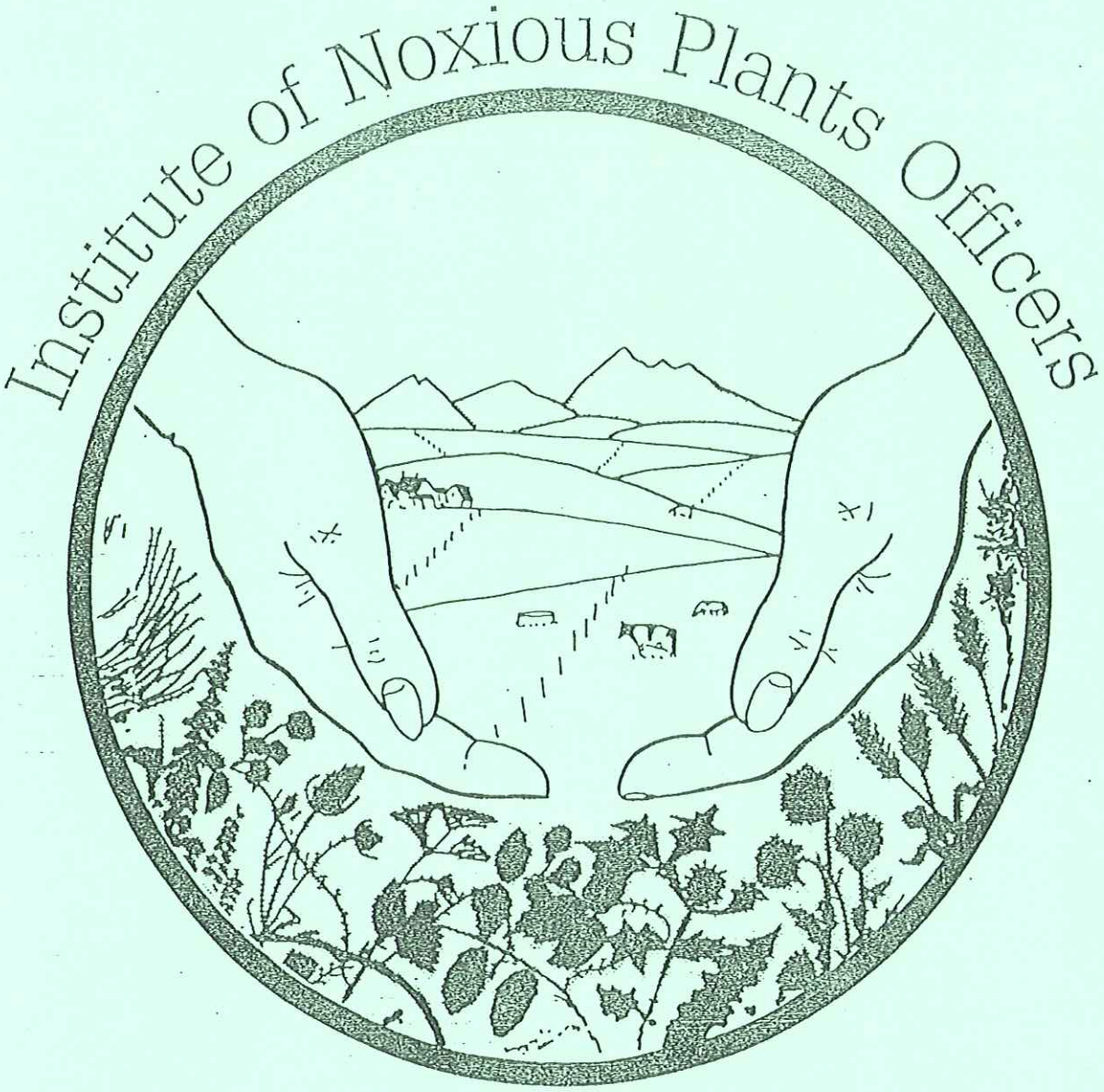
PROTECT



Journal of the New Zealand Institute of Noxious Plants Officers Inc

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From: The Sub-Editor's Desk

Well, this is it, the Auckland/Northland Branch effort at compiling this quarter's "Protect" in the new format.

At our last A.G.M. Members bleated about wanting more technical information, more expanded articles, more on what's happening on the ground and, of course, an expanded source of contributors and readers. Hence the articles from D.O.C., MAF, and ARC. Parks.

So here it is. I hope there is something of interest for everyone. How did the content of this "Protect" come about?

Well, for example, a few weeks ago I received a call from MAF Lynfield advising they had just received a complaint that a certain South Island grain stockfood was suspected of being the source of the parasite "Broom Rape" which suddenly appeared on a local horse owner's property.

"Broom Rape"? Parasitic plant? Dodder in New Zealand? (Tell me more.) So thank you Michele.

On another occasion I had a call from Alister McArthur ARC Parks; "Hey Rod, have you seen any seedling Phoenix palms in your travels late?" (Phoenix palms naturalised? Are they a weed?) My reply was: "Sorry Alister, I've only noticed the native Nikau palm". He replied; "Well that's not surprising because both species look similar as seedlings - difficult to tell apart." So my quick response was "How would you like to jot down your thoughts on paper, and I will publish in our Institute magazine which is distributed throughout NZ. You may even get a reply from those members who do know the difference (who knows maybe DOC and regional councils may need to take a closer interest in 50 year old Phoenix palms).

The article on "Boneseed" evolved from a personal curiosity arising from my 1990 Du Pont study travel trip to Australia where I was shown literally miles of "Bitou Bush" along the coastline. Since then I've been noticing a similar plant in NZ but the nagging question for me was, is it Boneseed or Bitou Bush, or another sub species? I collected a sample from Dunedin and various Auckland locations and they were identified by the Museum Herbarium as "Boneseed".

The technical data and research information is copied from Proceedings of past Australian Noxious Plants Seminars, which I have reproduced for the technically minded and sceptics alike.

I don't apologise for the "volume" of this data or that of the GREAT ESCAPE Project. For to edit or "hack" them down to a couple of pages may have been relevant but would have undoubtedly lost the many valuable points and themes. during the translation.

Besides, the primary objective of the publication was to inform and inspire those persons involved with Land Management rather than trying to please everyone within the "middle ground".

To this end I would like to thank all who contributed with articles and special thanks to Clyde Edmiston for acting as the "head and hunt dog" in rounding up our branch, to Monsanto NZ Ltd for having faith in where my heart is and getting this publication produced.

Thank you, Auckland/Northland Branch members, and thank you Monsanto. I trust you will find value and enjoyment in reading our production of "Protect".

Rod Smart
Acting Sub Editor.

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From the Sub-Editor's Desk - Rod Smart, Executive Member I.N.P.O.

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IDENTIFYING AND MANAGING THE NEXT CENTURY'S PROBLEM WEEDS

F. Dane Panetta
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Abstract

We live in a period of homogenization of the world's flora, with weedy species emerging as the major benefactors of this process. Future problem species have not been introduced to New Zealand, have been introduced but are not yet naturalized, or are experiencing a "lag period" in their invasion careers. Such periods present opportunities for the suppression of weed invasions, the extreme (and rare) expression of which is eradication. During the early stages of invasion it is difficult to identify the species that would warrant expensive managerial intervention; predictions of impact upon ecosystem structure and function or upon agricultural production must often incorporate a measure of "intelligent guesswork". A history of weediness elsewhere and poor reproductive success in a plant's native environment are two relatively reliable indicators of the potential negative impact of an incipient weed.

It is not commonly recognized how many serious weeds have been intentionally introduced for purposed of agriculture, gardening, rehabilitation, etc. To a certain extent this problem could be redressed by the identification of weediness in candidates for importation. However, for some uses, weedy characteristics are actually desired. In these cases, decisions regarding importation must rest upon assessments of the relative costs (including non-monetary values) and benefits of the individual introductions. Where there is potential for irreversible environmental damage, the Precautionary Principle should operate ("if in doubt, leave it out").

The implementation of noxious plant legislation must be both dynamic and flexible. In too many cases, major commitments of resources are made to chronic, longstanding weed problems, leaving few resources for the strategic management of other invasions. Noxious plant legislation should not be used to enforce weed control when a species is already widespread. For any given pest plant, the usefulness of legislation is restricted to the phases preceding extensive invasion. Where the availability of resources remains constant, declaration of one species should be accompanied by removal of another from the list of noxious plants.

It is important to focus on invaded ecosystems rather than solely upon single invaders. Since many weed problems are too intractable to be tackled economically, invaded areas may have to be "written off", with resources being directed instead to managing new invasions in priority areas.

ED,

ARTICLE FOR PROTECT MAGAZINE File No. P320-13

REGIONAL PLANT PESTS NATIONALLY BANNED FROM SALE AND DISTRIBUTION

by Lance Vervoort, Biosecurity Officer, ARC Environment

Introduction

In April 1995 the Biosecurity Technical Advisory Group (BTAG) empowered a subcommittee to explore, in conjunction with the Nursery and Garden Industry Association of New Zealand (NGIA), opportunities to have a large group of harmful plants nationally banned by regional councils from sale, propagation and distribution. After protracted negotiations with NGIA, it can be reported that regional councils have NGIA's endorsement to put into effect a national list of plant pests which are to be banned by all regional councils from sale, propagation and distribution. This will take effect on 1 July 1997.

Rationale

The concept of preparing a national list of plant pests regionally banned from sale, propagation and distribution evolved because the timing was right. With the enactment of the Biosecurity Act, regional councils have been preparing their individual plant pest management strategies. Consequently there was a unique opportunity here for regional councils to collectively consider new initiatives pertaining to plant pest management before new systems are put in place.

With respect to the national list of plant pests regionally banned from sale, the initiative evolved from recognition that simply banning a plant pest from sale in a region does not prevent the plant being sold in other regions where it has not been declared a pest. Consequently cross boundary trafficking of harmful plants that, while benign in one region, are potentially quite serious in other regions. Consequently, if regional councils could get the support of the industry through NGIA, for very little cost we could make considerable environmental gains throughout New Zealand by having these plants withdrawn from sale.

Nominated Plant Species

Of the original plants we sought to have banned, NGIA could not agree on the inclusion of Taiwan Cherry, Jasmine, Wandering Jew and Selaginella. At the end of this article are the plants nominated to be nationally banned from sale. There are 110 species. The plant species on the national list represent harmful plants which:

a) are generally recognised as having serious actual and unintended effects in one or more regions (it does not mean the plant has to be a problem throughout the country);

b) NGIA recognise and agree that these plants are indeed harmful and should be withdrawn from sale; and

c) regional councils agree to co-operate with and support other regional councils by declaring all plants on the list to be pests.

The national list represents a conservative negotiated package of harmful plants banned from sale. Throughout discussions, NGIA illustrated considerable goodwill and reasonableness when considering particular plants.

In addition to NGIA the national list has at various times been "vetted" by the National Institute of Water and Atmospheric Research Ltd, Royal Forest and Bird Protection Society and the Department of Conservation.

Management Regime

Regional councils may choose from a range of management options what level of regional intervention to adopt for particular plants given the importance or priority that Council has attached to the plant's control. Management options include service delivery, requiring the land occupier to undertake "total control" or "boundary control" or simply the provision of advice and education.

With respect to the national list of plant pests, it is intended that other than declaring those plants to be pests, very little regional intervention is required. It represents a minimalist approach whereby the regional council will simply enforce the Section 52 and 53 provisions, if need be. Other than the inspection of nurseries and retail outlets in the region (which most other regional councils will be doing anyway), no other systems and processes need be established.

There may be occasion when a regional council may wish to apply a greater level of regional intervention to a plant or plants on the list. In such an event, those plants are simply deleted from the national list and readdressed elsewhere in the strategy.

The Future

Now that the BTAG subcommittee has obtained the endorsement of NGIA for the national list it is up to regional councils to include it within their proposed strategy. Although one regional council had indicated they would not run with the national list, as they believed that there was not enough impact evaluation or documentation of preliminary screenings (required by Section 72 of the Biosecurity Act) for each species available, they have recently had a change of heart and have decided to give the initiative a go! Even if one, or a few, regional councils decide not to support the initiative, BTAG's view is that the initiative will not be weakened to any serious extent. However, from a public perception point of view it is better for all regional councils to support the initiative and show a united front.

Once regional strategies have been approved (hopefully with the national list in them) it will be up to the Noxious Plants Officers to make sure it works. It is hoped an educational and advisory approach is taken in the first instance, with regulation/enforcement being used as a last resort on the "difficult" few. With a one year lead-in period the education and advisory role is of paramount importance.

Conclusions

This BTAG initiative should be applauded, as it provides a cost effective and proactive way of controlling potential plant pests nationally. All those people involved with the Forest Friendly Awards over the past few years should also pat themselves on the back as this has been a great forerunner to the BTAG initiative. The Awards have not only "softened" up members of NGIA but have also helped gain considerable public support for controlling the sale of environmentally unfriendly plants.

Lets make this into a positive initiative and not turn it into a negative one!

