label. add a surfactant at rate of 100ml/100L or ıe as on the herbicide label. take from several weeks to 12 months to die raying, although growth stops immediately. retreat gorse for at least twelve months.	Ensure water is clean and free of clay. Apply as a fine mist, not to the point of run-off. Ensure all leaves are covered. Symptoms may take 2 weeks to develop.	A non-volatile plant hormone type herbicide, safer to use near vines, horticultural areas and homegardens than Garlon 600. Initial symptoms will show within 48 hours. Plants may take several weeks to die.

s underlined are not on registered label - ask the manufacturers for current recommendation

Products registered to control one or more bushland weed species that may not be safe to use over the root zone of some desirable vegetation.		
Herbicide	Products	Comments
Hexazinone	Velpar	Do not use near native vegetation. Not suitable for areas being revegetated.
Picloram	Grazon DS Tordon 50 D Tordon Timber Control	Do not use near native vegetation. Not suitable for areas being revegetated.
Metsulfuron-methyl	Ally Brushoff	Refer to herbicide label. May be used in areas prior to revegetation for control of blackberry, boneseed, gorse, hawthorn, myrtle-leaf milkwort and watsonia but not suitable over rootzone of established plants.

THE UNDERSTOREY NETWORK SO FAR

Els Hayward

Things happened very quickly after The Understorey Network gained a Landcare Grant last year.

- A new coordinator, Anna Povey, was appointed in October. She has been busy setting up an office and organising soil and seeds. The network now has potting mix, sand, mulch, tubes and seed available for anyone who wants to grow seedlings.
- Alan Gray from Greening Australia has been running field days around the State, showing people interesting understorey plants, telling them how to collect seed and propagate plants.
- Louise Guilfedder ran seed collecting days at Tunbridge and on the East Coast.
- Regional Coordinators had a morning at Biz Nicholson's property and have gone home to organise seed collection and seedling growing in their local groups.
- Media releases have led to more people contacting Anna. Interest from the public has been enthusiastic and almost overwhelming.
- Besides all this growing and seed collecting, development of the database will begin soon. This will enable people to find out what to grow in their particular area.
- Information displays are planned for AGFEST, SGAP flower shows and other events.
- Private Forestry has offered the Network the use of their direct seeding machine, pulled by 4WD motorbike. If anyone has a site suitable for a direct seeding trial, please let Anna know so that it can be organised for autumn.

Anna would like to hear from anyone who wants understorey plants for revegetation. Seedlings will be available by autumn for planting. If you know any landholders who would be interested in understorey planting, please tell them about the Understorey Network.

If you are enthusiastic to collect seed or grow seedlings, or if you have skills in botany, writing, education, office work, photography, etc. or have anything else that you would like to contribute, you are most welcome to get involved! For further information contact Anna Povey, 19 Gorge Rd, Trevallyn 7250, or phone/fax (003)346633.

Eucryphia Vol.11 No.9
March 1996 page 11
Newsletter of SGAP Tasmania
Region Inc.

Bush Chronicle
incorp.
Treespeak
May 1995
page 11

(088) 121555

Putting an old railway line t

A group of energetic farmers and environmentalists wants to use something that is dis-used ... an old railway line.

The line in question is in the Mid-North and the group is the Blyth-Brinkworth Revegetation Committee.

Those involved see the revegetation of this corridor as the starting point for a massive project – regreening the main railway corridor between Gawler and Wilmington and associated spur lines.

The idea is to create a network of wildlife habitats linking new plantings with remnant bush.

The Blyth-Brinkworth group is the first to be formed along the proposed corridor and comprises representatives of the Blyth and Brinkworth schools, Department of Road Transport, Hummocks Soil Conservation Board, local branch of the Society for Growing Australian Plants, local Progress Association, PI SA, Greening Australia, Blyth-Snowtown District Council, and local landholders including those whose land abuts the dis-used railway line.

Blyth-Brinkworth Revegetation Committee member Rosemary Pedler (left) and secretary Coral Dutschke check existing growth along the 20 km corridor.

Currently much of the 20 km long line comprises just ballast, but those involved are buoyed by the fact that a survey by Darrell Kraehenbuehl, of the Department of Environment and Natural Resources, has revealed the presence of some locally important species ... and seed sources.

Seed collection on the line and district roads has started under the supervision of committee personnel, Rosemary Pedler and Coral Dutschke who is also the group's secretary.

They explained that the seed would be used on four demonstration sites along the line to test establishment in various soil types and in the ballast itself.

Meanwhile group chairman, Kevin Jaeschke, and local revegetation officer, Hugh Longbottom, have organised soil samples to be taken and for tests to be conducted to determine if there are any potential constraints to plant vigor.

The Department of Road Transport is helping the group with signage about the project and in meeting some of the costs of direct seeding, while State Flora and Greening Australia will be involved in the trial work.

The Australian Trust for Conservation Volunteers has also been involved, collecting seed.

The group sees the project providing awareness and appreciation of local species; contributing to community knowledge about seed collection, plant propagation and direct seeding and being a natural resource for future generations to use.

They also point out that because of the ballast which dominates the corridor, its use for grazing would always be limited and this applies to cropping as well.

Far better therefore to revegetate it with local species and restore some of the important conservation value.

As mentioned, the Blyth-Brinkworth work is to be part of a major wildlife corridor through the lower and Mid-North.

One of the prime-movers behind this is former pastoralist and now Adelaide Hills resident, Kym Afford.

If you would like to know more about the project contact Kym on (08) 391 0182 or Hugh Longbottom on*

ISSN 1037-1000

STATE TREE CENTRE

TreeFacts

Brookway Drive, Campbelltown South Australia.
GPO Box 1671, ADELAIDE SA 5001. Tel: (08) 207 8767. Fax: (08) 207 8755

AGDEX 301/23 April 1993 TF 4/93

Making your own plant collection

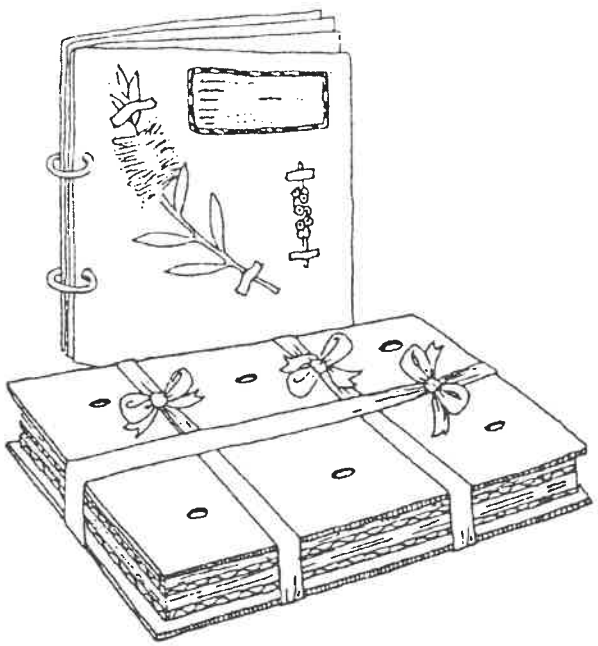
Compiled by the Native Vegetation Management Branch, Department of Environment and Land Management

Collecting samples of native plants is a valuable way to find out more about the scrub and plants in your local area. It helps to build a picture of the character of your district. Are the plants you collect typical for the soil for that region? Are they unusual or perhaps even rare?

This leaflet explains some ways to collect examples of the plants in your scrub or local area and to find out what they are.

Herbarium

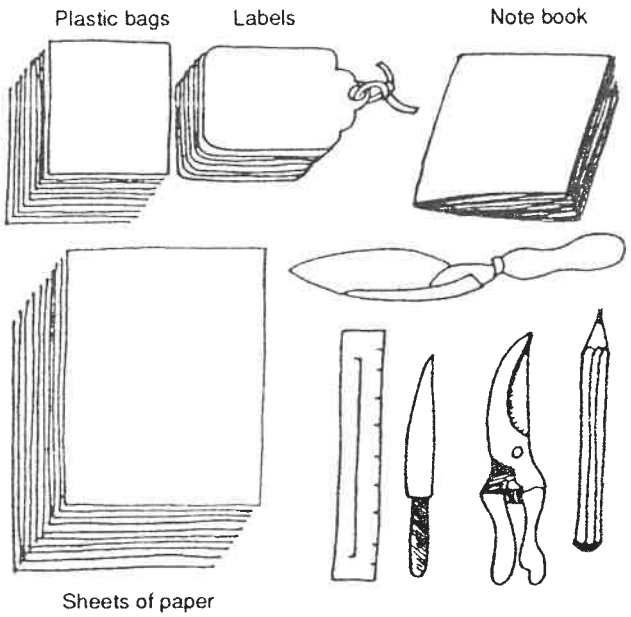
A dried plant collection, known as a herbarium, can vary in size from a small personal collection, to the State Herbarium's 400 000 specimens, or to the collection of more than six million specimens in the Kew Herbarium, London. Plant specimens are used for comparison and identification. Examples of variation and from a geographical range are kept.



Collecting equipment

You will need secateurs, adhesive labels or tags, a pencil, plastic bags and notebook. A knife, trowel and ruler will also be useful. When you come to dry and mount your specimen, you will need a stack of newspapers, cardboard, glue and plant press or some heavy objects.

Some tools you will require.



Before collecting specimens

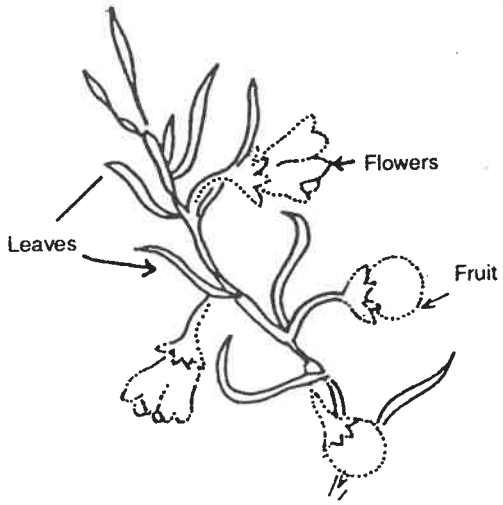
Take time to examine plants carefully, noting the colour of the flower, its shape, number of petals and number of stamens.

Flowers and fruit are the main distinguishing details of a plant while the leaves are next in importance. Superficially, some different plant species will look alike; alternatively, you may find members of the some species appear quite dissimilar.

Primary Industries South Australia
Australian Trust for Conservation Volunteers
Greening Australia™
Trees for Life
woods & forests
Native Vegetation Management Branch
Department of Environment and Land Management

Later identification of a plant can be helped by knowing where the plant is growing. Is it a wet spot or a rocky outcrop, and what plants grow nearby? For trees, take note of height, shape of leaves and type of bark.

Examples of reasonable specimen material needed for identification.



What to collect

The ideal specimen includes all parts of the plant. A stem with buds, flowers or fruit (including woody capsules) and leaves is the minimum requirement for an accurate collection. Bark, seeds and even roots can also be collected.

Several pieces of one plant can be used to show all features clearly. With plants such as grasses, sedges and small rushes, the whole plant can be included. When small plants are collected, a number of complete individuals can be taken. Collect enough material to cover the herbarium sheet.

To find all plant species in flower and fruit, you will need to collect over at least one whole year.

Specimens can be placed in plastic bags at the time of collection to maintain their moisture level and flexibility until pressed into appropriate shape, but should be transferred to newspaper folders as soon as possible to speed drying and pressing.

What to record

It is best to number each specimen at the time of collection. If several pieces are collected from the same tree or shrub at the same time (duplicates), they should bear the same number. If you collect duplicates, one can be sent to the State Herbarium for identification. Small herbs, which are clearly of the same kind from one small, defined locality and collected at the same time, can also be given the same number.

It is advisable to select a sequential numbering system and not to repeat numbers used previously, even when returning to the same spot and collecting the same plant at another time.

The collection number should be recorded on a sticker or tag attached to the specimen. Other data can be recorded on the tag or in a notebook and transferred to a label when the specimen is mounted. A plant without the necessary information, although well collected and carefully prepared, has little value as a botanical record. Although familiar at the time, information about the plant and where it is growing is easily forgotten.