NATIONAL LIST

(Resulting from extensive negotiations between the Nursery and Garden Industry Association and BTAG representatives Jack Craw and Lance Vervoort)

The following is the list of plants agreed to by NGIA (19 September 1995) for inclusion in all Regional Pest Management Strategies for the purposes of restricting their sale and distribution under Sections 52 and 53 of the Biosecurity Act. Note that the implementation date for these strategies has been agreed by NGIA and BTAG to be **1 July 1997.**

LISTED BY COMMON NAME

African feather grass *Pennisetum macrourum*
African love grass *Eragrostis curvula*
All *Stipa* species, apart from native spp.
Alligator weed *Alternanthera philoxeroides*
Artillery plant *Galeobdolon luteum*
Australian sedge *Carex longebrachiata*
Baccharis *Baccharis halimifolia*
Banana passionfruit *Passiflora mollissima, P. mixta*
Barberry *Berberis glaucocarpa*
Bartlettina *Bartlettina sordida*
Bathurst bur *Xanthium spinosum*
Blackberry (wild aggregates) *Rubus fruticosus agg.*
Bladderwort *Utricularia gibba*
Blue morning glory *Ipomoea indica*
Blue passion flower *Passiflora caerulea*
Bogbean *Menyanthes trifoliata*
Boneseed *Chrysanthemoides monilifera*
Boxthorn *Lycium ferocissimum*
Broomsedge *Andropogon virginicus*
Buddleia davidii (not including hybrids)
Bur daisy *Calotis lappulacea*
Burdock *Arctium minus*
Cape honey flower *Melianthus major*
Cape ivy *Senecio angulatus*
Cathedral bells *Cobaea scandens*
Chinese pennisetum *Pennisetum alopecuroides*
Clasped pondweed *Potamogeton perfoliatus*
Climbing asparagus *Asparagus scandens*
Coltsfoot *Tussilago farfara*
Cotoneaster glaucophyllus, C. franchettii
Eelgrass *Vallisneria gigantea* (Lake Pupuke variety)
Vallisneria spiralis (Meola Creek, Lake Whiritoa, Wanganui variety)
Egeria oxygen weed *Egeria densa*
Elaeagnus *Elaeagnus x reflexa*

Fringed water lily *Nymphoides peltata*
German ivy *Senecio mikanioides*
Goats rue *Galega officinalis*
Gorse *Ulex spp.*
Green cestrum *Cestrum parqui*
Hawthorn *Crataegus monogyna*
Heather *Calluna vulgaris* (not including double flowered cvs.)
Hemlock *Conium maculatum*
Himalayan honeysuckle *Leycesteria formosa*
Hornwort *Ceratophyllum demersum*
Horse nettle *Solanum carolinense*
Horsetail *Equisetum arvense*
Houttuynia *Houttuynia cordata*
Hydrilla *Hydrilla verticillata*
Italian (Evergreen) buckthorn *Rhamnus alaternus*
Japanese honeysuckle *Lonicera japonica* (including cultivars but not hybrids)
Japanese spindle tree *Euonymus japonicus*
Lagarosiphon oxygen weed *Lagarosiphon major*
Lantana camara var. *aculeata*
Lodgepole pine *Pinus contorta*
Manchurian wild rice *Zizania latifolia*
Marshwort *Nymphoides geminata*
Mexican daisy *Erigeron karvinskianus*
Mignonette (Madeira) vine *Anredera cordifolia*
Mile-a-minute *Dipogon lignosus*
Mistflower *Ageratina riparia*
Montpellier broom *Teline monspessullana*
Moth plant *Araujia sericifera*
Nardoo (Four leafed water clover) *Marsilea mutica*
Nodding thistle *Carduus nutans*
Noogoora bur *Xanthium occidentale*
Nutgrass (Purple nutsedge) *Cyperus rotundus*
Old Mans Beard *Clematis vitalba*
Oxylobium *Oxylobium lanceolatum*
Palm grass *Setaria palmifolia*
Pampas grass *Cortaderia selloana, C. jubata*
Parrots feather *Myriophyllum aquaticum*
Pennisetum setaceum (Fountain grass)
Perennial nettle *Urtica dioica*
Phragmites *Phragmites australis*
Plectranthus ciliatus, P. ecklonii, P. grandis
Plumeless thistle *Carduus acanthoides*
Port Jackson fig *Ficus rubiginosa*
Privet - tree *Ligustrum lucidum*
- chinese *Ligustrum sinense*
Ragwort *Senecio jacobaea*
Saffron thistle *Carthamus lanatus*
Sagittaria *Sagittaria graminea ssp. platyphilla*

Senegal Tea (Temple plant) *Gymnocoronis spilanthoides*
Sheeps bur *Acaena agnipila*
Skeleton weed *Chondrilla juncea*
Smilax *Asparagus asparagoides*
Spanish heath *Erica lusitanica* (not including double flowered cvs.)
Spartina *Spartina spp.*
Spiny broom *Calicotome spinosa*
St. Johns wort *Hypericum perforatum*
Sweet briar *Rosa rubiginosa*
Sweet Pea shrub *Polygala myrtifolia* (not including cv. "Grandiflora")
Tuber ladder fern *Nephrolepis cordifolia*
Tutsan *Hypericum androsaemum*
Variegated thistle *Silybum marianum*
Velvet groundsel *Senecio petasitis*
Water poppy *Hydrocleys nymphoides*
Water primrose *Ludwigia peploides ssp. montevidensis*
White monkey apple *Acmena smithii*
White-edged nightshade *Solanum marginatum*
Wild broom *Cytisus scoparius*
Wild ginger *Hedychium gardnerianum, H. flavescens*
Woolly nightshade *Solanum mauritianum*
Yellow flag *Iris pseudacorus*
Yellow water lily *Nuphar lutea*

LISTED BY BOTANICAL NAME

Acaena agnipila
Acmena smithii
Ageratina riparia (Eupatorium riparium)
Alternanthera philoxeroides
Andropogon virginicus
Anredera cordifolia
Araujia sericifera
Arctium minus
Asparagus asparagoides
Asparagus scandens
Baccharis halimifolia
Bartlettina sordida
Berberis glaucocarpa
Buddleia davidii (not including hybrids)
Calicotome spinosa
Calluna vulgaris (not including double flowered cvs.)
Calotis lappulacea
Carduus acanthoides
Carduus nutans
Carex longebrachiata
Carthamus lanatus
Ceratophyllum demersum

Cestrum parqui
Chondrilla juncea
Chrysanthemoides monilifera
Clematis vitalba
Cobaea scandens
Conium maculatum
Cortaderia selloana, C. jubata
Cotoneaster glaucophyllus, C. franchettii
Crataegus monogyna
Cyperus rotundus (Purple nutsedge)
Cytisus scoparius
Dipogon lignosus
Egeria densa
Elaeagnus x reflexa
Equisetum arvense
Eragrostis curvula
Erica lusitanica (not including double flowered cvs.)
Erigeron karvinskianus
Euonymus japonicus
Ficus rubiginosa
Galega officinalis
Galeobdolon luteum
Gymnocoronis spilanthoides
Hedychium gardnerianum, H. flavescens
Houttuynia cordata
Hydrilla verticillata
Hydrocleys nymphoides
Hypericum androsaemum
Hypericum perforatum
Ipomoea indica
Iris pseudacorus
Lagarosiphon major
Lantana camara var. *aculeata*
Leycesteria formosa
Ligustrum lucidum
Ligustrum sinense
Lonicera japonica (including cultivars but not hybrids)
Ludwigia peploides ssp. montevidensis
Lycium ferocissimum
Marsilea mutica
Melianthus major
Menyanthes trifoliata
Myriophyllum aquaticum
Nephrolepis cordifolia
Nuphar lutea
Nymphoides geminata
Nymphoides peltata
Oxylobium lanceolatum

Passiflora caerulea
Passiflora mollissima, P. mixta
Pennisetum alopecuroides
Pennisetum macrourum
Pennisetum setaceum
Phragmites australis
Pinus contorta
Plectranthus ciliatus, P. ecklonii, P. grandis
Polygala myrtifolia (not including cv. "Grandiflora")
Potamogeton perfoliatus
Rhamnus alaternus
Rosa rubiginosa
Rubus fruticosus agg. (wild aggregates)
Sagittaria graminea ssp. platyphilla
Senecio angulatus
Senecio jacobaea
Senecio mikanioides
Senecio petasitis
Setaria palmifolia
Silybum marianum
Solanum carolinense
Solanum marginatum
Solanum mauritianum
Spartina spp. (all species and hybrids)
Stipa spp. (all species except natives)
Teline monspessullana
Tussilago farfara
Ulex spp.
Urtica dioica
Utricularia gibba
Vallisneria gigantea (Lake Pupuke variety)
Vallisneria spiralis (Meola Creek, Lake Whiritoa, Wanganui variety)
Xanthium occidentale
Xanthium spinosum
Zizania latifolia

Rhamnus arrives on Waiheke

Rhamnus Alternus, a weed which is causing big problems on the cliff faces on Motutapu, has arrived on Waiheke.

Andrew Stein, Waiheke's pest control officer has found some well established samples of the plant growing along the Onetangi end of Seaview Rd, many of them looking as if they are being cultivated in ornamental native gardens. There are also samples of the weed along the beach front, some in Seventh Avenue, some halfway down the hill at the Ostend end of Sea View Rd and small plants growing at Matiatia.

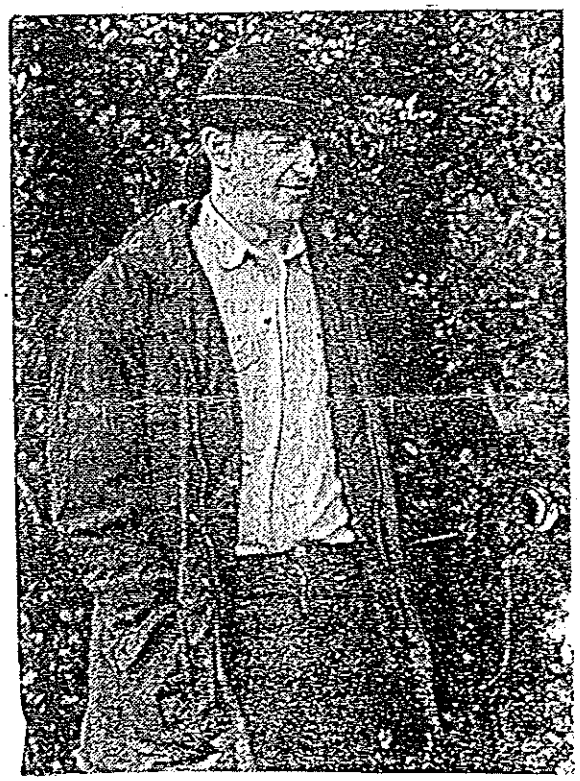
The problem with rhamnus is that it is shade tolerant and will invade native bush. It's place of origin is the Mediterranean and it likes a warm climate and can tolerate long dry summers. The Hauraki Gulf Islands provide it with an ideal habitat.

Drawings of Rhamnus Alternus showing the plant with flowers and with berries. The detail shows the male and female form of the flowers. The drawing was made by Catherine Beard for the Auckland Conservation Board.

Rhamnus has clusters of small red berries in November and December which are eaten by birds and spread in their droppings. There are male and female trees so not all carry berries. It typically sprouts under pohutakawa trees and the form of the bush is similar to karo or young pohutakawa. The leaves are dark green with slightly jagged edges. At this time of the year rhamnus plants have stems of green buds approximately one and a half centimetre in length. On Motutapu the largest specimens are six metres high.

It grows with a zig zag root which makes it difficult to pull out. If you just give a tug it snaps at the dog leg and sprouts again. To effectively get rid of the plant the whole root system needs to be dug up. On Motutapu conservation officer John Wotherspoon cuts the bigger trees down, painting their stumps with Escort.

According to Mr Stein, "there are so many weeds we have completely lost control of on this island, it would be good to get on top of this one while we can." Rhamnus has not yet been declared a noxious weed so he has no authority to ask land owners to remove it from their property. However he plans a public awareness campaign with samples of the plant made available for people to look at at the Forest and Bird stall at the Ostend market and at the Auckland City Council Waiheke Service Centre.



Pest control officer Andrew Stein stands beside a rhamnus bush in Sea View Rd.

Farm & Orchard

Ragwort control needs early spraying action

Ragwort spraying must begin now for effective control.

The Northland Regional Council is urging landowners to begin their ragwort control now, rather than be faced with a sea of yellow – and disgruntled neighbours next summer.

Noxious plants officer Ken Massey said the majority of landowners with a ragwort problem put a great deal of effort into control last year, with a large reduction of flowering plants.

He advises landowners to follow up with a winter programme of spot spraying using 24D; and better pasture management to control the invasive pasture weed.

Target

"We will be targeting specific ragwort prone areas with a campaign of education and advice, followed by inspections and warnings if necessary," Mr Massey said.

"Legal action can be taken against those who fail to take steps to control the weed.

by TRACY DALTON

"We can enforce the control of ragwort within 50m of any boundary, on land prone to flooding, within 50m of a river or stream greater than three metres wide and around quarries and gravel pits.

"There are definite economic benefits for farmers to get rid of ragwort.

"Ragwort can cover large areas of ground which should be productive pasture, and it has a debilitating effect on stock which eat it.

Productive

He said ragwort free farms are generally more productive and prosperous.

Winter spraying is effective and ensures there are no seeds to produce future generations of the noxious plant.

The annual plant usually germinates in April and May, and flowers in December.

The weed is effectively controlled with 24D which is a cheap and effective method at this stage, and has less impact on clover and other pasture plants than other herbicides.

Once the plant has developed a flower head, or has become multi-crowned due to disturbance or inadequate spraying, treatment with Escort, Tordon 50D or Tordon granules will be needed.

Bio-control

The council will accept bio-control methods such as the flea beetle once the ragwort is eradicated from within 50m of the boundaries, but this is a long term method that can be used once the ragwort has little chance of spreading onto neighbouring properties.

Mr Massey is happy to answer queries from landowners who want any advice on killing ragwort.

He can be contacted on 09 4384639 or 025 943490. Free pamphlets are also available at Far North District Council service centres.

Northland Regional Council noxious plants officer Ken Massey in a ragwort infested paddock near Kaikohe. He said neighbours can become very irate when ragwort spread onto their property.

Ragwort Biological Control Project for the Auckland Hunua Ranges — MICHAEL WHITE

Perhaps the largest single unit bio-control vector rearing and release project attempted has commenced in the Hunua range south-east of Auckland.