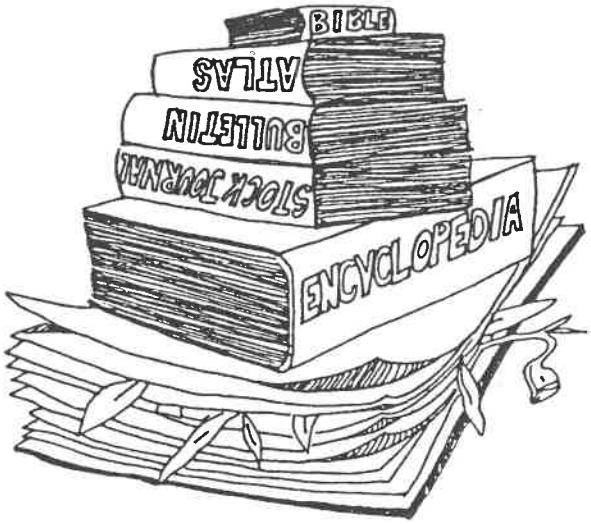
Number collected specimens sequentially.

Other details to record are the date of collection, flower colour (this could change in the drying process) the location, type of soil, other associated plants and any local names used for the plant in the area in which it is growing. The local names for the area (for example 'Harvey's Swamp') as well as information such as section number or latitude and longitude that would allow others to locate the spot.

How to press and dry plants

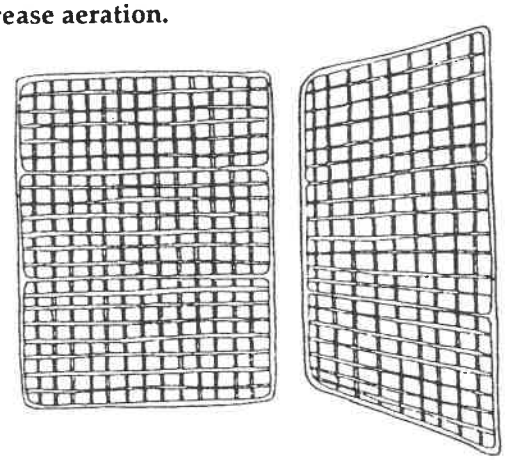
Arrange the specimen on one half of a sheet of newspaper, spreading or trimming it to show important details such as flowers or buds, avoiding crumpled leaves. Fold over the paper and continue to make a stack of specimens. Separate each specimen by several thicknesses of dry newspaper. Sheets of corrugated cardboard between groups of samples helps to ensure good drying. Cardboard cut from old boxes is suitable for this purpose. The stack can be enclosed between latticed frames of metal or wood and firmly secured with straps, twine or nylon tape. A lattice is used for increased aeration. You may be able to find material such as old refrigerator shelves to make your own plant press. Heavy books or house bricks are sometimes used for pressing. Use about 25 kg of weight for the purpose.

…ts can be pressed under a heavy weight.



Change newspapers in the stack regularly until the samples are dry. How often and when to change will depend on the moisture content of the plant and the absorbency and dryness of the paper used. Succulents will require a newspaper change of the specimen page and all surrounding pages every day to speed up drying and prevent mould. Specimens dried quickly under pressure will help to retain the colour of the flowers. It is not usually recommended that artificial heat be used in the SA climate, but you would do well to leave the stack in a non-humid environment. Well-prepared specimens can be preserved indefinitely, but they must be protected from insects and dampness and not left exposed to daylight.

Ideally, press plants within a lattice frame to increase aeration.



How to mount specimens

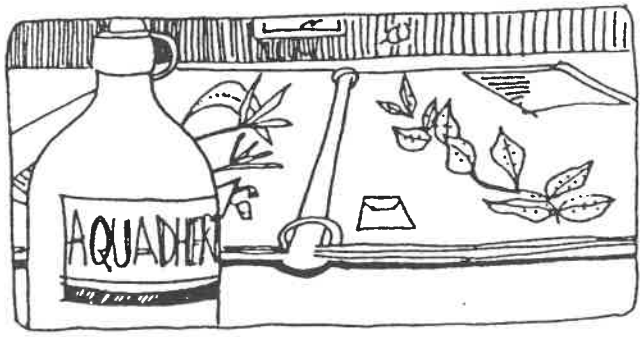
Lightly fix the specimen on heavy paper or light cardboard, using a clear glue such as Aquadhere. Mounted specimens can then be covered in plastic or slipped into a clear plastic bag that is then folded over and stapled through the card. Store samples in ring binders or cardboard boxes; arrange them alphabetically or in any other convenient order. Glue a clearly recorded label on the card with the specimen.

When collecting grasses or herbs, long stems can be bent several times to fit onto one piece of card.

Use envelopes or packets to retain loose seeds and staple them to the card.

You could also attach a colour photograph or transparency.

Wood glue is an ideal adhesive for fixing plant specimens to herbarium sheets.

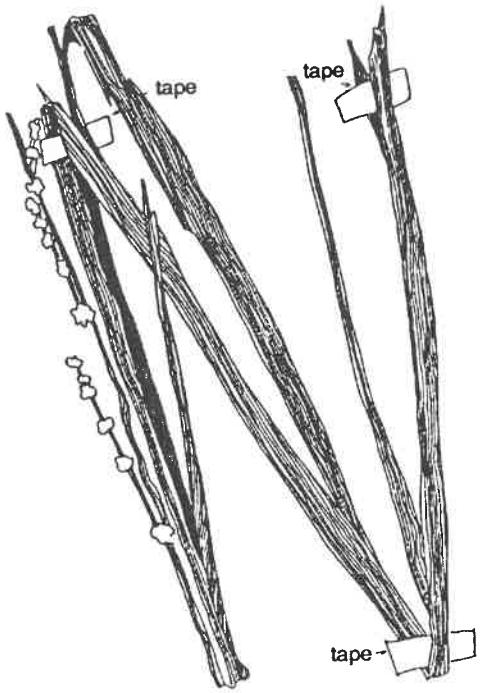


Suggested pattern for a label.

NAME:	Plantago varia
FAMILY:	PLANTAGINACEAE
COMMON NAME:	Small leaf-wort
LOCATION:	Gum Lagoon Conservation Park
MAP NO.:	NARACOORTE: 250.000
A.M.G. REF.:	1 ONE 54 217532
HABIT:	low forb
HABITAT:	Acacia brachybotrya low shrubland fringing dry lagoon
COLLECTED BY:	P.S. LANG
DATE:	7/12/1984
NUMBER:	A H 22731

Botanical Name .....
Common Name .....
Family .....
Locality .....
Size of plant ..... *Colour of flower* .....
Collector's name .....
Date Collected .....

When collecting grasses or herbs, long stems can be bent several times to fit onto a piece of card.



How to identify specimens

Plants can be identified from books using a plant 'key'. You may be able to get help identifying plants from a local native plant enthusiast.

Alternatively, you could send a duplicate dried specimen to:

Chief Botanist
State Herbarium of South Australia
Botanic Gardens
North Terrace
Adelaide SA 5000

Include a copy of the tag notes giving details of the plant and location, and say that you would like to have the plant identified.

The State Herbarium is the final reference collection for SA. Sometimes they may wish to retain a specimen for their records, especially if the plant is rare or growing outside its suspected usual home range.

Some books that may be of help in naming plants are listed under *Reference material*.

Tricky plants to collect

To complete your herbarium you may wish to collect plants that do not dry or press readily. Here are some ideas that may help.

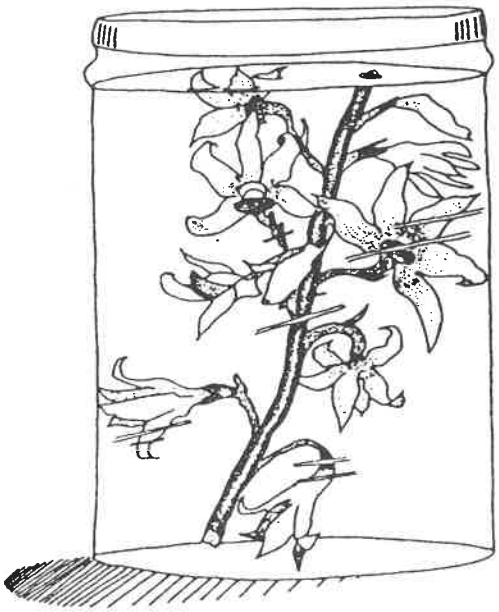
Mushrooms and toadstools

Mosses, lichens and fungi should be collected in paper bags and not pressed. Each specimen must be separately wrapped. Dry them in their bags, and number and label them.

Wet collections

Sometimes delicate plants such as small orchids are stored in liquid in small bottles or phials. A storage solution of 70 per cent methylated spirits/30 per cent water is quite suitable. When flowers such as orchids are preserved in this way they still lose their colour, but it is much easier to note their shape and arrangement of petals or stamens.

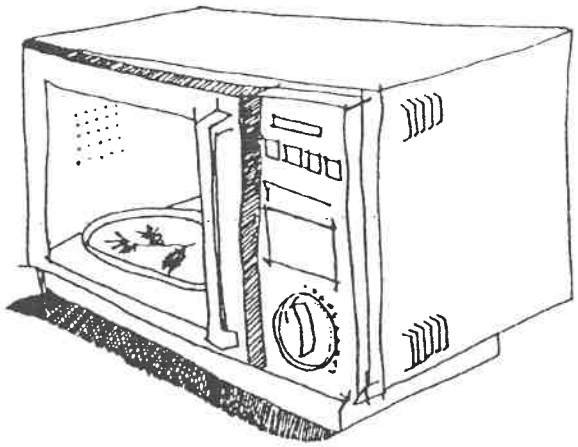
Delicate plants such as orchids can be kept in alcohol solution.



Succulents

Succulents are probably the hardest plants to collect. Some succulents can be treated in the usual way. Sometimes, they can have the skin removed from one side so that they dry easier, or they can be frozen to rupture the cells. When unfrozen, liquid can then be absorbed by the newspaper more quickly. The problem with these techniques is they make the sample liable to mould. A possible solution to this problem is to use a microwave oven.

Microwave ovens can be used to aid in drying plants.



You may have to experiment to correctly dry plants. Start with the recommendation in the owner's manual for drying parsley. Some collectors claim that microwave-dried specimens retain better colour, and the treatment certainly achieves a sterile sample. For this reason specimens of very rare plants should never be dried in a microwave. When a plant is approaching extinction, herbarium collections have been used to provide seed and keep the species going.

A large fleshy succulent, such as pigface, can require one to one-and-a-half minutes for primary drying, followed by some pressing. Other more delicate plants, such as some of the chenopods (saltbush), may need only 30 seconds to one minute exposure.

Do not rely on the microwave for complete drying because the plants can become brittle. It is best to reduce the moisture content in this way and then put them in the plant press. Microwave is not recommended for woody plants.

Reference material

Bates, R. and Weber, J. (1990) *Orchids of South Australia*. Government Printer, Adelaide.

Boomsma, C.D. (1981) *Native trees of South Australia*. Bulletin 19, 2nd edition, Woods and Forests. Government Printer, Adelaide.

Chippendale, G.M. (1973) *Eucalypts of the western Australian goldfields*. AGPS, Canberra.

Costermans, L. (1981) *Native trees and shrubs of south-eastern Australia*. Rigby, Adelaide.

Cunningham, G.M. et al (1981) *Plants of western New South Wales*. NSW Government Printing, Sydney.

Dashorst, G. and Jessop, J. (1990) *Plants of the Adelaide Plains and Hills*. Kangaroo Press Pty Ltd, Kenthurst, NSW.

Galbraith, J. (1977) *Collins field guide to the wildflowers of south-east Australia*. Collins, Sydney.

Jessop, J. (ed.) (1981) *Flora of central Australia*. A.H. & A.W. Reed Pty Ltd, Sydney.

Jessop, J. and Tolkien, H. (1986) *Flora of South Australia*. Fourth edition, parts I, II, III and IV. Government Printer, Adelaide.

Lamp, C.A., Forbes, S.J. and Cade, J.W. (1990) *Grasses of temperate Australia*. Inkata Press, Melbourne.

Prescott, A. (1988) *It's blue with five petals: wildflowers of the Adelaide region*. Prescott Publishing, Prospect.

Ross, W. (ed.) (1979) *A study guide for native Australian plants*. Flinders University, Adelaide.

Simmon, M. (1981, 1988) *Acacias of Australia*. Volumes 1 and 2. Viking O'Neil, Victoria.

Example herbarium page.

Printed by State Print, South Australia.