Enclosures to rear both cinnabar moth and ragwort flea beetle are being constructed.

The project envisages releasing between 30 and 50 establishment colonies of both predators annually in ARC parklands, bush areas and private exotic forest areas.

Retaining Control of a Ragwort Bio-Control Programme

The publicity which will be generated for the above project brings with it the opportunity for abuse (or at least misuse) if rules are not clearly established. Bio-control could be used by some as the soft option!

If random, haphazard and unofficial releases occurred, difficulties can be foreseen.

The Hunua project is entirely aimed at non-agricultural land - no releases will be made on any farm land although in time releases could spread from adjoining non-farmland properties.

The aim is to target land where conventional control is impractical.

We see the following points as being important and would appreciate any input by members with bio-control experience.

1. Only official project release sites will be recognised for District Programme Control requirements.

2. Official release sites will be given an "evaluation exemption permit" for a specified period probably four or five seasons. If the colony has not established satisfactorily, the permit could be revoked.

3. The whole property would not be exempt from the normal District Programme requirements Only an area of 200 metres around the release sites would be exempt for the first three years.

4. Only ARC, Landcare Research and NPO's would be permitted to collect and release vector colonies.

5. It would be made very clear that until the vectors were well established and widespread in the district, no private or unofficial releases would be recognised by the District Control Programme.

6. The evaluation exemption permits would not necessarily be transferable with the sale of the property and discretion would remain with the project controllers.

7. All release sites would be noted on a LIM with the Council land records to minimise the chance of any site destruction.

The project "drivers" - the Manukau City Council Noxious Plants Officers would be grateful for an additional thoughts - please fax (09) 262-5155.

BROOMSEDGE

Andropogon virginicus

Broomsedge was found in the Rodney area in 1987.

A specimen sent to the former D.S.I.R. was positively identified as Broomsedge (*Andropogon virginicus*), a perennial and widespread serious pasture weed in parts of the United States, the West Indies and South America.

Broomsedge is an erect grass-like plant growing in small clumps, with little resemblance to Broom.

Juvenile plant leaves are pale green, some with a light silver streak. As the plant matures the leaves become reddish-brown.

Plant growth is rapid from germination to seeding.

Slender stalks support seed heads which expand to form a downy inflorescence.

Ripe seeds appear to fall within close proximity of the parent plant. Viable seeds may remain dormant for some time.

Broomsedge is a persistent invasive plant which germinates in spring and autumn and is difficult to identify among other grasses during the juvenile stage.

Broomsedge is controlled by **GLYPHOSATE** plus the addition of **METSULFURON**.

"P.S. ALSO KNOWN AS WHISKEY GRASS" IN AUSTRALIA
E.D.

Researched by
DES TRAFFORD

FIGURE 17.—*Andropogon virginicus* L. Broomsedge. *A*, Habit—× 0.5; *B*, ligule (left, opened; right, compressed as in nature)—× 2.5; *C*, inflorescence—× 2.5; *D*, florets—× 7.5.

PREFACE

WILLOW WORKSHOP
WAIKATO CONSERVANCY – 24-26 NOVEMBER 1993

Willows were introduced into New Zealand in the 1840s and are now our most abundant and widespread exotic tree after pine trees. Planted originally for river bank control they are now widely distributed through mineralised wetland systems with two species in particular – crack willow and grey willow – posing a major threat to the integrity of these wetlands. Crack willow is vigorous in mineralised wetland and has the potential to overpower native species, while grey willow is a potential invader of acid peat bogs – a habitat which is inhospitable to most introduced plants.

Willows are the highest profile conservation weed in the lower Waikato and are a particular problem in the Whangamarino Wetland, which is listed with the International Union for Conservation of Nature and Natural Resources as a "Wetland of International Importance" under the "RAMSAR" Convention.

In addition to their impact on natural wetland values in the Whangamarino Swamp, willows provide homes for possums, even during periods of high water, and thus contribute to the TB threat to surrounding farms. While the raising of water levels in the wetland through construction of a weir has met with some landowner opposition, the Department of Conservation and neighbouring landowners all agree that urgent measures are needed to control willows.

Waikato Conservancy, the "Wetland Centre" of New Zealand, was therefore very pleased to be able to host this willow workshop and to contribute to the valuable exchange of ideas and experiences about willow control which ensued. An overriding conclusion of the workshop was that while control of the nuisance species is possible, it is costly to achieve and will be an ongoing challenge for wetland managers. Unlike in the North Island, grey willow is not yet a major problem in the South Island and the message is "Get it before it gets you!" WISE WORDS !! ED.

These Proceedings provide a very useful compilation of willow ecology, history, effects, and use as well as description and evaluation of the available control strategies. They are recommended reading for all who wish to tackle the willow problem.

Stella Penny
Regional Conservator
Waikato Conservancy
Department of Conservation

1. INTRODUCTION

Two species of willow – crack willow (*Salix fragilis*) and grey willow (*Salix cinerea*) – frequently have an adverse impact on wetter areas of the Conservation Estate, e.g., wetlands, rivers and lake margins. Large sums of money and large amounts of time are spent by each Conservancy on willow control. Control methods vary from one Conservancy to the next and the success of control efforts is often variable.

The aim of this willow control workshop was to bring together staff from the Department of Conservation to pool their knowledge on willows and their control. To assist the Department in gathering a corpus of information on willows in New Zealand, a number of external experts were invited to present papers and participate in discussions. These experts provided valuable perspectives on the history, extent, biology, ecology, and control of willows in New Zealand.

The first lesson learnt by workshop attendees was that "pussy willow" is actually grey willow, the commonest of the broad-leaved willows in New Zealand. The name "Pussy willow" has been applied to a number of species and hybrids by different people. So, we should all change to using a less confusing common name.

A group of speakers dealt with the effects of willows on different ecosystems. Willows are beneficial in a wide range of situations, e.g., as bank stabilisers; as habitat for birds; as a canopy beneath which regeneration of natives can occur. Conversely, willows are detrimental in an equally wide range of situations, e.g., as silt traps; as cover for predators of native birds; as invaders of native vegetation. The information presented by these speakers will enable managers to judge whether willows at any single site are having a beneficial, neutral, or detrimental effect on conservation values.

A second group of speakers dealt with willow control. Thus, having determined that the willows at a site are indeed detrimental, what is the most effective means of control? Here, we can acknowledge that the Department has some expert willow killers. Effective control of willows requires a good understanding of the biology of the species combined with a good knowledge of control methods. Control methods used depend on the situation and the species. However, every willow control operation must be planned in detail and the plan will include adequate provision for operational and performance monitoring. Examples of willow control recording sheets from Twizel Field Centre are appended to this report (Appendix A).

The workshop ended with a forum session involving all participants in discussion of "the future – where to now?" A summary of the points covered is presented in section 14, but the essence of the forum was a heightened awareness of the need for thorough planning before any control operation is undertaken. The essential first step is to determine whether willows at a site are actually a threat. If so, planning proceeds according to willow species, site characteristics, budget etc.

It is hoped that the proceedings of this workshop will be as beneficial to those who read it as the workshop was for those who were able to attend it.

The editor,
Protech newsletter,

Dear sir,

I have recently encountered a number of situations where, apparently as a result of bird dispersal, Phoenix palms, *Phoenix canariensis,* have established in places where they are far from welcome in natural forest reserves. One very much in the public eye is growing strongly in close to the trunk of a pohutukawa opposite the Western Springs park in Auckland, quite visible as one drives past. Large old trees at the Waiwera Springs north of Auckland are have no doubt been shedding seeds for years, and Regional Parks staff including myself find specimens across the estuary in the Wenderholm Regional Park. The latest I have heard about is a well grown specimen up on the ledges of the seaward facing cliffs. I noticed that a quite young plant, less than a metre high, at Bastion Point, under a pohutukawa, already had something of the distinctive shape of this well-known species. A minute or so with a sharp grubber would no doubt deal with a young plant like that, and I am fairly confident larger plants could be killed with a few well placed drill holes and some strong herbicide solution squirted in. Someone may have already encountered this issue and have something to share about how they poisoned one or more of these.

I need no advice on the poisonous nature of the vicious spines, having seen several people suffering from nasty septic wounds that went on painfully for weeks, if not months before they healed. It might well be informative to ask doctors how often they have to attend to people who have had a bad encounter with the old, dry spikes at the base of phoenix palm leaves. These trees may have a handsome tropical appearance in old historic gardens, but they have noxious, or downright obnoxious, qualities that some people may need to be aware of!

Alistair MacArthur,
Resource Technician,
Auckland Regional Council Parks Department,
Private Bag,
Auckland

NOXIOUS WEEDS ON THE INFORMATION SUPERHIGHWAY

The internet has been on the news quite a lot lately, though generally in connection with hardcore pornography and explosives recipes. In reality the net is a lot more than that. To those that don't know the internet or "Information Superhighway" or "Cyberspace", is an information network that can be connected into through various computer systems or 'sites' throughout the world. These nodes collectively contain vast amounts of information and this information can be freely accessed by anyone with access to the net. Pretty much any information desired can be found relatively easily on the net with many of the sites being operated by large companies, e.g. NASA, Government Departments, eg United States Department of Agriculture, or Universities such as Oxford University Plant Science Department.

Recently I have been searching through the net for information and sites that could be of use to myself as a noxious plants officer. There is a surprising amount of information available, from chemical companies to general gardening tips, example sites are given below.

Aquatic - General Weed Guide Information to Aquatic Weed control, herbicides to use and biocontrol using both fish and insects. Also contains extensive tables matching weeds and herbicides (http://hammock.ifas.utl.edu/Text/Aquatic)

Weed Control Guide - Contains an introduction to weed control principles, equipment and techniques and control of weeds in specific situations. Includes many specific weed examples. (http://hammock.ifas.utl.edu/Text/Wg/51591.html)

Weed Science Society of America - Information on the Society as well as weeds and herbicides. Messages can be left for society members via email. (http://piked2.agn.uiuc.edu/WSSA/wssanetscape/)

Monsanto Home Page - Information on all aspects of Monsantos research and products, still being constructed but it mentions Round-up. (http://www.monsanto.com)

Biological Control Home Page - Information on Biocontrol of both insects and weeds. Good pictures of control of Purple lossestrite using Gateracella calmariensis and G. pusilla. (http://www.nysacs.cornell.edu/ent/biocontrol)

IFS/OFI WWW server at the Department of Plant Sciences, Oxford University contains all sorts of interesting information on plants including information on the weeds of the World Database project. (http://its.plants.ox.ac.uk/wwd)

Weed Science photo of the Week - This week integrated Pest Management trials in Georgia. (http://www.emr/efs/fpmi/weedjobs/weedfoto.html) and lastly

Job swaps available in Weed Science - Anyone like to be Noxious Plants Control co-ordinator in Ballarat, Victoria, Australia for T to 12 months. (http://www.emr.ca/cfs/fpmi/weedjobs/swapjob.html)

This is just a fraction of the information that can be found on the net. To explore any of these sites all you need is, a computer, modem (14.4K or faster), a program such as mosaic or netscape to browse the net and an account with a server such as Iconz (Internet company of New Zealand) or IHUG. (Internet Home Users Group). Iconz connection rates are approximately $8.00 per month and $8.00 per meg of information accessed, which in terms of text equates to 3,000 to 5,000 pages of data. To sum up in spite of all the negative news and comment that has appeared in the media recently the internet is a useful tool for gathering and disseminating information and may even be of use to us in our role as noxious plants officers.

Footnote: alt. entertainment.supermodels.Gifs

Extolled by
MICHAEL HARRE

DIESEL KILLS PARROTS FEATHER... for two weeks!!!

And that was a good result!

When 3000 litres of diesel spilled into a water way and coated several patches of parrots feather in North Shore recently, I thought that it would be some time before there would be any regrowth, if at all. Two weeks later a reinspection of the site made me think again. The previously brown and dead looking vegetative parts above the water already had green shoots on them 40mm long. Wow!! Who knows, maybe the plant thrives on a good soaking in diesel?!

The main concern with parrots feather is that its root systems trap silt and organic matter, resulting in raised water tables and flooding.

There are six major sites of parrots feather on the North Shore. Trials and regular spray applications have been carried out over the last eight years at three of these sites with eradication being successful in two cases.

So what **does** kill parrots feather?

Glyphosate at 200mls per 10L water and 20mls of pulse, using a low pressure wand with a solid cone tip to produce a medium sized droplet. Carefully wet the emergent leaf growth until a change in colour is noticed (due to the addition of Pulse).

Carry out this method of application 3-4 times from late October to mid February ensuring 50mm of growth is visible above the water surface before respraying.

This programme reduces the length of the stems depleting the plants food storage and eventually kills it. Any regrowth will most likely be the result of a plant or fragment of stem that was missed or did not receive a lethal dose of herbicide. Regular follow up inspections are essential with additional spray applications when required.

WHAT IS PARROTS FEATHER?