Many and varied new ideas in farm forestry

As the photos on this page show, many and varied things are happening with farm forestry in SA.

Trees are being planted on mounds, on re-charge areas, on the contour and many other areas, particularly in the higher rainfall districts such as the Adelaide Hills.

Martyn England is the coordinator for the Hills Farm Forestry Project which involves demonstration plantings both on individual farms and also in catchment situations.

Funding comes from the National Farm Forestry Program and National Landcare Program.

Last year more than 40 sites were established using an array of species such as blackwood, eucalypts, poplars and pines.

The demonstrations are designed to show three different layouts – timberbelts, woodlots and wide-spaced plantings involving individual rows or alleys.

Planting techniques have varied and include the mounds shown here. Martyn is very encouraged by the establishment rate and growth of the seedlings planted in the mounds.

He says this technique gives seedlings better aeration, particularly in waterlogged areas, and they also materially help in lessening competition from weeds.

"We will probably do a lot more plantings with mounds this year but the technique is limited to the flatter country," Martyn said.

The mounds were made with a machine with two inverted discs. Spraying with Roundup was done in August 1994 and the seedlings were planted in the last week of September.

River oak has been used as a nurse crop for blackwoods on the mounds, but Sydney blue, spotted, grey, forest red and flooded gums have also been planted.

One of the farmer sites is being managed by Bill Klaebsch of Wistow.

Growth has been good despite the very dry 1994 with species planted including oaks, iron barks and gums.

The areas chosen are rocky-windy sites; sandy knobs and a break-of-slope, particularly above a wet flat.

Herbicides for weed control were used in two applications and sites ripped in June to facilitate plantings.

Couch has been a bit of problem and so too have grasshoppers.

Martyn says these can be controlled by spraying before Christmas and that they seem to be more prolific in the drier seasons.

Near Hope Forest, Richard Bennett, of the Dingabledinga Agroforestry Group, has some young forestry species growing on the contour.

These include silky oak, spotted gum and blackwood with Sydney blue gum being used as the nurse crop for the blackwoods.

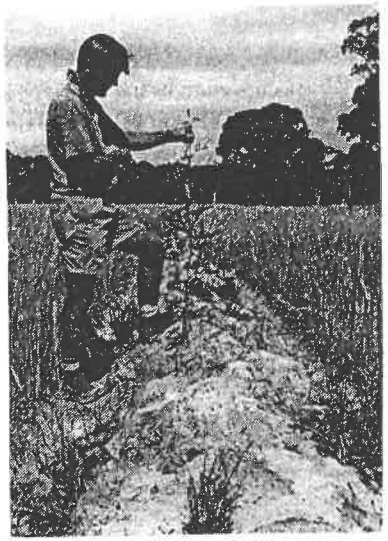
The contour planting is another demonstration site to show that a property's aesthetics can be improved and income generated at the same time.

Spacings used by Richard were seedlings 3 m apart on the outside rows and 2 m inside.

Martyn sees agroforestry being a useful addition to other economic pursuits in the Hills.

He would like more broadscale landowners to become involved and to learn how to combine agroforestry with conventional primary production, pointing out that in any revegetation program there is scope for plantings for nature conservation, to correct land degradation problems such as salinity, and plantings for later harvesting.

Meanwhile, and funding permitting, he will press on with an extension of the demonstration program which by the end of this year will see about 100 sites from Angaston to Normanville, growing forestry species.



INNOVATIONS
INNOVATIONS
INNOVATIONS
INNOVATIONS

Above left: Martyn England with some of the promising mound plantings.

Above:Bill Klaebsch, of Wistow, inspecting last year's plantings with Martyn.

Left: Richard Bennett checks some of his young trees.

Bush-Chronicle Incorp. Treespeak No53 March 1995 page 5.

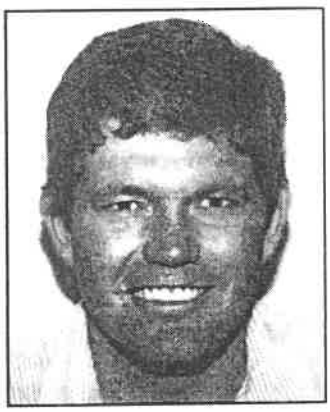
TECHNICAL

Testing a method of establishing forest vegetation in the wet tropics of the Sunshine State.

DIRECT SEEDING FOR REHABILITATION OF DEGRADED LANDS IN NORTH-EAST QUEENSLAND

DAN SUN — Queensland Forest Research Institute, QDPI, Atherton, Queensland.

GEOFF DICKINSON — Queensland Forest Research Institute, QDPI, Atherton, Queensland.



Abstract

In the wet tropical region of north-east Queensland, there is a serous land degradation problem, particularly in gullied areas, as evidenced by weed invasion, loss of soil fertility and soil erosion. Re-establishment of forest vegetation in these areas is an important component of any integrated program for rehabilitation of degraded land in the region. This can be achieved through direct-seeding, a quick, cheap and effective method. Results of direct-seeding are affected by a number of factors including species selection, techniques for seed germination, soil condition, site preparation and post-germination management. In north-east Queensland, some research work has been carried out and techniques in relation to these factors have been developed. This now provides a good opportunity for the application of the method at a large scale in the region. However, because the possibility of successful tree establishment from direct-seeding decreases with the increased degree of land degradation, revegetation should occur before the level of land degradation makes the success of the method less likely.

The wet tropical region in north-east Queensland lies between 15°30'S and 19°30'S and contains coastal lowlands and adjacent uplands (Fig. 1). Settlement of the area by Europeans began in the 1870s when many timber cutters arrived with the primary objective of harvesting red cedar (*Toona australis*), a high value rainforest timber species in the region. Since then, much of the original forest has been cleared for intensive grazing and agriculture. Land clearing was often undertaken without regard to land-use suitability and risk of soil erosion. As a result, there has been a problem of land degradation in the region which is evidenced by weed invasion, loss of soil fertility and soil erosion (Applegate *et al.* 1993). A survey undertaken recently identified 56 000 hectares of land or 34 per cent of the total area as degraded (Applegate *et al.* 1993). These degraded areas have become covered by unpalatable grasses and woody regrowth. The indiscriminate clearing of vegetation from hill slopes in order to increase the area of agricultural and pastoral land has particularly resulted in accelerated land degradation along many gullies, due to land slips and increased soil erosion.

Trees, with their deep and spreading root systems, provide the best form of protection against land slips and are effective in the prevention of gully and tunnel erosion (Marshall, 1990). Trees also create habitat for wildlife and provide protection at a catchment level. Therefore, re-establishment of forest vegetation in these gullies is important for a whole program of rehabilitation of degraded land in wet tropical north-east Queensland.

As rainforest is the original vegetation in most of these areas, it is desirable to re-establish rainforest species when possible. The main objectives of the re-establishment of vegetation in these gullied areas are to control soil erosion, protect against land slips, and to stabilise streambanks. The established vegetation will also have ecological, conservational and scientific study values. It can improve water quality in catchment areas and provide animal corridors. Although revegetation may be achieved by tree plantings, this is a relatively slow and expensive process and requires high labour inputs. As most of these gullied areas are also very steep, tree planting is extremely difficult. Alternatively, direct-seeding can overcome these problems.

Direct-seeding refers to the sowing of seeds of trees, shrubs and grasses or herbs directly onto the site requiring revegetation. This method has been used in parts of Australia since the late

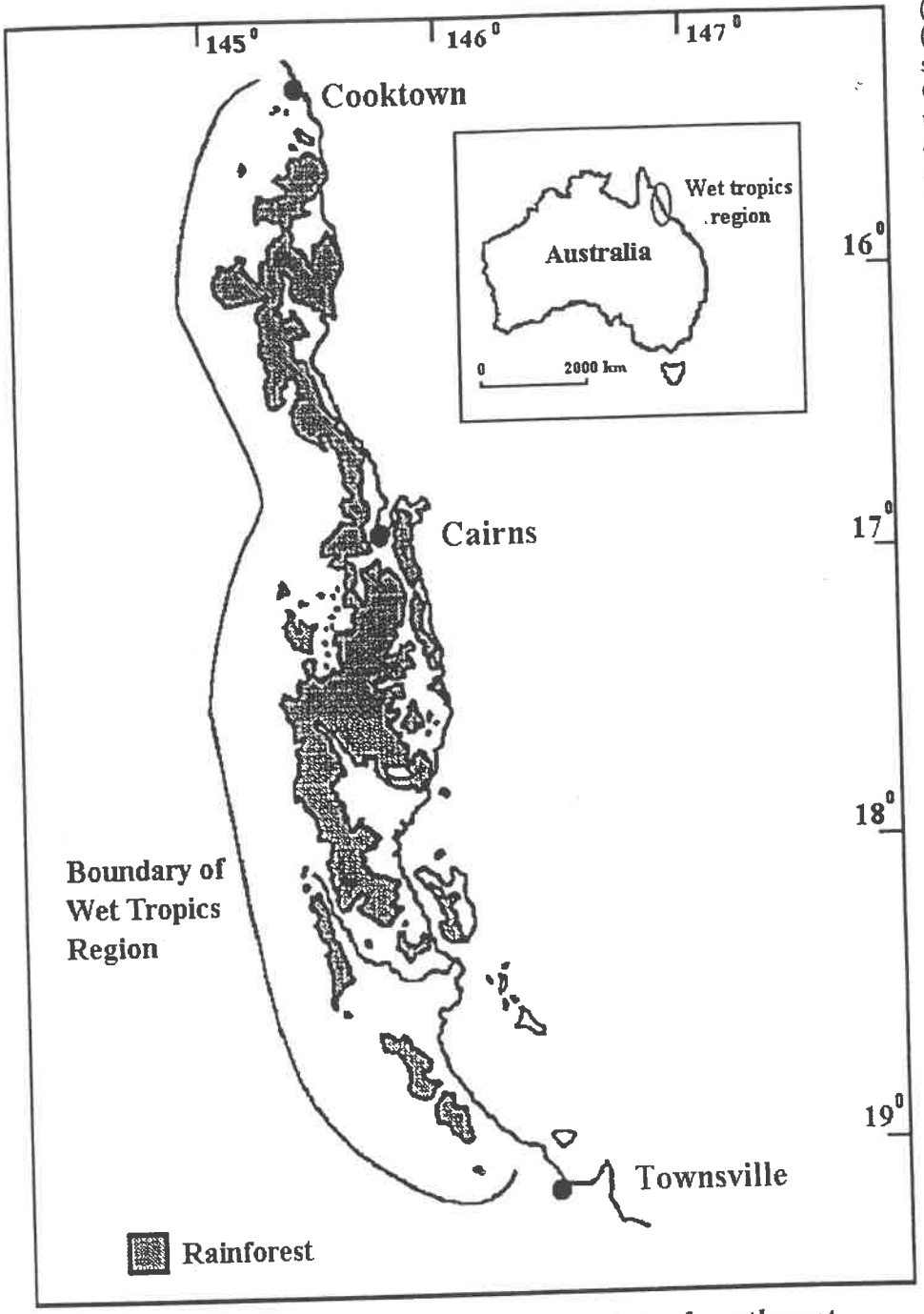


Figure 1. Map of the wet tropical region of north-east Queensland.

19th century. In recent years, with the increasing awareness of the problem of land degradation and the need to rehabilitate large areas of degraded lands, the direct sowing technique is becoming more popular because of its advantages of being quick, cheap and effective (Thomson, 1992).

Results of direct-seeding are affected by a number of factors including species selection, techniques for seed germination, soil condition, site preparation and post-germination management. Some basic direct-seeding techniques for site preparation which have been developed and widely used elsewhere (Thomson, 1992) are generally suitable for north-east Queensland. This paper focuses on the factors mentioned above.

SPECIES SELECTION

The first step in a direct-seeding program for the rehabilitation of degraded land is to choose correct species. In the natural sequence of succession of rainforest, pioneer tree species, bypassing the grasses/ herbaceous stage, come up before climax rainforest species (Devoe, 1992). Pioneer vegetation can be expected to enter large gaps while later successional vegetation is confined to smaller openings (Denslow, 1980). Sarsaparilla (*Alphitonia petriei*) and [illegible] (*Omalanthus populifolius*), such pioneer species in [illegible] Queensland. The fast growing [illegible] these two species provides for [illegible] canopy formation and the establishm[illegible] of microhabitat/microclimate which [illegible] favourable for germination and growth of the less light-tolerant rainforest species. Birds are considered the major mobile links for dispersal of many rainforest seeds (Whitmore, 1983). As these two species are attractive to some birds, a natural recruitment and germination of less light-tolerant rainforest species beneath established stands of these two species is a common pathway of rainforest development in the region. Studies on these two species in the region showed that they can be successfully established through direct-seeding, providing appropriate techniques of seed germination pre-treatment, site preparation and weed control, are used (Sun *et al.*, 1995; Dickinson and Sun unpublished data). In north-east Queensland, *Alphitonia petriei* and *Omalanthus populifolius* are recommended as two important species for rehabilitation of degraded lands through direct-seeding.

SEED GERMINATION PRE-TREATMENT

The second step is to determine the best pre-treatment to improve seed germination rate. As the response of seeds to various treatments may vary with species due to differences in seed structure and mechanism of dormancy, it is necessary to undertake a simple trial to quickly test a wide range of treatment techniques. The most common techniques include physical and chemical scarification, and a hot water/soaking combination. A range of these techniques were tested on *Alphitonia petriei*, a species with high seed dormancy, in a nursery mist house in 1992. Eight pre-treatments were tested in a randomised complete block design with four replicates, which were:

Treatment 1	Add cool water, soak for 48 hours
Treatment 2	Add cool water, soak for 48 hours, store at 5°C for 5 days
Treatment 3	Add boiling water, soak for 48 hours
Treatment 4	Add boiling water, soak for 48 hours, store at 5°C for 5 days
Treatment 5	Add gibberellic acid, soak for 15 minutes
Treatment 6	Add sulphuric acid, soak for 15 minutes
Treatment 7	Manual scarification (sandpaper)
Treatment 8	Control (no treatment)

results showed that boiling /soak for 48 hours was the best e-treatment which resulted in a significantly ($P<0.05$) higher seed germination (62%) compared with the control treatment (40%). This technique has since been used in several direct-seeding operations in the region.

Garwood (1989) considered seed destruction by animals to be an important factor in the natural regeneration of rainforest. She suggested that studies are needed to develop techniques to reduce damage caused by animals to seeds. Positive effects of seed coating and pelleting on predation of various temperate and subtropical tree species have been reported by Crouch and Radwan (1975) and Venning (1985). However, Sun *et al.* (1995) found that seed coating caused a reduction in the germination capacity and the quality of the germinates of *Alphitonia petriei* seeds in the wet tropical conditions of north-east Queensland. A similar result on mountain ash (*Eucalyptus regnans*) was also reported by Neumann and Kassaby (1986). As suggested by Dowling (1978) and Scott (1975), the pelleting effect varies with species and climates. Pelleting has been found to increase seed germination by increasing water absorption (Waldron and Cayford, 1967) and by preventing and reducing predation by small animals (Crouch and Radwan, 1975; Venning, 1985). This effect is most likely to be minimised in wet tropical areas where soil moisture is not a limiting factor and seeds can germinate relatively quickly after sowing, thus reducing the risk of predation. Hence, seed coating is not recommended for *A. petriei*. Whether this is also applicable to *Omalanthus populifolius* and other species remains unclear and it should be investigated in the future.

WEED CONTROL

In wet tropical north-east Queensland, weed control is one of the most important factors determining whether a successful direct-seeding operation can be achieved. Sun *et al.* (1995) and Dickinson and Sun (unpublished data) found that weed competition is significantly detrimental to the survival and growth of *A. petriei* and *O. populifolius* seedlings although it did not cause a negative effect on the seed germination rate for the same species. Harmer (1995) noted that the severity of competition effect depends on the species of competing weeds. A common grass species, signal grass (*Brachiaria decumbens*), is particularly competitive with direct-seeded tree seedlings in the region. Sun and Dickinson (1995) found that *B. decumbens* has a distinctly contrasting growth pattern from *A. petriei* and *O. populifolius*. In the first 6 weeks after seed germination, *A. petriei* and *O. populifolius* were slow in growth while *B. decumbens* had a rapid growth. It is suggested that the critical stage of the competition effect is the first several weeks after germination. This is when grass competition should be controlled.

In order to develop techniques to effectively control grass competition and thus to improve the survival and early growth of direct-seeded tree seedlings, studies have been conducted by Dickinson and Sun (unpublished data). They tested four pre-emergent and three post-emergent herbicides under both glasshouse and field conditions and found that after seed germination, applying Fluazifop-butyl and Sethoxydim, both post-emergent herbicides, at a rate of 0.4 kg/ha was effective in grass weed control and could be used in future direct-seeding operations.

• A typical eroded gully in tropical north-east Queensland.

SITE CONDITIONS

Although the problem of land degradation occurs in many gullied areas in north-east Queensland, it varies in extent. Some areas are completely bare of vegetation with the topsoil removed, some have <20 per cent grass cover with highly compacted soil, whereas some areas have up to 100 per cent grass cover. Sun and Dickinson (1995) examined the relationship between the performance of direct seeded *Alphitonia petriei* trees and the level of land degradation. They found that the possibilities of successful tree establishment from direct-seeding in north-east Queensland decrease with the increased degree of land degradation. The germination rate on areas where site preparation was conducted to reduce soil compaction to a depth of 10 cm, was 12 times higher than that on the heavily compacted areas. This suggests that compacted soil reduces both seed germination and the growth of seedlings. Compacted soils also restrict root penetration of seedlings and are thus inhospitable to their establishment (Sun *et al.* 1995). Similar results have also been reported on other tree species in temperate areas (Kerr and Evans, 1993) and on some shrub species in subtropical areas (Sun and Liddle, 1993). It is, therefore, strongly recommended that on heavily compacted sites, efforts should be made to reduce soil compaction prior to sowing. Sun *et al.* (1995) found that tilling the topsoil to a depth of 10 cm is effective in fulfilling this purpose.

Low soil fertility is another important site condition that has been found to cause poor survival and growth of direct-seeded trees (Sun *et al.*, 1995). Battaglia and Reid (1993) also reported that in Tasmania, sites which were favourable for seed germination of alpine ash (*Eucalyptus delegatensis*) were not necessarily favourable for seedling survival due to low soil fertility. To ensure that direct-seeded trees can be successfully established on poor soil, applying fertiliser at an early stage appears to be necessary.

Vegetative cover is possibly one of the most important site condition factors influencing direct-seeding results. The areas which are completely bare often have lost all topsoil. It is almost impossible to establish trees through direct sowing on such areas. It is

results showed that boiling /soak for 48 hours was the best e-treatment which resulted in a significantly ($P<0.05$) higher seed germination (62%) compared with the control treatment (40%). This technique has since been used in several direct-seeding operations in the region.

Garwood (1989) considered seed destruction by animals to be an important factor in the natural regeneration of rainforest. She suggested that studies are needed to develop techniques to reduce damage caused by animals to seeds. Positive effects of seed coating and pelleting on predation of various temperate and subtropical tree species have been reported by Crouch and Radwan (1975) and Venning (1985). However, Sun *et al.* (1995) found that seed coating caused a reduction in the germination capacity and the quality of the germinates of *Alphitonia petriei* seeds in the wet tropical conditions of north-east Queensland. A similar result on mountain ash (*Eucalyptus regnans*) was also reported by Neumann and Kassaby (1986). As suggested by Dowling (1978) and Scott (1975), the pelleting effect varies with species and climates. Pelleting has been found to increase seed germination by increasing water absorption (Waldron and Cayford, 1967) and by preventing and reducing predation by small animals (Crouch and Radwan, 1975; Venning, 1985). This effect is most likely to be minimised in wet tropical areas where soil moisture is not a limiting factor and seeds can germinate relatively quickly after sowing, thus reducing the risk of predation. Hence, seed coating is not recommended for *A. petriei*. Whether this is also applicable to *Omalanthus populifolius* and other species remains unclear and it should be investigated in the future.

WEED CONTROL

In wet tropical north-east Queensland, weed control is one of the most important factors determining whether a successful direct-seeding operation can be achieved. Sun *et al.* (1995) and Dickinson and Sun (unpublished data) found that weed competition is significantly detrimental to the survival and growth of *A. petriei* and *O. populifolius* seedlings although it did not cause a negative effect on the seed germination rate for the same species. Harmer (1995) noted that the severity of competition effect depends on the species of competing weeds. A common grass species, signal grass (*Brachiaria decumbens*), is particularly competitive with direct-seeded tree seedlings in the region. Sun and Dickinson (1995) found that *B. decumbens* has a distinctly contrasting growth pattern from *A. petriei* and *O. populifolius*. In the first 6 weeks after seed germination, *A. petriei* and *O. populifolius* were slow in growth while *B. decumbens* had a rapid growth. It is suggested that the critical stage of the competition effect is the first several weeks after germination. This is when grass competition should be controlled.

In order to develop techniques to effectively control grass competition and thus to improve the survival and early growth of direct-seeded tree seedlings, studies have been conducted by Dickinson and Sun (unpublished data). They tested four pre-emergent and three post-emergent herbicides under both glasshouse and field conditions and found that after seed germination, applying Fluazifop-butyl and Sethoxydim, both post-emergent herbicides, at a rate of 0.4 kg/ha was effective in grass weed control and could be used in future direct-seeding operations.

• A typical eroded gully in tropical north-east Queensland.

SITE CONDITIONS

Although the problem of land degradation occurs in many gullied areas in north-east Queensland, it varies in extent. Some areas are completely bare of vegetation with the topsoil removed, some have <20 per cent grass cover with highly compacted soil, whereas some areas have up to 100 per cent grass cover. Sun and Dickinson (1995) examined the relationship between the performance of direct seeded *Alphitonia petriei* trees and the level of land degradation. They found that the possibilities of successful tree establishment from direct-seeding in north-east Queensland decrease with the increased degree of land degradation. The germination rate on areas where site preparation was conducted to reduce soil compaction to a depth of 10 cm, was 12 times higher than that on the heavily compacted areas. This suggests that compacted soil reduces both seed germination and the growth of seedlings. Compacted soils also restrict root penetration of seedlings and are thus inhospitable to their establishment (Sun *et al.* 1995). Similar results have also been reported on other tree species in temperate areas (Kerr and Evans, 1993) and on some shrub species in subtropical areas (Sun and Liddle, 1993). It is, therefore, strongly recommended that on heavily compacted sites, efforts should be made to reduce soil compaction prior to sowing. Sun *et al.* (1995) found that tilling the topsoil to a depth of 10 cm is effective in fulfilling this purpose.

Low soil fertility is another important site condition that has been found to cause poor survival and growth of direct-seeded trees (Sun *et al.*, 1995). Battaglia and Reid (1993) also reported that in Tasmania, sites which were favourable for seed germination of alpine ash (*Eucalyptus delegatensis*) were not necessarily favourable for seedling survival due to low soil fertility. To ensure that direct-seeded trees can be successfully established on poor soil, applying fertiliser at an early stage appears to be necessary.

Vegetative cover is possibly one of the most important site condition factors influencing direct-seeding results. The areas which are completely bare often have lost all topsoil. It is almost impossible to establish trees through direct sowing on such areas. It is

suggested that, on these areas, establishing herbs/grass vegetation at the first successional stage is needed before the direct-seeding of woody plants can be implemented.

Although the difficulty for successful establishment of pioneer rainforest trees may increase with the degree of slope, steepness is not regarded as a limiting factor for the use of the direct seeding method. A high germination and survival of *A. petriei* on a steep gullied area in north-east Queensland has been reported by Sun *et al.* (1995).

CONCLUSION

Using direct seeding for rehabilitation of degraded tropical land, particularly in eroded gully areas, in the wet tropical region of north-east Queensland is effective and economical with the techniques developed to date. This provides a good opportunity for the application of this method at a large scale in the region. However, because the possibility of successful tree establishment from direct seeding decreases with the increased degree of land degradation, revegetation using direct seeding in this region should occur before the level of land degradation becomes serious, as indicated by high compaction levels, loss of topsoil, poor cover and/or low soil fertility. On the bare-earth areas where the topsoil has been lost, extra work, such as establishing herb/grass vegetation at the first successional stage, is needed before the direct seeding of woody plants using these techniques can be implemented. Application of fertiliser and reduction of compaction are also likely to be necessary.

• A river bank being prepared for direct seeding.

REFERENCES

Applegate, G. B., Robson, K. J. and Kent, G. A. (1993). Afforestation for rehabilitation of degraded land in the tropics. In: R. N. Thwaites and B.J. Schaumberg (Eds.). *Australian Forestry and the Global Environment*, The Institute of Foresters of Australia Inc. Canberra.