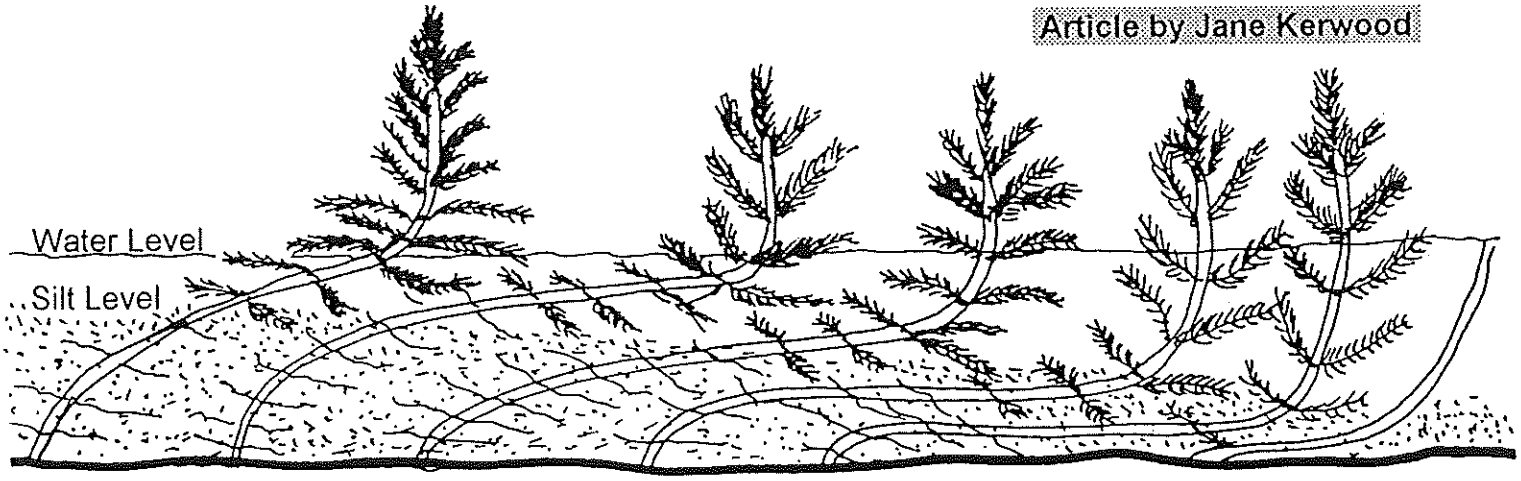
Myriophyllum aquaticum previously know in New Zealand as *M. brasiliense.*

An aquatic bottom-rooted perennial from Brazil growing in shallow freshwater with stems that emerge up to 250mm above the water. It has light to medium green, finely divided leaves larger than those of its close relative water milfoil.

New populations are easily formed by vegetative reproduction and stems readily become detached especially during floods or disturbance by machinery, animals or humans.

It is a troublesome weed in many parts of the world and has been found in scattered localities from Auckland to the Wairarapa and South Manawatu but is particularly common in Auckland and Waikato Provinces.

Article by Jane Kerwood



Drawing by Rod Smart

Aquatics in the Underworld.

Kelly Tarltons Underwater World now has another aquatic display in the foyer of the popular tourist attraction on Aucklands Tamaki Drive. Designed and put together by Craig Thorburn and Chris Hazard, staff at the Underwater World, the display comprises some of the fresh water aquatic plants causing problems in Auckland waterways.

With large numbers of tourists and locals alike passing through the complex, particularly school groups, it is hoped that this display will help people identify and be aware of some of the invasive aquatics found in the Region. On display are;

Water poppy *(Hydrocleys nymphoides)*
Egeria *(Egeria densa)*
Lagarosiphon *(Lagarosiphon major)*
and Parrots feather *(Myrophyllum aquaticum)*

It is hoped that some of the Regions other aquatics, such as Marshwort, will also be added to the display in the near future.

The display tank and plants just after completion with signage still to be erected.

In conjunction with the aquatic plants, Grass carp are also present in the display. The small number of these fish present are still consuming considerable quantities of vegetation, requiring replenishment of the aquatics on a regular basis, particularly the Egeria.

Aucklands Noxious Plants Officer, Clyde Edmiston, assisted Underwater World staff member Chris Hazard, in collecting specimen plants principally from Western Springs, while the Auckland Regional Council Environment is providing pamphlets which will be available to the public. Unfortunately permission to display the Class A aquatics was not granted by MAF, detracting from what would have undoubtedly been one of the focal points of the display.

PARASITIC PLANTS – MICHELE DICKSON, MAF.

Parasitic plants depend on their host plants to a greater or lesser extent, developing intimate attachments to their hosts through which they draw water, minerals and some of their carbohydrate requirements. Parasitism occurs in at least 17 different plant families, 8 of these important as weeds. Any parasite will have some detrimental effect on its host though this is very minimal in many cases. Those known as weeds can cause weakening, water stress and reduced yields in crops. Severe problems exist with the worst of the parasites, *Striga* spp (the witchweeds, not found in NZ) through semi-arid areas of Africa and parts of Asia, where cereal and legume food sources of rural communities are at risk.

In New Zealand parasitic plants are not much of a problem but worth an awareness. There are two introduced genera, *Orobanche* (broomrape) and *Cuscuta* (dodders). These are classified as weeds as they are overseas. In the native flora parasitic plants are represented in the families Loranthaceae with about 5 genera and some 8 or so spp and Balanophoraceae with a single species which is an endangered root parasite. The Loranthaceae members are mistletoes which usually attach to the host's branches and have chlorophyll enabling photosynthesis (semi-parasitic). All the native parasitic plants are endemic to N.Z., some being quite rare and protected while one is now presumed extinct.

The family Orobanchaceae has 15 genera and 150spp of which the most economically important weeds are a few spp of *Orobanche*. They are mostly found in temperate and subtropical Eurasia and North Africa with a host range from annual herbs to trees. An *Orobanche* plant lacks chlorophyll and attaches to the host's root with a short underground swollen tuber. *Orobanche minor*, the only species in NZ, is well established and naturalized. It is a perennial with a thick stem 10-60cm high rather like an asparagus spear with snapdragon-like flowers coloured yellow and purple developing on the upper part of the stem. It flowers from August to January and develops capsules 6-9mm long containing numerous tiny seeds .2-.3mm. One capsule can contain several thousand seeds which when germinating must find a host plant within millimetres for survival. It is a common weed on pastures and crops, roadsides, embankments, waste places and open cliff faces. It is important on clover. For other hosts in NZ see Vol. IV of the flora. For a photo, see Weeds of Lawns, Pasture and Lucerne in NZ, R L Taylor 1981.

The genus *Cuscuta* (belonging in the Convolvulaceae or the separate family Cuscutaceae) has about 170 spp which have a widespread distribution. In NZ there are 4 naturalized spp, the most common being *Cuscuta epithymum* which is fairly widespread. It grows mostly on legumes, especially clover but has a wide range of hosts including bracken. See Vol IV again. For a photo see Taylor (as above) p31. A lesser found species, *C. campestris* is a host of carrot, sugar beet crops and *Calystegia sepium*. None of the dodders are seen as often as *Orobanche* in NZ. These *Cuscuta* spp are annual or perennial herbaceous rootless parasites with thread-like, mainly cream-yellow, twining stems which coil round and attach to the host's stems often forming a dense mass on the host plant. They lack practically any chlorophyll. The flowers are small, white to pink or yellowish. The fruit is a globose capsule, splitting open to release 1 to 4 seeds (2-3mm long). The seeds of both Cuscuta and Orobanche can remain viable for many years and pass through animals unharmed.

Control measures for Orobanche and Cuscuta overseas are usually integrated, ranging from rotation of crops to herbicides, fumigation and biological control. Probably the most useful in NZ for troublesome areas would be hand pulling, prevention of seeding by mowing, grazing or harvesting the crop for silage. Fumigation with methyl bromide is listed as effective with *Orobanche*.

MAF prohibites the entry of any species of *Orobanche* and *Cuscuta* other that those here already and all species of *Striga* and members of the family Viscaceae.

OROBANCHACEA

(Broomrape Family.)

Broomrape (*Orobanche* spp.)

There are a number of species of broomrape which act parasitically on certain crop and pasture plants. They are mostly natives of Europe and the Mediterranean region. A species of broomrape has been found infesting some areas of subterranean clover in south-western New South Wales.

Broomrape appears above ground in October. The plants have thick, fleshy roots, brownish stems up to 18 inches high, no leaves and pale blue to purplish flowers. Large numbers of very small black seeds are produced which are easily carried as dust on subterranean clover seed (see Fig. 139).

It causes stunting, reduced vitality and diminished yields, the severity of the symptoms depending on the age of the host plant. Although the infestations in New South Wales have been chiefly on subterranean clover, it has also been seen on oats and skeleton weed.

Control

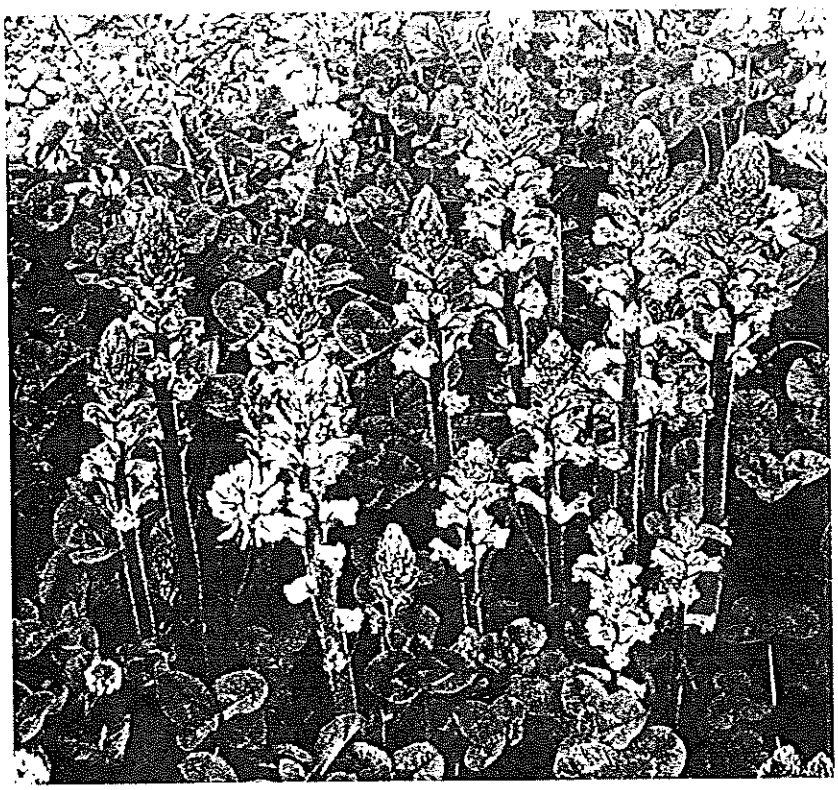
Cultivate affected areas just prior to the broomrape flowering. Spraying with a general contact herbicide such as sodium chlorate or power kerosene will assist to check this pest. To prevent the spread of this parasite, seed of clover or other short-growing crops should not be harvested from or near infested areas.

ex Weeds, the Farmers Handbook Series. Govt Printer Sydney 1962

BROOMRAPE *(Orobanche minor)*

Vertical stem about 1cm diameter emerging quickly from the ground like an asparagus spear, 10-60cm tall, height varying with the host species. Stem of light colour tending to yellow or purple. Flowers on upper stem. Each flower yellow and purple, the shape of foxglove flowers but much smaller, producing a multitude of small seeds. When seeds germinate, broomrape seedlings will quickly perish unless they can find a host plant root within a few millimetres. Germination depends on stimulation from roots of host plants. Broomrape is an important weed on red, white and subterranean clover, and on tobacco. It grows also on many weeds and ornamental plants.

About 100 species of the broomrape family grow throughout the world, many on one host plant only, but only one species is common in New Zealand. It is native to Eurasia. All members of the broomrape family are root parasites without chlorophyll, and are closely related to the snapdragon family.



Broomrape growing on white clover

ex R.L. Taylor – Weeds of Lawns, pasture & lucerne in NZ.

See also No. 113 in NZ Common Weeds in Colour
compiled E.A. Upritchard.

Orobanche minor J. E. Smith — CLOVER BROOMRAPE

Parasitic herb, reproducing by seeds (Fig. 170); *Stems* pubescent, pale yellowish-brown, 1–4.5 dm. tall; *Leaves* scalelike, the scales ovate to lanceolate, 6–20 mm. long, acute, sessile, without chlorophyll; *Spike* loosely flowered, interrupted below, continuous above, 1–2 dm. long, each purple-tinged flower in the axil of a basal bract; *Bracts* lanceolate, as long as the flowers or longer; *Calyx* pubescent, cleft before and behind almost or quite to the base, the lateral lobes often 2-cleft, lanceolate awl-shaped; *Corolla* glandular-pubescent especially along the back, irregular, the tube slightly curved, yellowish, the lips bluish with 2 rounded lobes, the upper lip erect or incurved, the lower lip spreading; *Capsule* oblong, less than 1 cm. long, 2-valved. April–July.

Parasitic on roots of clover and tobacco. Adventive and naturalized from Europe. Along the Atlantic coast from New Jersey to North Carolina.

Distribution of *Orobanche minor* J. E. Smith

ex: Selected Weeds of the United States
Agriculture Handbook No 366

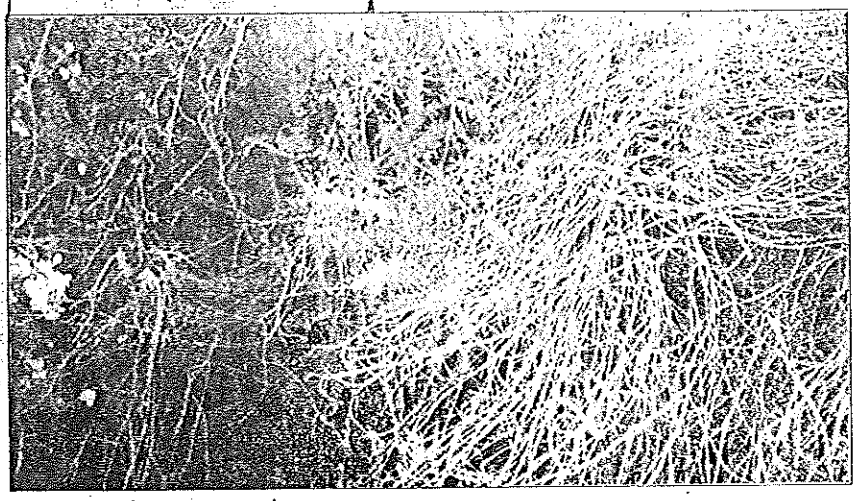
There are descriptions of several other spp in A California Flora - Munz & Keck University of California Press 1968.