Battaglia, M. and Reid, J. B. (1993). The effect of microsite variation on seed germination and seedling survival of *Eucalyptus delegatensis*. *Aust. J. Bot.* **41**, 169-181.

Crouch, G. L. and Radwan, M. A. (1975). Coating and impregnation with Endrin protects field sown douglas fir seed. *Pesticide Sci.* **6**, 337-345.

Denslow, J. S. (1980). Gap partitioning among tropical rainforest trees. *Biotropica* **12**, 47-55.

Devoe, N. N. (1992). Regeneration from seed under a range of canopy conditions in tropical wet forest, Puerto Rico. In: M. J. Kelty and B. C. Larson (Eds.), The Ecology and *Silviculture of Mixed-Species Forests*. Kluwer Academic Publishers. London.

Dowling, P. M. (1978). Effect of seed coatings on the germination, establishment, and survival of oversown pasture species at Glen Innes, new South Wales. N. Z. J. Agric. Res. 6, 161-166.

Garwood, N. C. (1989). Tropical soil seed banks. In: *Ecology of Seed Banks*. (Eds. M. A. Leck *et al.*). Academic Press, New York.

Harmer, R. (1995). Natural regeneration of broadleaved trees in Britain: III. Germination and establishment. *Forestry* **68**, 1-9.

Kerr, G. and Evans, J. (1993). Growing Broadleaves for Timber. Forestry Commission handbook 9. HMSO, London.

Marshall, C. J. (1990). Control of erosion. In: *Trees for Rural Australia*. Cremer, K. W. (Ed.). Inkata Press. Sydney.

Neumann, F. G. and Kassaby, F. Y. (1986). Effects of commercial pesticides in seed-coats on seeds and germinants of *Eucalyptus regnans*, and their potential as seed protectants in the field. *Aust. For. Res.* **16**, 37-50.

Sun, D. and Liddle, M. J. (1993). A survey of trampling effects on vegetation and soil in eight tropical and subtropical sites. *Environ. Managt.* **17**, 497-510.

Sun, D., Dickinson, G. and Bragg, A. (1995). Direct-seeding of *Alphitonia petriei* (Rhamnaceae) for gully revegetation in tropical northern Australia. *For. Ecol. Managt.* **73**, 249-257.

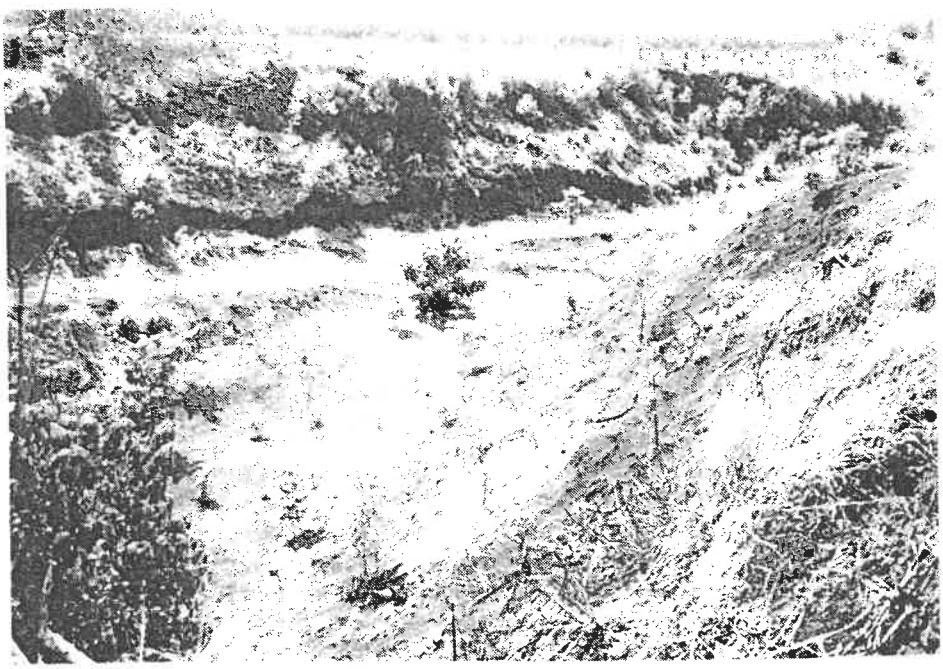
Sun, D. and Dickinson, G. (1995). The competition effect of *Brachiaria decumbens* on the early growth of direct-seeded trees of *Alphitonia petriei* in tropical north Australia. *Biotropica*..(in press)

Thomson, D. (1992). Direct-seeding — an effective broadacre tree establishment technique. *Landscape Australia*, **14**, 313-319.

Venning, J. (1985). Direct-seeding: assessing its potential. *Trees Nat. Res.* **27**, 26-28.

Waldron, R. M. and Cayford, J. H. (1967). Improved germination of white spruce seed by increasing moisture content with absorptive powders. *For. Chron.* **43**, 149-154.

Whitmore, G. J., (1983). Secondary succession from seed in tropical rainforests. *For. Abst.* **44**, 767-769.



• Direct-seeded trees establishing along an eroded gully.

...onitoring native fauna on seeded sites

Bush Chronicle incorp. Treespeak No 53 March 1995 page 7

by Neville Bonney, Greening Australia

Just across the SA border and next to the Little Desert National Park, Little Desert Tours and GASA have created a Mallee Fowl habitat.

In 1992, about 25 km of locally collected seed was sown over 11 hectares into what was described then as a difficult site infested with Evening Primrose.

Despite the fact that the soil was non-wetting and that less than 200 mm of rain fell that year, many thousands of shrubs and trees are now around 1 metre tall, with a density of about 2,200 stems per hectare.

This block of land, to the south of the Little Desert Lodge, which attracts guests from all over the world, was cleared in 1970 and planted with Evening Primrose for summer stock feed.

Whimpey Reicheldt bought the block in 1975. In 1992 he placed a kangaroo and rabbit-proof fence around the block and seeded it with 12 species of native plants.

The project was completed with the assistance of GASA, which performed the direct seeding. GAVic assisted with signage.

Of particular interest to Whimpey and his guests is the return of native animals to the block.

To monitor this, we have set out five lines of pitfall traps – a very successful means of finding out which ground-dwelling animals are visiting a site.

Our lines of pitfalls run from surrounding vegetation into the heart of the cleared block and when we visit the pitfalls each night during the monitoring, we record the creatures found in each.

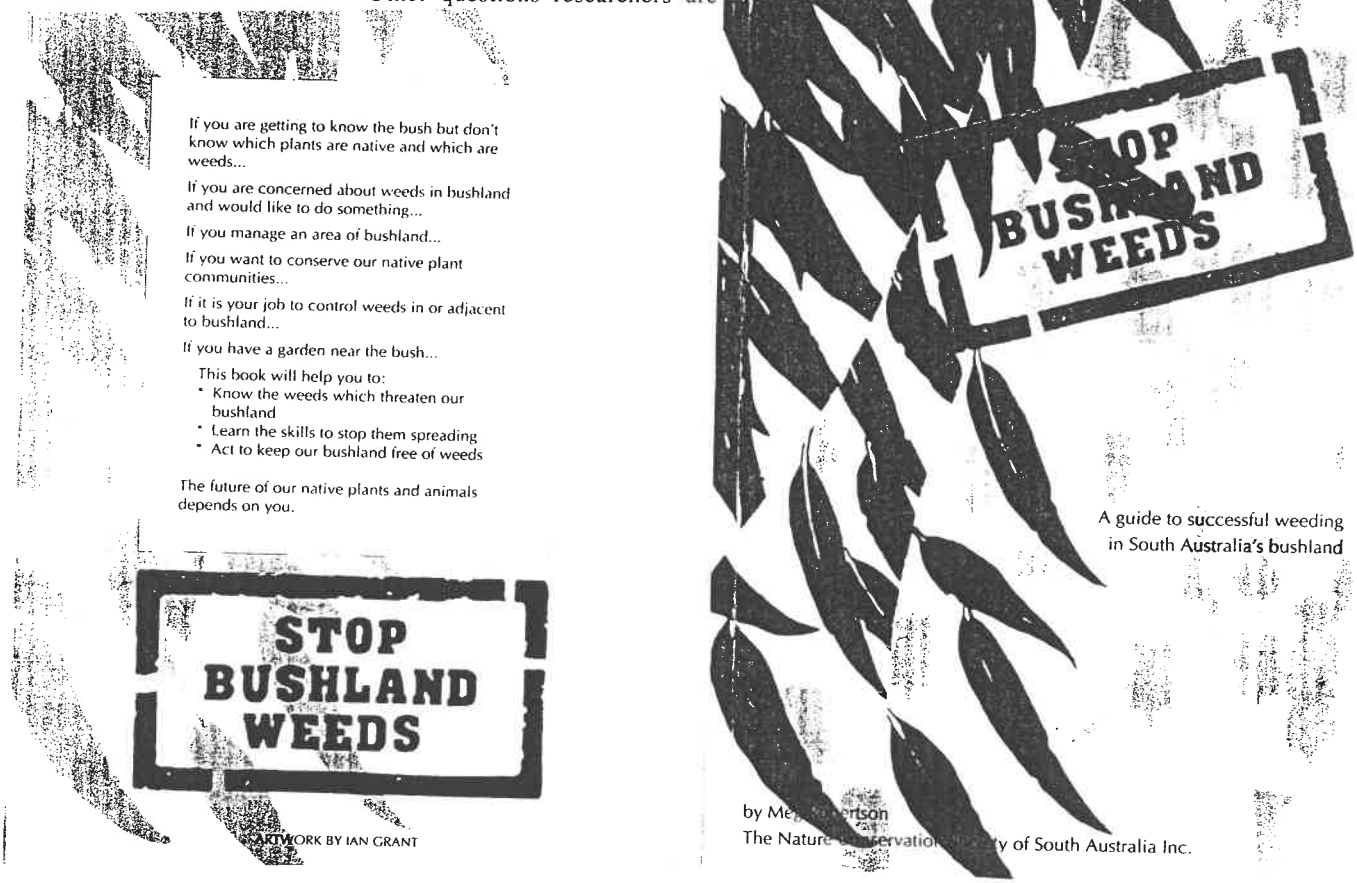
Visitors to the area will note the difference between the uncleared area and the area currently being revegetated.

Other questions researchers are asked to observe are: 'Are all the kinds of animals in the adjacent vegetation found in the cleared block? What do you think may be the reasons for the differences? Are our pitfalls likely to pick up all kinds of animals in the bushland and on the cleared block? If not, what other kinds of techniques should we use to detect their presence?

To date the following fauna has been recorded in the direct seeded site, which is not yet three years old:

- Silk Desert Mouse
- Three frog species
- 11 bird species
- Shingle-back Lizards
- Skinks
- Brown Snakes
- Painted Dragons

... and Whimpey expects that this list will grow considerably over the next few years.

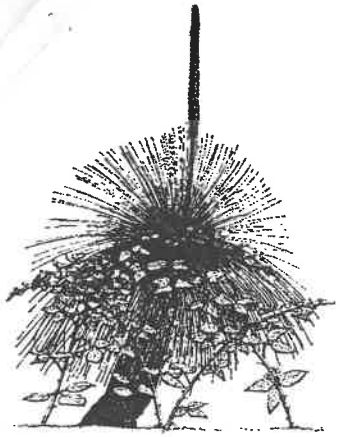


PURPOSE OF THIS BOOK

In bushland we now find many plants which are not native to the area. Those that threaten native plant communities are bushland weeds or "environmental weeds".

This book is a guide to keeping bushland free from these "weeds", in order to conserve the diversity of native plants and animals. The problem is not that there are weeds in the bush, but that the bush is threatened by weeds. Weeding bushland with minimal disturbance can encourage natural regeneration of native plants and helps remove this threat.

To undertake effective bushland weeding you need some skills in identifying weeds, in getting rid of them without disturbing the native vegetation and in working to a plan. These skills can largely be learnt on the job. This is a starting point for those who want to learn bush conservation through practical experience.



SAVE THE BUSH from WEEDS

HERBICIDES FOR BUSHLAND WEED CONTROL

By Richard J Carter, Senior Adviser (Plants)

Herbicides are useful when managing weeds in bushland. They reduce the cost of control and are easy to apply. Often herbicides are integrated with other techniques. In many cases herbicides are preferable to slashing, bulldozing or digging. Herbicides do not disturb the soil, reducing weed regrowth.

Do not use herbicides that have a long soil life, or that are readily taken up by plant roots as these may damage desirable vegetation.

A wetter or surfactant helps the spray droplets penetrate the plant. Only use surfactants recommended on herbicide labels.

BEFORE USING ANY HERBICIDE READ AND HEED THE LABEL

Glyphosate
Glyphosate is available in a wide range of pack sizes and is suitable for control of a wide range of bushland weeds. It is not selective and may damage or kill any plant that spray droplets contact. It can be applied as a spray or wiped on to green foliage of weeds. It is inactivated and rapidly broken down by in the soil. It is carried through the plant from foliage to the root system. It may take up to two weeks before you see the effects so it is best to add a dye to avoid double treatment or missing plants.

Triclopyr
Triclopyr (Garlon®), is effective on a wide range of bushland weeds. It is sprayed on leaves and stems and moves in the sap throughout the plant. It can be selective. Triclopyr does not affect grasses.

It may drift from treated areas and damage tomatoes, vines, fruit-trees and vegetable crops. This can happen at the time of spraying or up to three days later. The danger of damage is greatest during warm weather.

Triclopyr is more effective than glyphosate on old woody weed growth. It is faster acting than glyphosate. It has low toxicity, similar to glyphosate, but has a strong odour.

Metsulfuron-methyl
Metsulfuron-methyl (Brushoff®) cannot be used over the root-zone of native vegetation, especially in the drier areas. Use it prior to re-establishing vegetation, or on the margins of areas of native vegetation. The residues may persist for many months.

It is very safe for users. It is non-toxic and odourless.

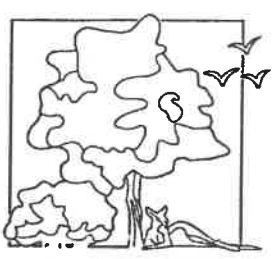
2,4-D amine
The hormone herbicide 2,4-D amine is non-volatile. It works much like triclopyr, but is not as effective on woody weeds. It is sprayed onto the stem and leaves, moving in the sap throughout the plant. It can be selective, and does not affect grasses.

The residues in the soil degrade rapidly.

It is safe for users and has low toxicity. The odour of solvents in the formulation may be unpleasant to some users.

Produced by the
SA ANIMAL & PLANT CONTROL COMMISSION
GPO Box 1671, Adelaide 5001
With assistance from the
SAVE THE BUSH - REMNANT VEGETATION PROGRAM

For further information contact your local Animal and Plant Control Board or telephone 08 2264888



October 1991

RESEARCH

Investigating the effects of chemical weed control in the establishment of trees on the granite tablelands of central New South Wales.

THE USE OF HERBICIDES IN RESTORING TREE COVER TO BATHURST GRANITE SOILS

BILL SEMPLE — Soil Conservation Service, Orange, New South Wales.

TERRY KOEN — Soil Conservation Service, Cowra, New South Wales.

CHRIS MARSHALL — Environment Protection Authority, Bathurst, New South Wales.

Abstract

Long-term weed control options for tree planting in the Bathurst district (NSW) have been limited by a belief that tree deaths would result from 'leaching' of residual herbicides in the sandy granite soils. This hypothesis was tested in experimental plantings of 360 seedlings of eight native tree/shrub species in spring 1991 and a further 270 seedlings of six species in autumn 1992. Two residual herbicides, simazine (at a rate used for tree plantings on non sandy soils) and chlorsulfuron (at a rate used for cereal fallows) were compared with a non-residual (glyphosate) control.

Insects severely damaged trees in the first planting and rabbits damaged some trees in the second planting, but no deaths could be attributed to the residual herbicides. Statistically significant, though not marked, height depression occurred in trees of three species in the residual herbicide treatments in the second planting. At the rates used, simazine controlled weeds for a longer period than chlorsulfuron and for a lower cost of chemical than any of the treatments.

Bathurst was the first New South Wales inland settlement, having been proclaimed in 1815, two years after the first crossing of the Blue Mountains. The long period of European settlement is evidenced by the number and depth of erosion gullies, presence of exotic pastures and absence of native trees (Fig. 1). The sandy granite soils once supported large areas of blakely's redgum — yellow box *(Eucalyptus blakelyi — E. melliodora)* (Anon., 1974). Sizeable areas of this woodland are now rare in NSW (Benson, 1989). When and how tree decline commenced is uncertain. The original woodlands and grasslands would not have required clearing for grazing which was the initial use of the land. Nor were they initially cleared for agriculture which commenced in the relatively treeless, broad river valleys.

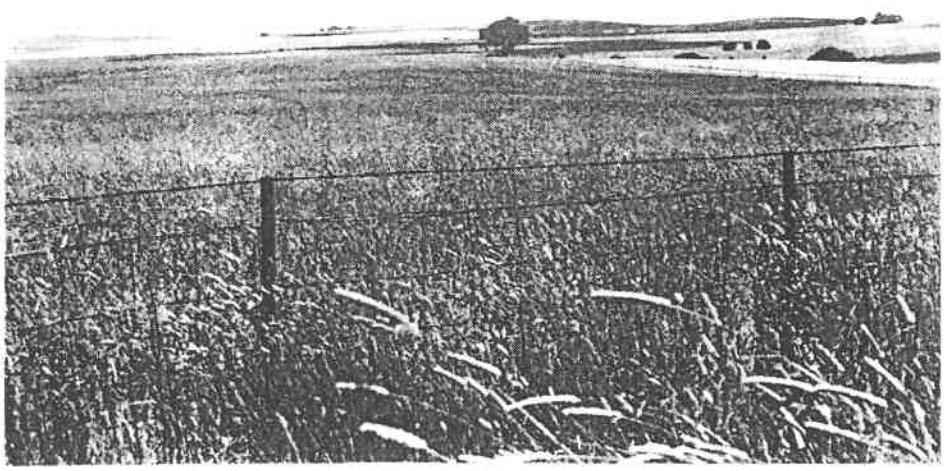


Figure 1. Downs country on granite east of Bathurst. Timbered hills in the background are non-granite.

However, a major episode of clearing in upland areas, for cereal growing, occurred in the early 1930s (Smith, undated). It is probable that natural tree deaths and lack of regeneration are of equal, or more, importance than deliberate clearing of trees in creating the current landscape. Attempts at replanting native trees and shrubs have had mixed success.

TREES AND TREE PLANTING

To what extent the gullies of the Bathurst Granite (Fig. 2) can be blamed on the removal of the original woodland is debatable. Although erosion is minimal in intact forests, replanting an area with trees does not necessarily reduce erosion, at least until sufficient ground cover of vegetation or litter has developed. However, trees and shrubs do have a role in revegetating these gullies: as sediment traps and in reducing seepage flows (Marshall, 1989).

From a soil and water conservation viewpoint, the major role of trees — particularly in upland areas — is in maintaining groundwater at low levels. This reduces the occurrence of seepages, (which could initiate or aggravate gullying) and downstream salinisation. Although granite is a potential source of high levels of sodium, salinisation is not common in the Bathurst area — possibly due to rapid removal of salts in incised drainage lines. To what extent the Bathurst Granite contributes to salinisation further west is conjectural.

Trees have many other useful functions: protection of stock and crops, wildlife habitat, timber and firewood, aesthetic value and in some cases browse for stock (Wakefield, 1989). They also reduce wind speed. Even at densities as low as 17 trees/ha, wind speed may be reduced by 50 to 60 per cent (Knight cited by Bird *et al.*, 1992). As a consequence, they are highly valued by many in the rural community. In a recent survey of landcare groups in the Wellington (NSW) area, for example, all but four of the twenty-seven groups reported tree decline/tree planting as an issue of concern (Brock, 1994). Despite recent advances in the technology of establishing trees from tubestock, direct seeding and to a lesser extent, natural regeneration (Bird *et al.*, 1994; Dalton, 1993), tree establishment can still be risky.

On the sandy granite soils of the Bathurst area, attempts to establish native trees by direct seeding and natural regeneration have generally failed. This has been attributed to the difficulty of controlling herbage competition in improved pasture and insect damage (L. Kingham, former Landcare Coordinator, *pers. comm.*). Defoliation of seedlings by wingless grasshoppers (*Phaulacridium vittatum*) is a major problem in many summers. The widespread occurrence of "improved pastures" and high stocking rates create ideal conditions for these insects (Baker, 1981).

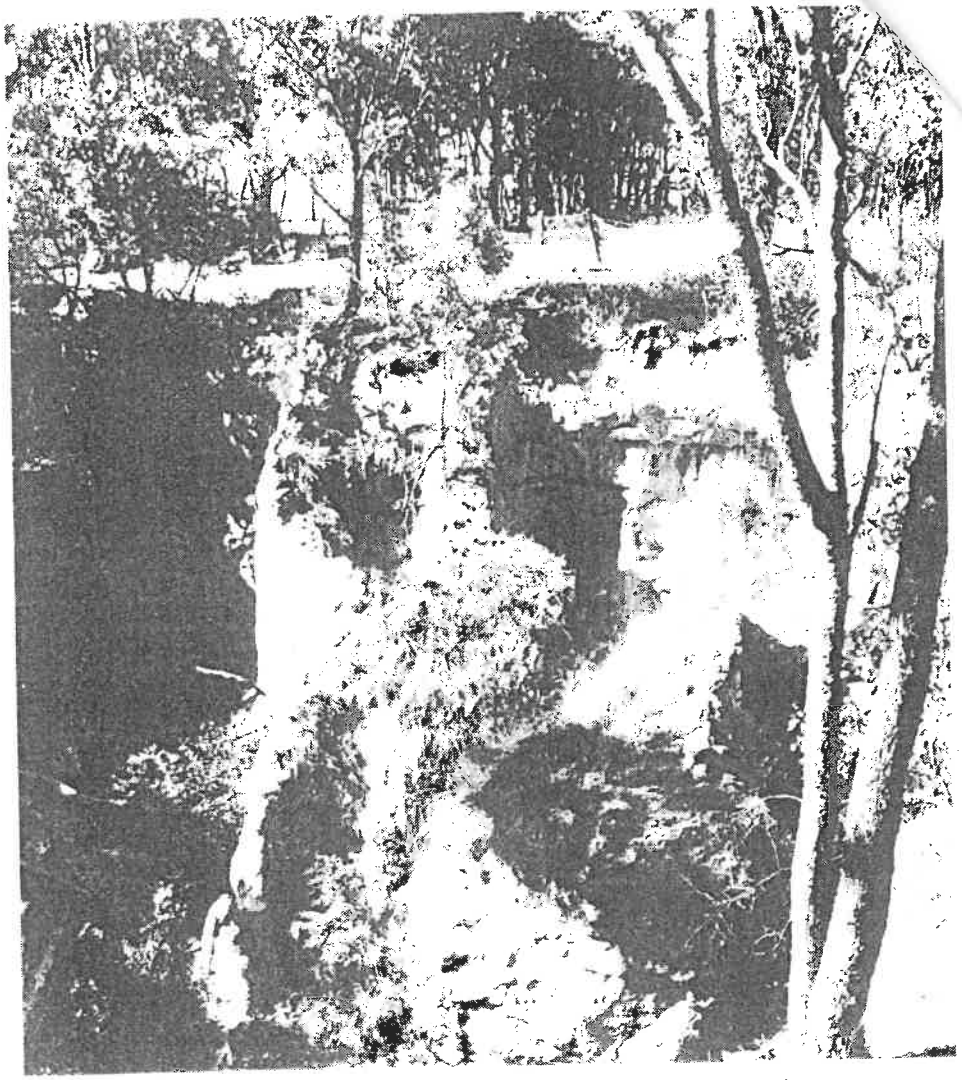


Figure 2. One of the larger erosion gullies on the Bathurst Granite: "The Kings Docks", south-east of Bathurst.

The use of tubestock seedlings remains the primary means of establishing trees on the Bathurst Granite. The usual procedure is to rip planting lines, apply glyphosate (a systemic herbicide) and plant into moist soil in either autumn or spring. Pegged-down drink cartons, usually with a small plastic "weed mat", provide protection from rabbits and limited weed control. Applications of glyphosate are necessary for longer term weed control but being labour intensive and a regular requirement, it is often compromised. Growth and survival of trees would be enhanced if long term weed control could be incorporated into the initial tree planting program, i.e. if a cost-effective residual herbicide could be used in this environment.