0.—*Orobanche minor* J. E. Smith. Clover broomrape. *A*, Habit—× 0.5; *B*, enlarged flower spike—× 1.5; *C*, flower diagram—× 2.5; *D*, capsules—× 2.5; *E*, seeds—× 25.

NEWS

Far North Times Aug 3 1994

Native creeper spreading rapidly throughout Far North



TRAVELLERS throughout the Far North will have noticed a golden brown creeper plant growing over small trees and bushes along our roadsides that is so thick and dense in places that it is covering relatively large tracts of scrub with an impenetrable mat.

Called mawhai, this native is a member of the plant family Lauraceae, which includes other species such as taraire, tawa and mangeao. Known overseas as 'dodder,' mawhai's scientific name of *Cassytha paniculata* links the plant with fifteen other species of plants, all tropical, which are found as far afield as South Africa, Borneo and Australia.

Mawhai attaches to its host by suckers. Its leaves are reduced to minute scales, and its tiny flowers can be seen in September.

The stems of mawhai, which can grow up to three metres in length, form such a tangled mass that the unfortunate host plant looks as if it has been caught in the embrace of some crazed giant's beard.

Officially described as found on "North Island lowland scrub from North Cape to Ahipara and Mangonui," mawhai appears capable of severely inhibiting the growth of the plant it is growing upon. Common on gorse and teatree, this rapidly spreading native creeper might be one plant species that is capable of smothering gorse. Here's hoping.

BUT THE MEDICINE MAY BE WORSE THAN THE SUFFERING !!

ED.

MANCHURIAN WILD RICE - Zizania latifolia (Griseb.) Stapf

Concern

Forms dense stands in aquatic or semi-terrestrial situations. It can impede drainage, diminish land stability, destroy stopbanks, block drains, cause flooding, invade and deteriorate pasture, and, indirectly, diminish livestock production.

Description

A very tall, coarse, aquatic, perennial grass that has far-spreading rhizomes. This plant looks similar to raupo but grows somewhat taller, with the smooth culms growing to a height of around 3 metres.

The large glaucous-green leaf blades are course with wide, pale, smooth, striated sheaths. They reach 50 to 100cm in length and are 2 to 3cm wide. The hairless blades have very stout midribs and are linear, tapering to a sharp point at the tip. The sharply pointed ligule is whitish and is up to 3.5cm long. The leaves of Manchurian wild rice are usually erect but may bend over at the top without twisting, whereas leaves of raupo twist but do not bend.

The panicles are 40 to 60cm long, narrowly pyramidal and have long branches that are rough to the touch. These branches have a tuft of long white hairs in the axils. The lower branches spread outwards and bear mainly male flowers while the ascending upper branches have mainly female flowers.

Male spikelets are lanceolate, 8 to 12mm long and are usually purplish. They are sharply pointed or short-awned, have 6 stamens and linear anthers that are up to 10mm long. Female spikelets are pale green to chestnut brown in colour, linear, 18 to 25mm long and are very rough. The erect awns are 2 to 3cm long.

Spread is by birdborne and waterborne seeds, fragments of rhizomes spread by water, machinery and other human activities, and by large floating mats which take root to form new infestations.

It can grow in both fresh and salt water and has the potential to cause good land to become water-logged, forming swampy areas.

Manchurian wild rice was introduced to Dargaville from Asia in ballast, first being recorded as naturalised in 1906. It has since increased in abundance in the northern Wairoa River and has spread some considerable distance in watercourses in all directions from this initial site. It is not feasible to eradicate the heavy infestations but there are two known sites (Hauraki Plains and Horowhenua) outside of Northland where it should be eradicated before it spreads from these areas.

Prepared by
PETER JOYNT

MANCHURIAN WILD RICE - Zizania latifolia

A. INFLORESCENCE; X 0.25
B. PISTILLATE (FEMALE) SPIKELET; X 2
C. STAMINATE (MALE) SPIKELET; X 2
D. LOWER PORTION OF PLANT, SHOWING RHIZOMES AND "DAUGHTER" PLANT
E. HABIT

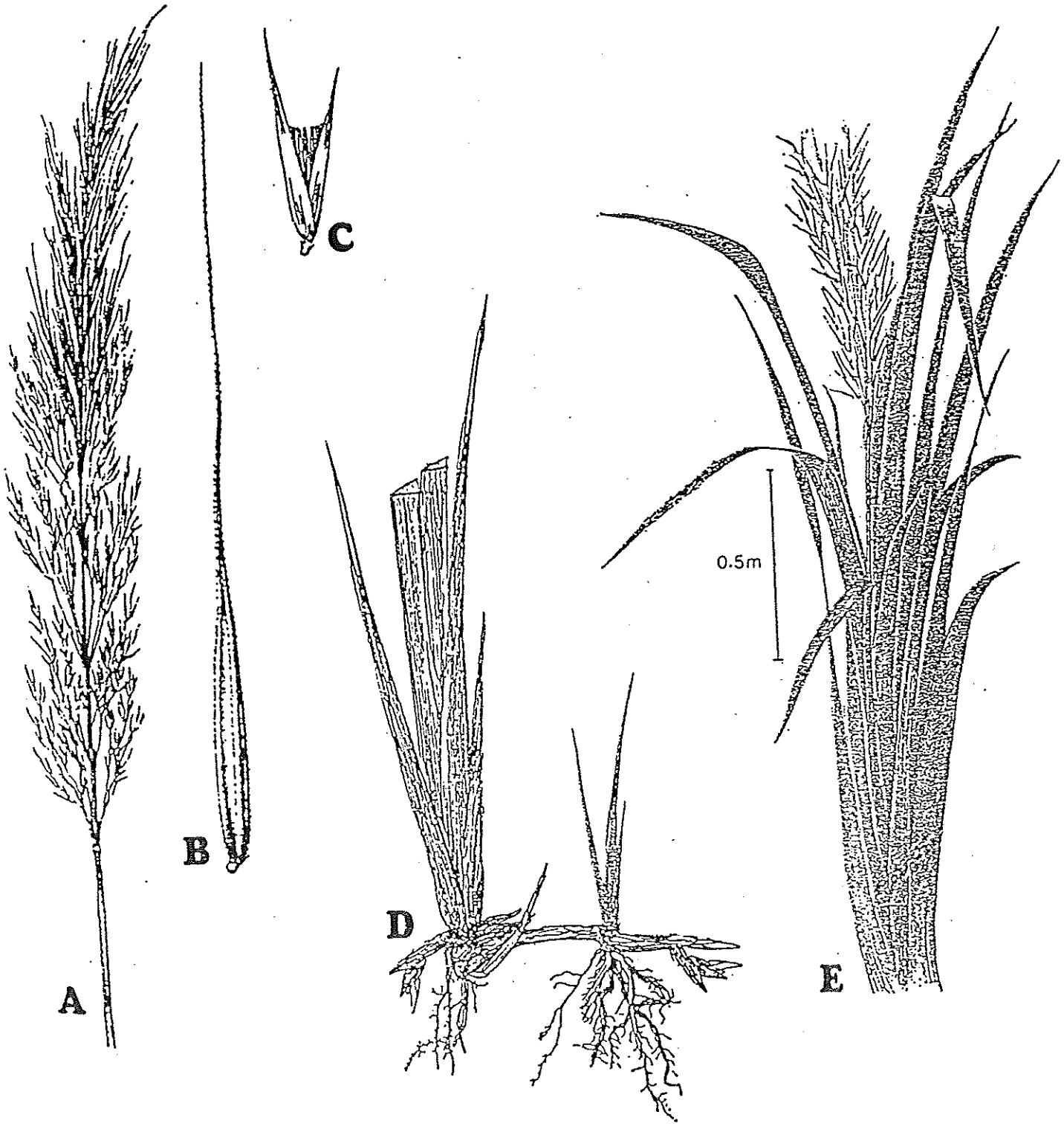


Illustration A-C courtesy of: The Botanical Institute of the Academy of Sciences - U.S.S.R.
E - courtesy of: Dr Peter Johnson, D.S.I.R.

MANCHURIAN RICE GRASS
(Zizania latifolia)

THE PLANT
2-5 metre tall coarse raupo-like perennial, with massive rhizomes (creeping underground stems). Forms impenetrable masses at waters edge, damp pastures and waste areas. Once established can move via its rhizomes into other land. Also spreads downstream by seed movement. Very common around Dargaville.

THE PROBLEM
Manchurian rice grass is almost totally unpalatable to stock and, as the tall dense growth replaces all other vegetation, production on infested land falls to nil. Drains and streams become blocked, raising watertables and causing flooding. Diggers used to clear drains (predominantly around the Dargaville area), can carry rhizome fragments into new catchments.

CONTROL
(In water or wet areas)
Currently no satisfactory control method exists. The plant responds poorly to herbicide treatment as the rhizomes are largely unaffected. Mechanical removal is usually impossible because the rhizomes extend downwards for many metres. In pasture, frequent rotary slashing gives temporary relief only.

At present our only option is to attempt to prevent rice grass from spreading via contaminated diggers. All landowners should enquire the previous whereabouts of diggers, draglines, etc, before allowing this machinery on to their land. If it has come from Dargaville or the lower Northern Wairoa/Kaihu catchments, then landowners should insist that machinery is thoroughly cleaned beforehand.

(On dry land only)
Chemical control can be obtained with repeat applications at 6-8 monthly intervals of either:

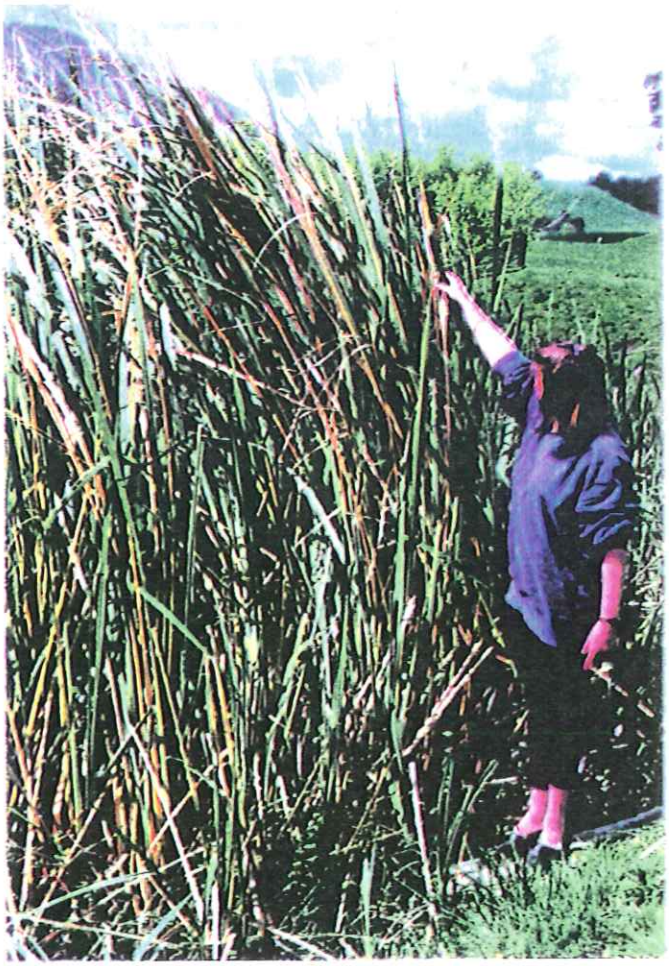
a. 1 litre Gallant + 1 litre Amitrole + 20 grams Escort + 100 ml Pulse in 200 litres water; or
b. 3 litres Glyphosate + 200 ml Pulse in 100 litres water; or
c. 1 litre Amitrole + 1.5 kilograms Dalapon + 250 mls Triton X45 in 100 litres water.

REMEMBER PREVENTION IS THE ONLY CURE

OCCUPIERS RESPONSIBILITY:
(This applies only outside of the lower Northern Wairoa area)
All infestations must be sprayed or otherwise controlled, at least once annually, to prevent seeding. Small infestations must be rigorously treated until eradicated.

AIM:
To contain Manchurian rice grass within the lower Northern Wairoa catchment and eradicate all other sites in Northland.

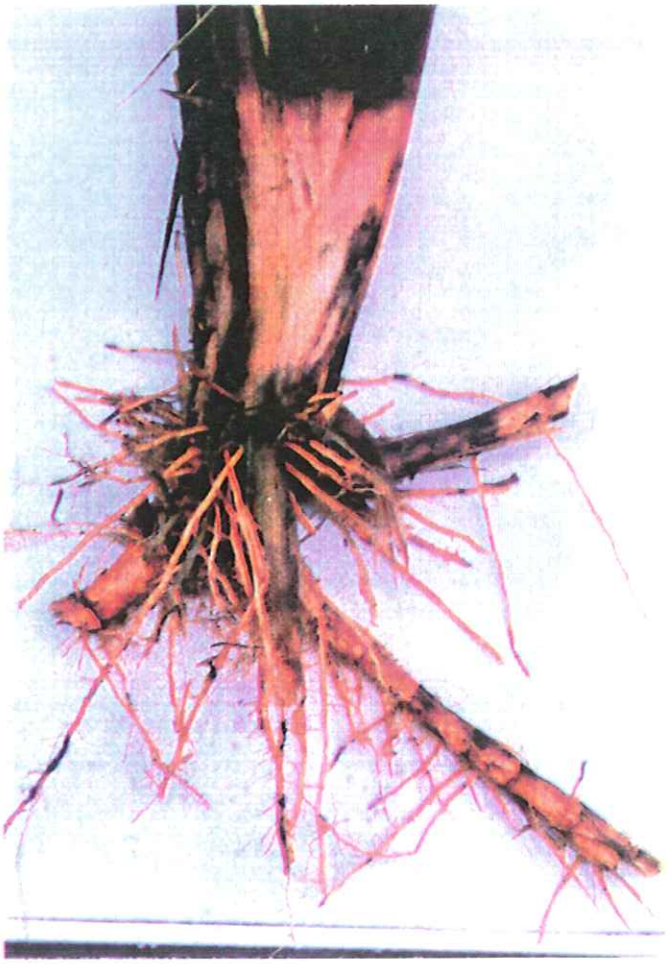
MANCHURIAN RICE GRASS



- Raupo or flax-like perennial
- Grows to 5 metres high
- Dull grey-green leaves
- Forms a dense mass
- Spreads easily by seed, root and underground stems

Take note of the tough grey-green leaves

Manchurian Rice Grass cannot be controlled by chemicals. Make sure that your digger is clean before leaving an infested area.