A variety of residual herbicides has been developed for broad-scale cropping, horticulture and pine plantation situations. Though some are species specific, most are effective through the roots of all plants. By being "fixed" in clays at the soil surface, they are particularly effective on germination in this zone, with pre-existing plants, or seedlings emerging from greater depth, being unaffected. Many of these herbicides have been evaluated for use in direct seeding of trees but they are removed from the sowing line by scalping prior to sowing. Simazine and atrazine, however, are not recommended for use on sandy soils as they are likely to leach into the sowing line after scalping (Bird *et al.*, 1994; Dalton, 1993).

Residual herbicides can also be applied to the soil prior to planting tubestock or as an overspray on mature seedlings. Only one herbicide, oxyfluorfen, is registered in NSW for residual weed control in native tree/shrub plantings; but because of its high cost, it is not commonly used. In parts of Victoria, however, one of the least costly of the residuals, simazine at 6 L/ha, is

mended (Bird *et al.*, 1994).

e applicability of using simazine as a eplanting herbicide was evaluated in the trial described below. In response to concern about trialling this herbicide on the sandy Bathurst soils, Dr P. R. Bird suggested removing a small quantity of treated soil ("scuffing it off with your boot") prior to planting. In addition to simazine, another residual herbicide, chlorsulfuron (Glean R), was also trialled. As only one application rate (the upper limit for use in cereal fallows) was used, comparisons of its effectiveness with simazine at a relatively much higher application rate, were limited. Both herbicides were, however, compared with standard weed control practice in the area, *viz.* repeated applications of glyphosate.

METHODS

Description of Trial Site

The trial site, which was enclosed by a stock-proof fence, was located on a hillslope with a south-westerly aspect, 7½ km SW of Bathurst, on the Central Tablelands of NSW. Subterranean clover, annual grasses, sheep sorrel (*Acetosella vulgaris*) and skeleton weed (*Chondrilla juncea*) were common pasture components. Texture of the topsoil was a loamy sand to sand to sandy loam (85 per cent sand) and pH (water) was 6.5. At an elevation of 780 m, summers are mild and winters cold. Mean annual rainfall is 658 mm with more rainfall occurring in the warmer months on average, than in autumn-winter. Warm season rainfall was above average during the period of the trial (Fig. 3).

TABLE 1. DETAILS OF EXPERIMENTAL TREATMENTS FOR TUBESTOCK AND RESIDUAL HERBICIDE TRIAL AT BATHURST.

Treatments	Spring 1991	Autumn 1992
TREATMENT TIMES		
Glyphosate (Roundup®) application	20-08-91+24-09-91	18-03-92+6-04-92
Ripping	23-08-91	26-03-92
Residual herbicide applications	23-09-91	07-04-92
Planting	24-09-91	27-05-92*
Subsequent application of glyphosate (treatment in parenthesis)		03-06-92 (control) 03-11-92 (control) 11-12-92 (chlorsulfuron) 19-01-93 (control)
RESIDUAL HERBICIDES AND RATES OF APPLICATION		
Nufarm Flowable Simazine Liquid® (A.I. 500 g/L simazine)	6.0 L/ha §	6.8 L/ha †
Dupont Glean Cereal Herbicide® (A.I. 750 g/kg chlorsulfuron)	30 g/ha §	36 g/ha †
TREE/SHRUB SPECIES		
Non-eucalypts		
Acacia implexa	X	-
A. dealbata	X	X
Casuarina cunninghamiana	X	X
Melaleuca ericifolia	X	X
Eucalyptus (subgenus Symphomyrtus)		
Section Exsertaria		
E. blakelyi	X	-
Section Maidenaria		
E. mannifera	X	X
E. viminalis	X	-
E. macarthurii	-	X
Section Adnataria		
E. melliodora	X	X

* *Acacia dealbata* planted on 09-06-92.

§ Applied with a Micron Herbi R calibrated to desired rate. Variations from these may have occurred.

† Applied with a knapsack. Rate determined from amount of herbicide actually used.

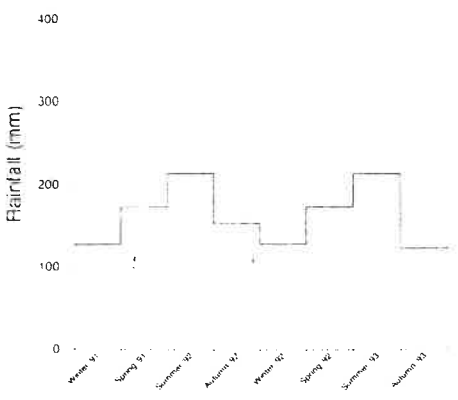


Figure 3. Seasonal rainfall (mm) recorded at NSW Agriculture's Research Station, Bathurst, during the trial. Also shown is the seasonal rainfall averaged over the 1971-1991 period (—). Arrows indicate planting dates.

Site Preparation and Planting Procedures

Two evaluations were carried out: in spring 1991 (which failed due to insect attack) and a repeat in autumn 1992. For the spring 1991 trial, an area of approximately 0.1 ha was sprayed with the knockdown herbicide, glyphosate, in August 1991 and planting lines ripped shortly afterwards. The area was then subdivided into 15 plots arranged on an 8 by 2 grid, each plot measuring 4 x 7 m and a 2 m buffer zone. Within each plot, the two residual herbicides chlorsulfuron and simazine, together with a glyphosate control, were randomly assigned to 7 m long planting strips which were 2 m apart. Residual herbicides were applied in 1.2 m wide strips with a Micron Herbi R in September 1991. Following spraying, seedlings of eight tree/shrub species (Table 1) were randomly planted 1 m apart beside the riplines, thereby requiring 360 seedlings in total. The only variation from normal procedures (viz. Hamilton Tree Planter R, drink carton tree guards and 20 x 20 cm plastic weed mats as described earlier) was that a small quantity of surface soil was scraped to the side prior to planting.

Due to severe damage to seedlings (and herbage) by wingless grasshoppers in the spring 1991 planting, no follow-up with glyphosate occurred prior to an early termination of the trial in February 1992.

Some slight modifications were made for the autumn 1992 trial in that six species were used (Table 1) and residual herbicides were applied using a knapsack in 1 m wide strips. Replication and plot layout were similar to the spring 1991 trial except that blocks were arranged on a 5 by 3 grid. Unlike

the spring 1991 plantings, follow-up applications of glyphosate were applied as required to the control and also, at a later date, to the worst performing residual herbicide treatment.

Herbicide Effects on Seedlings and Herbage Growth

In both experiments, seedling vigour was rated (1 = OK i.e. no obvious damage from any source, 2 = Fair, 3 = Poor, 4 = Apparently dead) at regular intervals for about 12 months after planting, after which time, treatment effects were likely to be confounded by competition from weeds and adjacent trees. Heights were measured (Fig. 4) at the end of the observation period, except in the case of the spring 1991 planting, where results were confounded by wingless grasshopper damage.

An indication of herbage (weed) growth was obtained by regular ratings of pasture cover [1= <30%, 2= 30-70%, 3=>70%] following the autumn 1992 planting. Vegetative cover in the spring 1991 experiment was assessed on only two occasions: by a rating in December 1991 and by modified step pointing (Cunningham, 1975) in February 1992.

Data Analysis

There were no missing data in the seedling vigour data from the spring 1991 planting, however, 28 of the 270 seedlings were excluded from the autumn 1992 planting data set due to the known application of incorrect herbicide and/or grazing to ground level by rabbits.

The analysis of data from various observation periods in each trial closely followed the generalised linear model (GLM) approach used by Semple and Koen (1993). In summary, 3-way frequency tables were formed from data on the 360 (270 in experiment 2) young trees/shrubs, based on the 4 vigour rating levels, 8 species and 3 herbicide treatments. Following Nelder (1974), these contingency tables of discrete counts were each analysed using a GLM model which assumed a Poisson error distribution and logarithmic transformation (link function). The procedure was to examine for association between the vigour rating levels and each of the species, herbicide and species-by-herbicide terms in a manner analogous to the interaction terms in a factorial analysis of variance model.

Figure 4. Measuring tree heights 13 months after the 1992 planting.

RESULTS

Tree and Shrub Survival Following Planting in Spring 1991

Seedlings from this planting suffered severe damage from wingless grasshoppers between early December 1991 and mid February 1992. With the exception of acacias, most plants were leafless by January 1992. A systemic insecticide, dimethoate, was applied on four occasions, but as it was applied to all plants, the extent to which it reduced damage to the plants cannot be determined. Many plants did not regenerate following defoliation and growth of survivors was depressed.

Analysis of seedling vigour rating data recorded before grasshopper damage (Table 2) indicated that the simazine treatment was associated with greater numbers of plants in the 'poor' and 'dead' categories than in the other treatments (χ^2_6 = 50.6; P < 0.0001), and this was particularly so for *Eucalyptus mannifera* and to a lesser extent, *Acacia dealbata* and *Eucalyptus viminalis* (χ^2_{12} = 49.3; P = 0.005).

TABLE 2. SPRING 1991 PLANTED VIGOUR RATINGS, TWO AND A HALF MONTHS AFTER PLANTING (i.e. before grasshopper damage), FOR THE EIGHT TREE AND SHRUB SPECIES SUBJECTED TO TWO DIFFERENT RESIDUAL HERBICIDES.

	No residual herbicide				Simazine				Chlorsulfuron			
Species	**OK**	**Fair**	**Poor**	**Dead**	**OK**	**Fair**	**Poor**	**Dead**	**OK**	**Fair**	**Poor**	**Dead**
Acacia implexa	15				14		1		15			
A. dealbata	15				7		7	1	15			
Casuarina cunninghamiana	15				13		2		14		1	
Melaleuca ericifolia	14	1			13		2		14		1	
Eucalyptus blakelyi	15				12	1	2		15			
E. mannifera	13	1	1		8	1	3	3	8	6		1
E. viminalis	14		1		9	1	3	2	13		2	
E. melliodora	15				10		4	1	14	1		

N.B. Fifteen individuals were tested in each herbicide-species combination. For clarity, cells with zero frequency have been left blank.

and Shrub Survival owing Planting in Autumn 992

Though some wingless grasshoppers were present during the 1992/93 summer, the autumn 1992 plantings suffered no observable damage. However, many seedlings were browsed by rabbits or hares during July-August 1992. Apart from cases where tree guards were knocked over, possibly by strong winds at the time, the effects of grazing were short-lived. Where guards had been knocked over, seedlings were browsed to ground level. Two seedlings died as a result, and growth of the six remaining grazed plants remained depressed. Only one seedling (in the glyphosate only treatment) died from 'unknown causes'.

Analysis was performed on seedling vigour rating data recorded 3 months after seedlings were planted. No significant herbicide effects, nor herbicide by species effects were detectable after either time period. After 3 months, a general species vigour effect was evident ($\chi^2_{15} = 86.6$; $P < 0.0001$), with *Eucalyptus macarthurii* having a greater proportion of counts in the 'poor' class, while *E melliodora* and *E. mannifera* both had a higher than average proportion in the 'OK' class (Table 3a). This apparent effect of species vigour was not detectable 13 months after planting ($\chi^2_{15} = 13.4$; $P = 0.58$) (Table 3b). Overall survival rates 13 months after planting are presented in Table 4.

TABLE 4. SURVIVAL OF TREES AND SHRUBS 13 MONTHS AFTER PLANTING IN AUTUMN 1992.

Species	Survival (%)
Acacia dealbata	97
Casuarina cunninghamiana	100
Melaleuca ericifolia	100
Eucalyptus mannifera	100
E. melliodora	100
E. macarthurii	100
All species combined	99.6

Mean tree heights at the end of the trial are presented in Table 5. Though not evident from casual observation, plants of *Acacia dealbata*, *Eucalyptus mannifera* and *E. macarthurii* in the residual herbicide treatment were significantly shorter ($F_{10,200} = 3.62$, $P = 0.0002$) than members of the same species in the non-residual herbicide treatment.

Weed Control

Five months after herbicides were applied in the spring 1991 planting, average herbage cover in the simazine, chlorsulfuron and glyphosate treatments was 32 per cent, 47 per cent and 47 per cent respectively (ns, $P = 0.11$). Cover would probably have been higher in the absence of grasshoppers. Two months earlier, before grasshopper damage became evident, herbicide effectiveness had been rated as simazine > chlorsulfuron > glyphosate ($P = 0.003$, Kruskal-Wallis nonparametric test).

The overall pattern of weed control in the autumn 1992 planting is shown in Fig. 5. As data presented are "averages" of ratings (1, 2 or 3), it is diagrammatic only. Simazine was very effective in suppressing germination for about six months and progressively less effective thereafter. Chlorsulfuron's effectiveness was relatively short lived, being apparently ineffective at six months, necessitating an application of glyphosate in January 1992 (though could have been applied as early as October 1991). Herbage growth in the glyphosate treatment was maintained between low and moderate levels by three further applications of chemical.

DISCUSSION

Seedlings planted in spring 1991 suffered considerable damage from prolonged attack by wingless grasshoppers between mid December 1991 and late February 1992. An apparent adverse effect of simazine prior to this was subsequently masked by damage associated with grasshoppers.

Despite acceptable growth in all autumn 1992 treatments (Table 5) and most plants appearing healthy after 13 months, small but significant treatment differences were evident in tree heights of *E. macarthurii* and *E. mannifera* (the two representatives from Section Maidenaria of *Eucalyptus*) and *Acacia*

TABLE 3. AUTUMN 1992 PLANTED VIGOUR RATINGS FOR THE SIX TREE AND SHRUB SPECIES SUBJECTED TO TWO DIFFERENT RESIDUAL HERBICIDES.

(a) 3 months after planting (i.e. 20 August 1992)

	No residual herbicide				Simazine				Chlorsulfuron			
Species	OK	Fair	Poor	Dead	OK	Fair	Poor	Dead	OK	Fair	Poor	Dead
A. dealbata	2	10	1		2	8	1			12		
Casuarina cunninghamiana	3	11			2	10			4	11		
Melaleuca ericifolia		15			1	11				15		
Eucalyptus mannifera	7	8			6	4	1		9	6		
E. macarthurii	2	10	3			9	2			10	5	
E. melliodora	9	6			4	8			8	6		

(b) 13 months after planting (i.e. 16 June 1993)

	No residual herbicide				Simazine				Chlorsulfuron			
Species	OK	Fair	Poor	Dead	OK	Fair	Poor	Dead	OK	Fair	Poor	Dead
A. dealbata	12			1	10	1			12			
Casuarina cunninghamiana	13	1			11	1			15			
Melaleuca ericifolia	15				12				15			
Eucalyptus mannifera	15				11				15			
E. macarthurii	15				10	1			15			
E. melliodora	15				12				14			

N.B. Missing plots for some species result in less than 15 individuals being analysed in some herbicide-species combinations. For clarity, cells with zero frequency have been left blank.

dealbata at the end of the experiment. Whether or not this cost outweighed the once-only application of a residual herbicide versus follow-up applications of glyphosphate is discussed later.

Simazine provided the best weed control in both plantings, particularly following the planting in autumn 1992 — possibly due to the higher application rate than in 1991. Chlorsulfuron's effects waned rapidly three months after application, whereas simazine continued to suppress weed growth for six to seven months before waning (Fig. 5). However, the application rate of chlorsulfuron was at the recommended rate for weed control in cereal crop fallow, whereas simazine was applied at well above the comparable rate of 1 to 2.5 L/ha. If chlorsulfuron had been used at a higher rate, longer weed suppression may have occurred.

The reason for reduced heights of some trees/shrubs in the residual herbicide treatments in the autumn 1992 planting may have been due to poor weed control — early in the trial in the case of the chlorsulfuron (and follow-up glyphosate) treatment, or later as with simazine (Fig. 5). However, the lack of a consistent pattern of weed control, together with apparently adequate moisture following planting (Fig. 3), suggests phytotoxic effects as the most likely cause.

The estimated costs of using simazine or chlorsulfuron versus follow-up application of glyphosate (the current "best practice") for the autumn 1992 planting are presented in Table 6. Simazine looks attractive, particularly in view of its effectiveness and once-only application. However, these must be balanced against the costs of height depression of some species and the apparent need (which was not tested in the experiment) to remove some surface soil prior to planting. Also, the mobility of this chemical in sandy soils raises the question of its ultimate fate. Though many Bathurst soils have sandy topsoils, clay is usually present at shallow depth. It is believed that the herbicide would be "fixed" by these clays thus preventing movement to the water table.

Tree guards are reported to have many values (e.g. moderating temperature/wind extremes, conserving moisture, allowing seedlings to be easily seen), but their main value appear to be protection against follow-up herbicides and damage from small herbivores (though the 30 cm guards in this trial were effective against rabbits/hares, they were not against wingless grasshoppers). If post-planting herbicides are unnecessary because an effective residual herbicide is used and if rabbits/hares and environmental extremes are not problems, then the

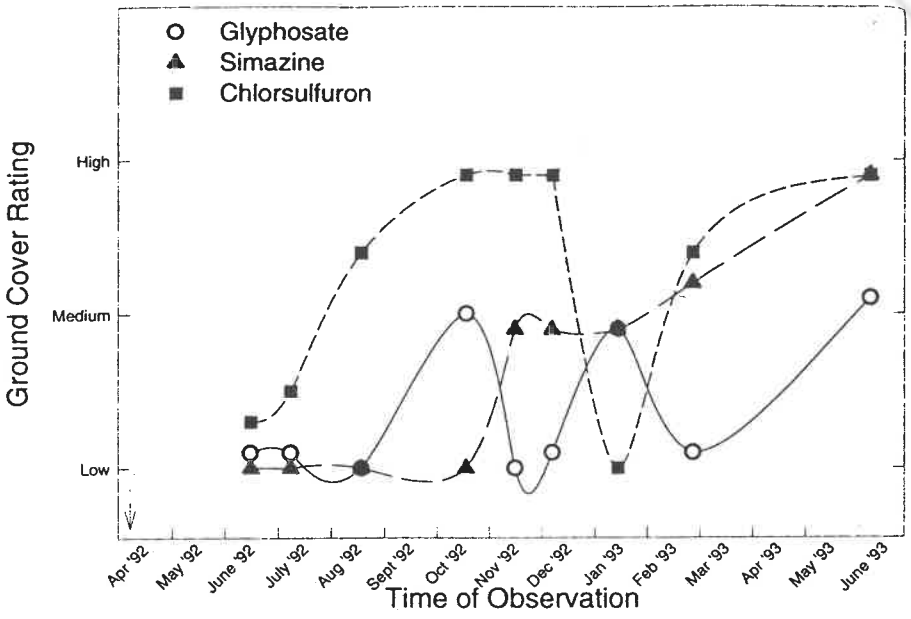


Figure 5. Diagrammatic representation of average ground cover ratings during the autumn 1992 trial. Sudden decreases in cover follow applications of glyphosate. Arrow indicates time of application of residual herbicides.

TABLE 5. MEAN HEIGHT (cm) OF SURVIVING TREES AND SHRUBS PLANTED IN AUTUMN 1992 (after a 13 month growing period).

Species	Treatments		
	glyphosate (control)	glyphosate+ simazine	glyphosate+ chlorsulfuron
Acacia dealbata	252	†180 (-28.6%)	†213 (-15.5%)
Casuarina cunninghamiana	124	117 (-5.6%)	109 (-12.1%)
Melaleuca ericifolia	103	106 (+2.9%)	99 (-3.9%)
Eucalyptus mannifera	156	†129 (-17.3%)	†131 (-16.0%)
E. macarthurii	183	†123 (-32.8%)	†132 (-27.9%)
E. melliodora	97	85 (-12.4%)	88 (-9.3%)
All species combined	149	123 (-17.4%)	126 (-15.4%)

† significantly different from the control for that species.
l.s.d. (5%) for differences between herbicides for the same species = 18.6
N.B. Plants browsed to ground level by rabbits/hares early in the trial have been excluded. Percentage increase/decrease compared to the glyphosate control shown in parentheses.

TABLE 6. QUANTITIES AND COSTS OF HERBICIDES USED FOLLOWING RIPPING AND INITIAL GLYPHOSATE APPLICATION.

Treatment	No. of applications and amount of herbicide used			Approx. cost (mid 1995)
	simazine (6.8 L/ha)	chlorsulfuron (36 g/ha)	glyphosate (c.2 L/ha)	
Glyphosate	-	-	3 x 0.2 L	$5.95
Simazine	1 x 0.68 L	-	-	$3.65
Chlorsulfuron	-	1 x 3.6 g	1 x 0.2 L	$4.85

N.B. Based on a 1 km x 1 m (0.1 ha) treatment strip over a 13 month period following planting in autumn 1992.

nse of installing tree guards may be necessary.

CONCLUSIONS

Despite expectations of low survival rates — at least for some species — trial results did not support this. No deaths could be attributed to the effects of residual herbicides. However, height depression was recorded in the autumn 1992 planting. This effect was statistically significant in three species but was not visually obvious as most trees grew well during the 13-month period of observation. These results were probably due to different tolerances to "leached" simazine or chlorsulfuron in the root zone. Species with the lowest tolerance appeared to be *Acacia dealbata*, *Eucalyptus macarthurii* and *E. mannifera*.

A once-only application of simazine (the most effective of the two residual herbicides used in this trial) was a cost-effective means of weed control compared to follow-up applications of glyphosate. Additional savings could be achieved if tree guards were not used, though some form of plant protection would be needed if glyphosate was to be applied after simazine ceased to be effective (about nine months after application in the autumn 1992 experiment). However, savings must be balanced against some height depression and the probable need to remove surface soil from the vicinity of trees at planting time.

ACKNOWLEDGMENTS

Donation of tubestock by Farm Trees and Planting Services (J and N Thompson of Orange) (1991 and 92), Forestry Commission of NSW in 1991 and Oberon Plateau Farm Trees (S and V Keen) in 1992 and the participation of Mr C. Ross on whose property the trials were carried out, is gratefully acknowledged. The trials were funded by the Soil Conservation Service of NSW.

Our thanks also to those who assisted in the field: Landcare and Bathurst Soil Conservation Service staff and student volunteers (M. Ellis and K. Lorimer); to T. Wilkinson, D. Waterhouse and an unnamed referee who drew our attention to errors in drafts of this paper, and to J. Kramer and E. Davidson who transformed numerous drafts of this paper into the final product. Permits under the NSW Pesticides Act were obtained for the use of simazine and chlorsulfuron in this trial. Neither chemical is currently registered for use in native tree plantations in NSW.

REFERENCES

Anon. (1974). Vegetation. In 'Bathurst District Technical Manual'. Soil Conservation Service of NSW, Sydney.

Baker, G.L. (1981). Wingless grasshopper. *Agfact* AE.1 (Second edition). NSW Agriculture.

Benson, J. (1989). Establishing priorities for the conservation of rare or threatened plants and plant associations in NSW. In Conservation of threatened species and their habitat. Occasional Paper No. 2. Australian Committee for IUCN. Canberra.

Bird, P.R., Bicknell, D., Bulman, P.A., Burke, S.J.A., Leys, J.F., Parker, J.N., van der Sommen, F.J., and Voller, P. (1992). The role of shelter in Australia for protecting soils, plants and livestock. *Agroforestry Systems* **20**, 59-86.

Bird, P.R., Kearney, G.A., and Jowett, D.W. (1994). Trees and shrubs for south-east Victoria. Technical Report Series No. 205. Department of Agriculture, Victoria.

Brock, P. (1994). 'Project Directory for Wellington/Dubbo Landcare Groups'. Landcare: Wellington, NSW.

Cunningham, G.M. (1975). Modified step-pointing — a rapid method of assessing vegetative cover. *J. Soil Cons. NSW* **31**, 256-265.

Dalton, G. (1993). *Direct Seeding of Trees and Shrubs*, Primary Industries (SA), Adelaide.

Marshall, C. (1989). Tree planting for gully erosion control. *Farm Trees 4*. NSW Trees on Farms Program.

Nedler, J.A. (1974). Log linear models for contingency tables: a generalisation of classical least squares. *Appl. Statist.* **23**, 323-329.

Semple, W.S. and Koen, T.B. (1993). Some effects of fire on the survival of sifton bush *(Cassinia arcuata)* R.Br. *Rangel.J.* **15**, 320-330.

Smith, G. (undated). 'A History of Fitzgerald's Valley Wimbleton' (No publisher: Bathurst Historial Society?).

Wakefield, S.M. (1989). Why you need trees on your farm. *Farm Trees 1*. NSW Trees on Farms Program.