Take note of the large underground stems.

CARING FOR NORTHLAND
AND ITS ENVIRONMENT

NORTHLAND REGIONAL COUNCIL

All correspondence to be addressed to: Northland Regional Council, Private Bag 9021, Whangarei, Northland, New Zealand.
Whangarei: Quay Street and Robert Street Offices: Phone (09) 438 4639. Fax (09) 438 0012.

File: 840.5
CJC:CJC

16 October 1995

To: All Noxious Plants Officers via PROTECT

POISONOUS PLANTS BOOK

You may have seen a copy of the this publication, which has created a lot of interest amongst child care and education organisations in Northland and elsewhere. It has also satisfied a number of submissions to Pest Management Strategies on the subject of poisonous plants. The Northland Regional Council has now made the book available to other Regional and Unitary Councils at cost. Normally they would sell at $20 (incl. GST) but individual copies can be purchased at $12 and bulk orders at $8 (both incl. GST and postage).

If your Council wishes to personalise the publication with its own logo, foreword and list of Council functions, then I can arrange the printing plates to be altered and checked and the printing supervised. I am already doing this for Lance Vervoort at ARC Environment. We will not charge for this service, however the plate set-up would be at your expense (approx. $1500).

The conditions Northland places upon altering the book's format are as follows (bearing in mind that the publication is copyright):

1. Placing your Councils logo on the front cover alongside the Northland Regional Council logo, which can be made smaller. The Northland Regional Council" Caring for Northland and its environment" motto can be deleted if you wish.

2. Altering the Foreword so it is written and signed by your chairperson (or similar), but including a reference to Northland Regional Council as the publisher and thanking Northland Regional Council for allowing the book to be reproduced.

3. Swapping Northland Regional Council logo and information on the back cover with anything you wish to include.

Please send me any bromides and new scripts, preferably on disc (Word 6 or similar) and I will handle the rest for you. I am sure your Council would obtain great benefit from this initiative.

Yours sincerely

Jack Craw
Land Management Officer

DARGAVILLE: 61B Victoria St. Ph (09) 439 6662. Fax (09) 439 1562 • OPUA: Beechy St. Ph (09) 402 7516. Fax (09) 402 7510.
KAITAIA: 192 Commerce St. Ph (09) 408 1451. Fax (09) 408 1689.
ENVIRONMENTAL HOTLINE 0800 504 639

Poisonous Plants and Fungi in New Zealand

A guide for parents, schools and child minders.

Northland Regional Council
Caring for Northland and its environment

LANDOWNERS / OCCUPIERS.

REPLY SELECTION CHART.

To save you time in giving a smart reply to your Noxious Plants Officer please select one of the following replies.

(1) What is a Noxious Plants Officer anyway?

(2) It's been that way for years.

(3) I'll sell the bloody property and leave the problem to someone else.

(4) The other Officer said it was okay.

(5) P___ Off.

(6) When did they bring in this new Regulation?

(7) Everybody does it this way, why pick on me?

(8) You Officers are always costing me money.

(9) Bloody money-grabbing bureaucrats.

(10) The (a) Stock Agent
(b) Environmental Protection Officer | Select one
(c) District Planning Team

have been over the property and they didn't say that there was anything wrong.

(11) Haven't you Officers got anything better to do they annoy me.

(12) Well I never knew.

(13) Not another damn Council Officer, no wonder my rates are high.

(14) We did it like this in the ..... Regional Council
(enter name)

Why not here?

Please detach and hand to the Noxious Plants Officer.

==========

Dear Officer,

I acknowledge your anxiety concerning the noxious plants on my land and/or lack of a management plan covering same. Reply number (..) is repectfully submitted.

Yours faithfully.

Landowner / Occupier.

Sourced by
DAVE GALLOWAY

"THE GREAT ESCAPE" - INTRODUCTION TO BRIDIE FLEMING'S SCIENCE PROJECT

Public education is a primary function of "pest" control, particularly to the next generation of land owners, and in recent years, schools have started to show a greater interest in environmental issues, especially noxious plants and possum invasion. Many schools now include these topics for 6-7th form projects.

Some schools are even introducing the subject at intermediate level, and then encouraging pupils to enter their projects in school science fairs.

One such project was awarded 2nd place and was the work of Bridie Fleming, a 12 year old lass of Bruce McLaren Intermediate School, Waitakere City (extracts of her project are attached at pages A.....).

Although Council Noxious Plants/Pest Officers provide information to dozens of school projects during the course of a year, this particular project stands out for various reasons, namely:

(a) The chosen topic is less well known than noxious plants or possums.

(b) Incorporates statistical research.

(c) Provides useful researched information for local/regional councils.

(d) Presented in clear, precise format.

(e) Instructive to other pupils and adults.

(f) And of course, judged 2nd best project at the recent E.C.N.Z. sponsored science fair.

To put Bridie's project into perspective, Councillors should be aware that Council, is contracted to the A.R.C. Environment to control legally declared Noxious Plants. -At this point in time, the contract does not include "environmentally damaging plants" or "garden escapes".

There is however, a long list of plants currently being sold or propagated, escaping to cause damage in native habitats, including the Waitakere Ranges. Legally, Council's Noxious Plants Officers can only monitor and advise land owners on how to control these environmentally damaging plants.

Consequently the Institute of Noxious Plants Officers, and the Royal Forest and Bird Protection Society, have taken the initiative and developed a "Forest Friendly Award" to promote the voluntary removal from sale of 26 "environmentally damaging plants", and at the same time, rewarding those sellers who agree not to stock or sell them.

The "Forest Friendly Award" has a time span from 1/9/93 to 31/8/95 and is financed, promoted and policed by volunteers from both organisations.

Bridie Fleming's research project independently surveys the results of this initiative.

Possibly the most important message from the research is that Lantana, Jasmine and Mexican Daisy could quite well be the noxious plants of the future, in that they are already causing environmental degradation, have potential to spread naturally further

and are the most popular of the listed environmentally damaging plants presently being sold in garden centres.

RECOMMENDATION

1. That the information be received.

2. That Miss Bridie Fleming of Bruce McLaren Intermediate be commended on her foresight in environmental interests, thanked for sharing the results of her "Forest Friendly Award" acceptance survey, and congratulated in attaining 2nd place in the E.C.N.Z. sponsored School Science Fair.

Report prepared by Rod Smart, Senior Noxious Plants/Pests Officer

THE GREAT ESCAPE

Miss Bridie Fleming
Bruce McLaren Intermediate School
WAITAKERE CITY

THE GREAT ESCAPE

INTRODUCTION

Our native bush is being strangled to death by exotic plant species. Many plants become garden escapes. They escape across the countryside invading our native bush, smothering native trees and causing great damage. Efforts to persuade gardeners not to plant plants that are most likely to present these problems must be made. A Forest Friendly Award is presented to garden centres, nurseries and plant sellers who voluntarily decide not to sell invasive species that pose dangers to native bush.

However, not all nurseries and garden centres display the award certificate, and there is a greater need for conservation awareness.

The prospect of New Zealand's unique native bush being destroyed by foreign plants is horrifying. Yet people do not realise that the plants that are causing these problems are the same plants we admire in our own gardens. From where they escape with alarming frequency.

Some of the major problem plants have been around for many years, and are now out of favour with gardeners. Incredibly, others are still freely sold and promoted all over New Zealand.

WHAT KIND OF PLANTS ARE LIKELY TO CAUSE PROBLEMS?

1) Plants capable of self replication, by seed, rhizome, stem fragments, spores, corms, and other methods.

2) Plants are also capable of forming a dense community on their own without other plants in that area.

3) Plants that can spread their seeds far and wide by wind, birds, or water.

4) Plants that can grow in the shade easily and thrive in a number of environmental conditions.

The worst offenders are Old Man's Beard, Wild Ginger, Climbing Asparagus, Jasmine, Honeysuckle, Mile-A-Minute vine, and Lantana.

HOW PLANTS BECOME INVADERS OF THE NATIVE BUSH

Over the years, many species have been planted in gardens and for a variety of reasons have fallen from favour. Some have been dumped, others spread naturally but now they have spread into the native bush and along roadsides and rivers. The discarded plants don't go away; instead they are capable of spreading and multiplying.

Restrictions on the range of plants sold by nurseries did not sound like it could be good for business, and nurseries soon became unenthusiastic about the award.

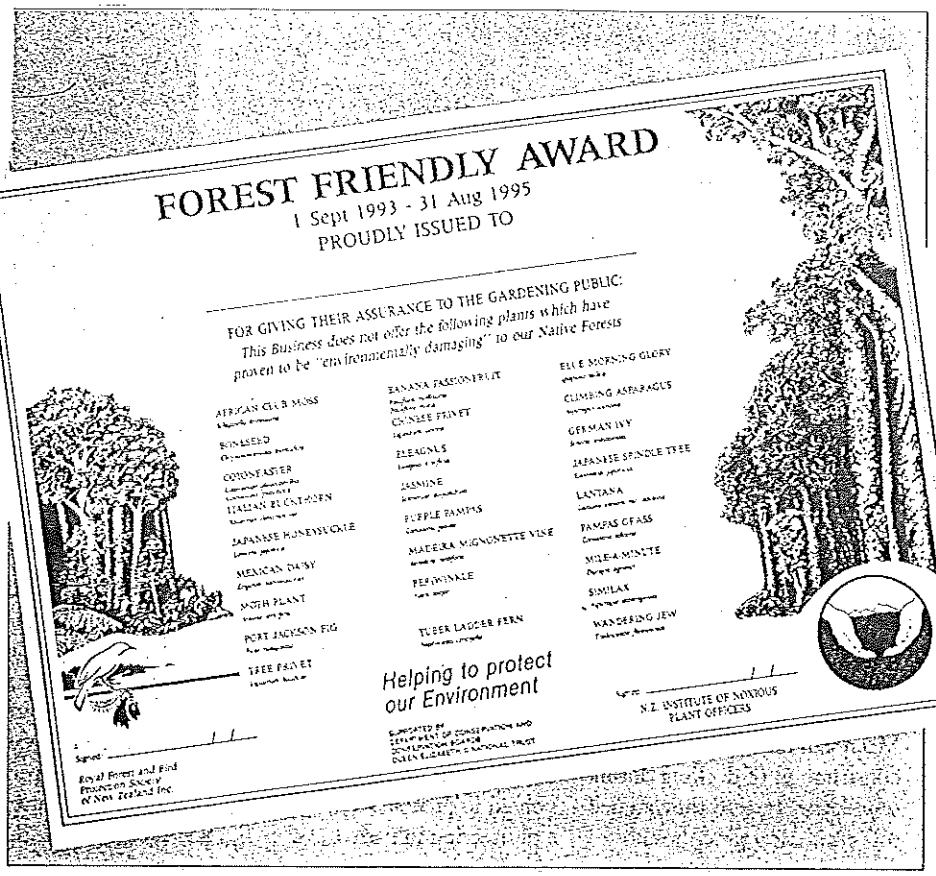
- It was obvious that if all the forest invasive species currently on sale were included that many of the plant sellers would definitely not be interested. To overcome this, it was decided that with some species a concession would be made:
  Sweet Pea Shrub
  Potato Vine (Soulanum Jasminoides)
  Monkey Apple (Acmena Smithii)

However, there was disagreement over two species in particular:

Mexican Daisy and Jasmine - both big sellers; both ecologically unacceptable.

HOW CAN YOU HELP TO STOP GARDEN ESCAPES?

1. Make sure discarded plants are destroyed properly.
2. Consider the possible environmental problems before purchasing these plants, even although they have been accepted through concession.
3. Don't buy any plants listed as a proven invader and destroyer of our native bush.
4. Buy your plants from a garden centre that displays a Forest Friendly Award.



Noxious plants officer Rod Smart wheels out a barrowful of listed plants plus Stephen Lightfoot, the manager of Browns Bay Mitre 10 Gardener in Auckland, as Forest and Bird executive member Claire Stevens looks on. Late last year Mitre 10 agreed to join the Forest Friendly scheme and the Browns Bay store was the first in the country to receive the award.

HOW THE AWARD WORKS

1) Every garden centre is visited by a Forest and Bird officer to explain the aims and advantages of the award.

2) A contract to cease selling or displaying the listed plants or their seeds for two years is then given to the seller.

3) If agreed, the contract is signed by both parties.

4) All plants on the list are removed from sale with no exceptions.

5) The garden centre is given local publicity.

6) The Award will last for two years to allow for any updating of the list.

7) One problem with the award is that uncooperative sellers could rename plants as to avoid a drop in their sales.

THE EFFECTS OF THE AWARD

1) The supply of invasive plants would decrease.

2) Gardeners no longer desire these plants due to adverse publicity, and get rid of them from their gardens.

3) People become aware that pretty plants can be environmental problems just like possums and rabbits.

4) Native plants are no longer competing with the exotic imported species.

FOREST FRIENDLY AWARD

FOR GIVING THEIR ASSURANCE TO THE GARDENING PUBLIC : THIS BUSINESS DOES NOT OFFER THE FOLLOWING PLANTS WHICH HAVE PROVEN TO BE "ENVIRONMENTALY DAMAGING" TO OUR NATIVE FORESTS.

AFRICAN CLUB MOSS
Selaginella kraussiana

BANANA PASSIONFRUIT
Passiflora mollissima

BLUE MORNING GLORY
Ipomoea indica

BONESEED
Chrysanthemoides monilifera

CHINESE PRIVET
Ligustrum sinense

CLIMBING ASPARAGUS
Asparagus scandens

COTONEASTER
Cotoneaster glaucophyllus

ELEAGNUS
Eleagnus x reflexa

GERMAN IVY
Senecio mikanioides

ITALIAN BUCKTHORN
Rhamnus alaternus var

JAPANESE HONEYSUCKLE
Lonicera japonica

JAPANESE SPINDLE TREE
Euonymus japonicus

JASMINE
Jasminum ployanthum

LANTANA
Lantana camara

MEXICAN DAISY
Erigeron karvinskianus

MIGNONETTE/MADERIA VINE
Anredera cordifolia

MILE-A-MINUTE
Dipogon lignosus

MOTH PLANT
Araujia sericifera

PAMPAS GRASS
Cortaderia selloana

PERIWINKLE
Vinca major

PORT JACKSON FIG
Ficus rubiginosa

PURPLE PAMPAS
Cortaderia jubata

SMILAX
Asparagus asparagoides

TREE PRIVET
Ligustrum lucidum

TUBER LADDER FERN
Nephrolepis cordifolia

WANDERING JEW
Tradescantia fluminensis

QUESTIONAIRE

Name:

1) Are you aware that many exotic plants escape from gardens and invade our native bush? YES NO

2) Have you heard about the Forest Friendly Award (FFA)? YES NO

If NO, go to 7.

3) Have you got a FFA on display? YES NO

If NO, go to 7.

4) Since you have been awarded the FFA, has it increased your sales? YES NO

5) Are you satisfied with the promotional efforts promised by the Departments that give out the awards? YES NO

6) Do you feel that the FFA is being taken seriously? YES NO

7) Do you sell:

- Climbing Asparagus
- Mexican Daisy
- Japanese Honeysuckle
- Jasmine
- Mile-A-Minute
- Japanese Spindle Tree
- African Club Moss
- Lantana
- Smilax
- Blue Morning Glory
- Periwinkle
- Chinese Ladder Fern
- Wandering Willie
- Migonette Vine

8) To solve this environmental problem, which option do you think will work:
   a) Make it illegal to sell these plants?;
   b) Voluntarily stop selling invasive plants?; or
   c) Give out FFAs?

HYPOTHESIS

Our native bush is being strangled to death by exotic plant species that escaped from gardens. These plants are being sold by many of our nurseries, and because of this, is there a greater need for conservation awareness?

METHOD

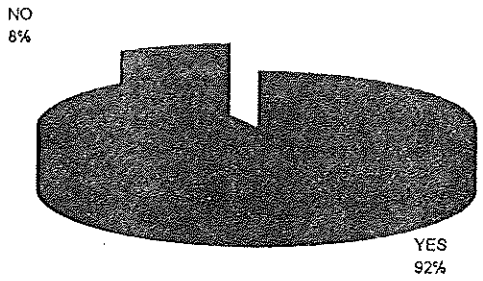
- Of the sixty eight garden centres and nurseries in the Auckland Yellow Pages that I rang, eight were not prepared to assist me with my questionnaire.

- Sixty garden centres and nurseries answered the telephone questionnaire on the Forest Friendly Award. In the case of chain garden centres like Palmers, each branch was rung because they varied in what they sold.

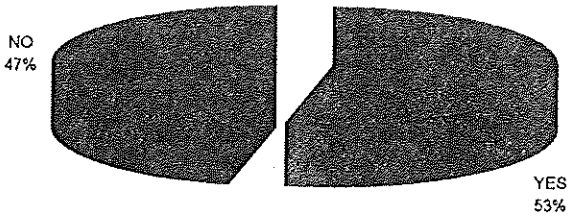
- I spoke with the Senior Noxious Plants/Pest Officer, Mr Rod Smart, from the Waitakere City Council.

Two major seed manufacturers, Yates and Watkins, also responded to a questionnaire on forest unfriendly plants.

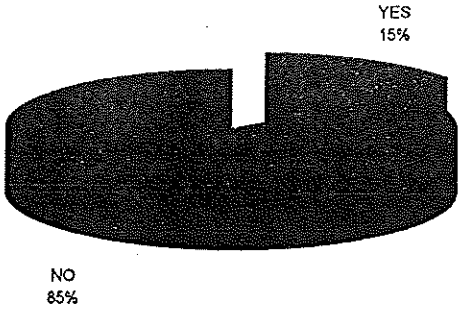
ARE YOU AWARE THAT MANY EXOTIC PLANTS ESCAPE FROM GARDENS AND INVADE OUR NATIVE BUSH?



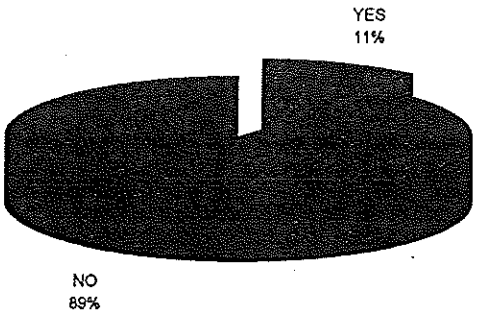
HAVE YOU HEARD OF THE FOREST FRIENDLY AWARD?



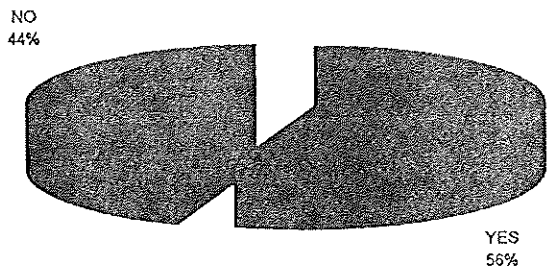
HAVE YOU GOT A FOREST FRIENDLY AWARD ON DISPLAY?



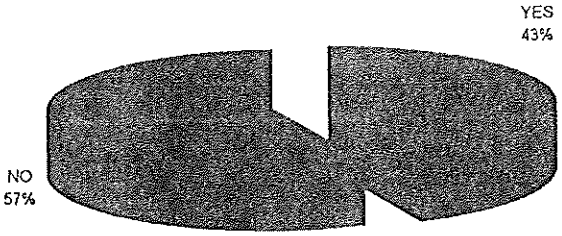
SINCE YOU HAVE BEEN AWARDED THE FOREST FRIENDLY AWARD, HAS IT INCREASED YOUR SALES?



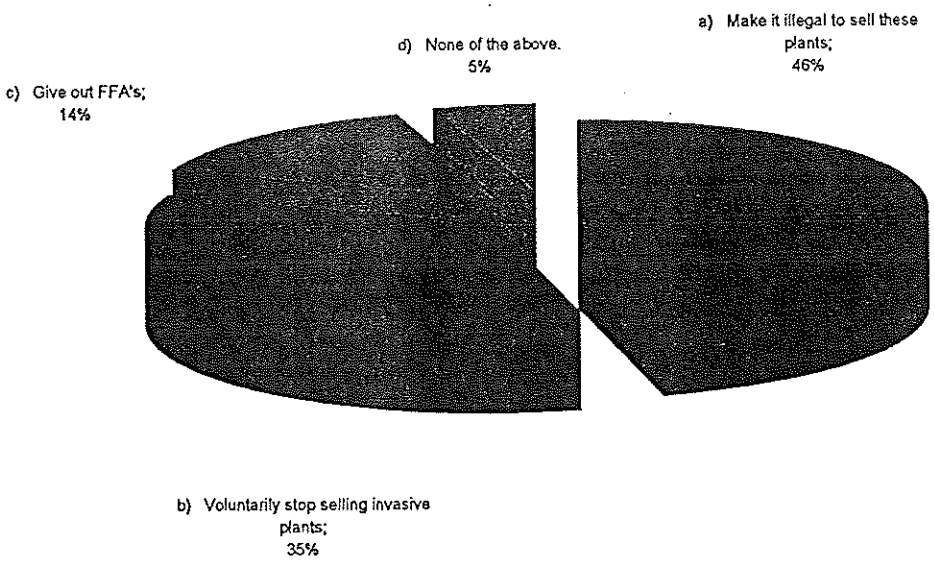
ARE YOU SATISFIED WITH THE PROMOTIONAL EFFORTS PROMISED BY THE DEPARTMENTS THAT GIVE OUT THE AWARDS?



DO YOU FEEL THAT THE FOREST FRIENDLY AWARD IS BEING TAKEN SERIOUSLY?



TO SOLVE THIS ENVIRONMENTAL PROBLEM, WHICH OPTION DO YOU THINK WILL WORK?



7. Sellers without the Forest Friendly Award were then asked if they sold some of the worst invasive plants. In order of popularity, the invasive plants sold were:

- 61% Lantana
- 53% Jasmine
- 35% Mexican Daisy
- 35% Periwinkle
- 25% Blue Morning Glory
- 18% Chinese Ladder Fern
- 16% Migonette Vine
- 12% Japanese Honeysuckle
- 12% Smilax
- 7% Mile-A-Minute
- 7% Climbing Asparagus
- 7% Japanese Spindle Tree
- 5% Wandering Willie
- 5% African Club Moss

All of these plants are currently on sale in New Zealand and are actually proven invaders and destroyers of the native bush.

8. To solve this environmental problem, 46% thought the option to make it illegal to sell the problem plants would work. 35% liked the idea to voluntarily stop selling invasive plants, whereas only 14% thought that to give out the Forest Friendly Award would work.

9. The answer to this environmental problem could be to legislate.

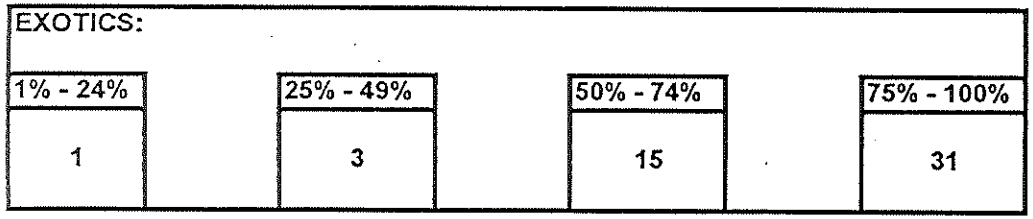
10. The Forest Friendly Award Scheme is only a step towards addressing the problems of garden escapes.

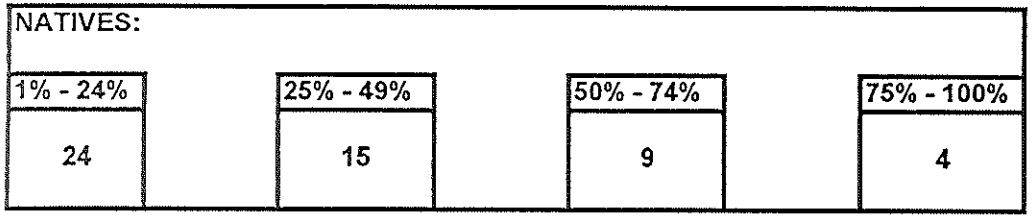
PERCENTAGE OF EXOTIC PLANTS TO NATIVES HELD BY NURSERIES

QUESTION:

COULD YOU PLEASE TELL ME WHAT IS YOUR PERCENTAGE OF EXOTICS TO NATIVES?

RESULTS:





CONCLUSION

1. Of the sixty eight sellers living in the Auckland region, sixty completed questionnaire. When asked if they were aware that exotic plants escape from gardens and invade the native bush, 92% answered yes.

2. The aim of the Forest Friendly Award is to increase awareness that some introduced plants are a serious threat to native communities. 53% of the sellers had heard about the Award. However, only 15% had an Award on display.

3. 89% of the sellers with the Forest Friendly Award felt that it had not increased their sales.

4. The promised benefits to the seller apart from self satisfaction was that it would increase custom because the Awards are being promoted nationally and locally on TV, radio, and in the newspapers. However, only 56% of the sellers with a Forest Friendly Award were satisfied with the promotional efforts.

5. The Institute of Noxious Plants Officers and the Royal Forest and Bird Protection Society think that a voluntary approach should be tried first. To encourage this, an Award to reward those sellers who do not sell these nasties has been introduced.

6. When asked if the Forest Friendly Award is being taken seriously, 57% did not think so. In fact one seller said "the Forest Friendly Award is a load of rubbish!".

11. Unfortunately legislative prohibition only comes after the species in question is well out of control.

12. Two major seed manufacturers, Yates and Watkins, currently sell proven invaders.

13. Some of the plants that are imported each year could end up as a garden escape. Importers and sellers are the only ones to benefit, leaving landowners, gardeners, and the environment to suffer the cost and long term consequences.

14. Virtually no controls on the importation of exotic plants exist, apart from quarantine regulations for various plant diseases.

15. Most New Zealanders have become more environmentally minded. Possums and rabbits taught us that lesson. In the future new exotic plant species arriving into New Zealand should include a full envirnmental impact assesssment. In that way potential problems could be kept out, keeping the great escapees behind bars.

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1) **Rural Garden;** 'Nurturing Natives', Dec.1994, page 21.

2) **Forest and Bird;** 'Keeping Our Gardens Forest Friendly', Feb. 1994, page 8.

3) **New Zealand Growing Today;** 'The Great Escape', April 1994, page 30.

4) **'A Guide To The Identification Of NZ Common Weeds In Colour';** compiled by E.A.Upritchard for the NZ Weed and Pest Control Society (Inc).

5) **Auckland Regional Council District Noxious Plants Programme.**

6) **Waitakere City Noxious Plants Information.**

7) **Royal Forest and Bird Protection Society,** 'Forest Friendly Awards', January 1995.

NEW ZEALAND SCIENCE FAIRS

Bridie Fleming

of

Bruce McLaren Intermediate

has presented a scientific investigation in the

Plants

1995

REGIONAL SCIENCE FAIR

for the Board

for the Organising Committee

NZASE
NZ Association of Science Educators

THE ROYAL SOCIETY of NEW ZEALAND

WAITAKERE CITY SCIENCE EXHIBITION

1995

2ND

SECOND PLACE

THE GREAT ESCAPE

BRIDIE FLEMING

AN E.C.N.Z. SPONSORED SCIENCE FAIR

ORGANISER: [signature]

MANAGER: [signature]

Younger, P. D.; Kapustka, L. A., 1981. Acetylene reduction (N_2 fixation) by *Alnus rugosa* (Du Roi) Sprengel and the allelochemic effects of *Populus tremuloides* (Mich.) in the northern hardwood forest. (Abstract). *Chio J. Sci., 81* (April Programme Abstracts): 23.

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CHEMICAL WELFARE IN THE FOREST
A Review of Allelopathy with regard to New Zealand Forestry.

PIERS MACLAREN*

ABSTRACT

Allelopathy is reviewed and shown how it could relate to New Zealand forestry. The author speculates that allelopathy may be a significant factor in the following areas: the "replant problem", our understanding of competition between plants, and in the ecology of natural forests.

INTRODUCTION

"Allelopathy" is the term used to refer to certain biochemical interactions between all types of plants, including micro-organisms. The chemical exudates or leachates which are released from leaves, stems or roots (living or dead) can have an inhibitory or a stimulatory effect on other species or on the same species. The word does *not* refer to *direct* competition for water, minerals, food or light (Molisch, 1937).

"A rapidly growing body of data suggests that allelopathy is often important in the survival and growth of trees in both plantations and natural stands. An awareness of this phenomenon, and its potential effects on regeneration and site productivity, is essential in the practice of intensive silviculture". (Fisher, 1980).

"Phenomena previously attributed to competition for light, moisture, or minerals should be evaluated with a cognizance of possible allelopathic effects." (De Moral and Cates, 1971).

"The evidence is obviously accumulating rapidly indicating that many important forest tree species exert allelopathic effects against either herbaceous species or woody species or both. Such effects can no longer be ignored in forestry." (Rice, 1979).

Allelopathy has been known (though not under that name) for a long time. For example, Pliny the Elder reported the toxic relation of walnut to other plants (Plinius, first century B.C.). In addition, allelopathy is well known in folk lore. The non-specialist would usually consider, however, that allelopathy is a minor phenomenon restricted to exceptional species. Black walnut

*Moonsilver Forest, R.D.1, Upper Takaka

(*Juglans nigra*) is one of the best known (Massey, 1925; Schneiderhan, 1927; Brooks, 1951; Bode, 1958; Fisher, 1978; Funk *et al.*, 1979). Only since 1970 have research projects revealed the extent and potential importance of this subject (Rice, 1979). For example, Whittaker (1970) states that "allelopathy is not a peculiarity of a few plants but a widespread and normal, although mostly inconspicuous phenomenon of natural communities". Perhaps allelopathy could be detected in *any* plant, at least in the laboratory, given enough intensive research?

There is now a considerable literature on many aspects of allelopathy, but this article concentrates on those areas of research that appear to hold the greatest importance for forestry in New Zealand, although work in other areas (such as in agriculture) is relevant because it may serve to highlight the principles and processes by which this phenomenon operates.

As a caution it should be added that many of the experimental data are in need of verification, and many of the possible implications in this article are only speculation.

1. THE REPLANT OR REGENERATION PROBLEM

Numerous workers have found that second-rotation crops do not always grow as well as the first (for example Savory, 1966; Fisher 1980). For radiata pine, this has been noted in Australia (Keeves, 1966; Bednall, 1968) and even in New Zealand (Whyte, 1973), (although the latter is not very pronounced). The cause is tentatively attributed to nutrient deficiency, but this may not be the whole story or even the main factor. The allelopathic explanation for Whyte's observations will be discussed further under "general observations".

Chu-Chou (1978) has produced evidence that water extracts of root residues of radiata pine inhibit seedling growth of the same species. Pickett and Baskin (1973) suggest that the decay of roots may release allelopathics. Patrick (1955) reported the replant problem for peaches, Woods (1960) for jack pine, Florence and Crocker (1962) for *Eucalyptus pilularis*, Maliszewska and Moreau (1960) for *Abies alba*, Webb *et al.* (1967) for *Grevillea robusta*, and de Bell (1971) for cherrybark oak.

In horticulture this could be of some considerable economic importance as the replant problem has been observed for apples, grapes, cherries, plums, peaches, apricots and citrus and allelopathy is implicated in most of these (Proebsting and Gilmore, 1941; Patrick *et al.*, 1964).

Poor regeneration has often been noted in areas of our native forests, and many intriguing explanations have been offered. It is often said, for example, that the forest duff provides some sort of physical obstacle to seedling growth. This could well be true, but Molloy *et al.* (1978) found that aqueous extracts of fresh kahikatea leaves produced 100% mortality in kahikatea seedlings. Leaf extracts of matai and totara were also shown to be toxic. As will be discussed later, the ultimate effect of these toxins depends on many edaphic factors.

2. ESTABLISHMENT PROBLEMS DUE TO "COMPETITION"

Auto-inhibition as noted above appears to be less common, not surprisingly, than inhibition between species. Researched examples of the latter are too numerous to relate, but a few examples will suffice. Brown (1967) found that leaf extracts of nine species inhibited jackpine out of fifty-six species tested. Del Moral and Cates (1971) found allelopathic agents in nine of forty species investigated. Matveev (1977) found allelopathy in most of 47 species examined. Timofeev (1979) found that most of the above-ground plant parts of 12 species of ground flora inhibited germination and seedling development of Dahurian larch. Horsley (1977a,b) examined regeneration failure in black cherry and ruled out the effects of browsing, microclimate and competition for light and nutrients. He deduced that allelopathic inhibition by fern, grass, goldenrod and aster was the main cause.

(a) *Grass "Competition"*

Radiata pine planted directly into pasture does not succeed well (Tustin *et al.*, 1979). This is normally attributed to competition, for moisture. But Pickering (1903) concluded that the pernicious effects of grass on apple trees were due to a direct poisoning effect on apple roots, as did Howard (1925). Spurr and Barnes (1973) report that grass extracts inhibit hybrid poplar growth. Naturally, we must specify which species of grasses we are discussing. It cannot be assumed that all grass species share the same allelopathic properties.

Wheeler and Young (1979) found that fescue chemically inhibited loblolly pine. Rietveld (1975) discovered that *Festuca arizonica* reduced germination and early growth of ponderosa pine. Walters and Gilmore (1976) observed that *Festuca arundinacea* chemically inhibited sweetgum. Hilgendorf (1948) describes this species as being "excessively common on the heavy lands

from Wellington up both coasts at least as far north as the Waikato, and it is very difficult to eradicate".

Not all the research favours allelopathy. Webb and von Althen (1979) report that couch-grass affected sugar maple seedlings by competition and not by allelopathy.

The word "competition" is used very loosely in forestry circles. For example, the NZFS handbook (1982) on forest farming research at Tikitere declares (on p. 3) that "the trees and pasture compete for moisture, nutrients and light". Let the authors of this document substantiate their claim. They, and others, should carefully contemplate these words by Muller (1969):

"There is in the botanical literature a singular paucity of proven cases of plant competition in the field for water or for mineral nutrients. Few students of such competition have ever felt obliged to demonstrate that biochemical inhibition was not causally operative in the apparent cases of competition they were studying".

This sentiment is supported by Rice (1974) who says that: "virtually none of the papers I have read, which purported to demonstrate some aspect of competition, has in any way eliminated allelopathy as a possible cause of the observed results".

The exact cause of observed growth reductions is not an idle academic point. To facilitate an effective and efficient cure, we must make an accurate and precise diagnosis of the complaint.

(b) *Bracken "Competition"*

Torkildsen (1950) prepared an extract of bracken roots with cold, distilled water and found that it killed or dwarfed Norway spruce seedlings. Del Moral and Cates (1971) showed that bracken litter chemically inhibited Douglas fir. On the other hand, Stewart (1975) found that extracts of senescent bracken reduced germination in two species of *Rubus* but *not* in Douglas fir! Also Brown (1967) found that the *best* germination of jack pine occurred with bracken extract, from 56 plants tested. Giessman and Muller (1972) showed that the phytotoxin was leached from dead fronds, but not from living ones. They suggest that allelopathy is often the limiting factor on the growth of associated plants, rather than competition as is commonly supposed. Bohm and Tryon (1966) identified some toxins in bracken and in many other common ferns.

The same species of bracken *(Pteridium aquilinum)* occurs in New Zealand, albeit of a different variety. Even after good burns, bracken roots are still alive and could be exuding phytotoxins

harmful to young tree seedlings. If this is correct, then perhaps there is a case for herbicidal pretreatment of bracken, rather than mere burning, even if bracken regrowth does not cause competition as such.

(c) *Heather "Competition"*

Calluna vulgaris is a common exotic weed of the Central Volcanic Plateau (Healy 1973), and colonises a site very rapidly after a fire. Is this to the detriment of radiata seedlings planted in a heather matrix? For *Calluna vulgaris* is known to inhibit mycorrhizae of various tree species (Harley, 1952, Handley, 1963; Robinson, 1972; Mantilla *et al.*, 1975).

(d) *Hawkweed "Competition"*

Dawes and Maravolo (1973) found that hawkweed (*Hieracium aurantiacum* L.) inhibits tree seedlings. Makepeace (1976), working in New Zealand, found that *Hieracium pilosella* also produces phytotoxins. He says that *H. pilosella* is a drought-tolerant perennial that has become increasingly common in high country short tussock grassland in the past 25 years. *H. aurantiacum* is described by Hilgendorf (1948) as established in parts of Canterbury and making headway in tussock grassland near Cass.

(e) *Effects of Lichen*

New Zealand has many species of lichens that grow on bare ground, often beneath a manuka canopy. It is a rare forester that takes an interest in such small, seemingly insignificant plants. And yet Brown and Mikola (1974) and Fisher (1979) found that reindeer lichen has a very toxic effect on key mycorrhizae of jack pine. Leibundgut (1952) observed similar inhibition of *Pinus sylvestris, Pinus mugo* and *Picea abies.* New Zealand shares three species of lichen with those researched overseas: *Cladonia alpestris, Cetraria islandica* and *Cladonia pleurota.* These are known to cause inhibition, but the former two are not likely to be found in places where exotic planting would be undertaken (Martin and Child, 1972).

(f) *Sphagnum moss*

We do not plant radiata in places where sphagnum moss grows: the soil is too badly drained. We do, however, collect this plant and export it. This is a rapidly developing industry on the West Coast of the South Island, and the NZFS is involved as it controls much of the suitable land. Brown (1967) observed

that *Sphagnum capillaceum* contained phytotoxins. The significance of this becomes obvious when we consider that the main use of sphagnum is a plant growing or packing medium. The moss is of proven worth for general purposes, but perhaps certain species of commercial plant may be especially sensitive to any phytotoxins present.

3. PLANTING IN MIXTURES

We may be satisfied that radiata pine is best grown as a monoculture. For black walnut or Tasmanian blackwood, however, a mixture may be more suitable. But perhaps before we decide on a given combination, we should be aware of possible allelopathic interactions.

Funk *et al.* (1979) reported the deleterious effect of black walnut (*Juglans nigra*) on various coniferous seedlings: Japanese larch (*Larix leptolepis*), Norway spruce, eastern white pine (*Pinus strobus*) and Scots pine (*Pinus sylvestris*). The first and the last were killed by concentrations of juglone as low as 10^{-4} M. Perry (1932) observed that black walnut was capable of killing *Pinus strobus* and *Robinia pseudoacacia* growing in its vicinity. Given this, it is curious that the Forest Research Institute, Rotorua, report that "*Juglans nigra* grows well in association with *Robinia*, according to the American literature. The walnut responds well to the nitrogen supplied by the *Robinia*". (Errol Hay, 22 November 1979, pers. comm.). The answer probably lies in site differences, as is discussed later.

Leibundgut (1976) describes growth gains arising from judicious mixtures of trees. Often the gain can be attributed to the nitrogen fixation of one species (such as *Alnus incana* or *A. glutinosa*) providing benefit to a more valuable tree (such as *Picea abies*). But how does one explain the fact that larch (*Larix decidua*) increased Scots pine growth by 13% (remember that allelopathy is defined to include stimulation as well as inhibition).

Moreover, it might be unwise to rely on nitrogen fixation. Younger and Kapustka (1981) found that the nitrogen-fixing properties of *Alnus rugosa* experienced a 56.4% decrease due to the allelochemic effects of aspen (*Populus tremuloides*).

Kolesnichenko and Audryushchenko (1978) found that *Larix sibirica, Pinus sylvestris,* and *Betula verrucosa* chemically inhibited Norway spruce. Kolesnichenko and Kryukov (1978) found that ten well-known timber species inhibited *Quercus rubra,* and three provided stimulation. Leibundgut (1976) found that six

common timber species inhibited germination in *Pinus sylvestris.* Tubbs (1976) found that leachate of sugar maple (*Acer saccharum*) roots significantly retarded growth (after only 24 hours) of four out of five timber species. Kruger (1963) found that western red cedar produced substances toxic to Douglas fir. Chumakov and Alcikina (1977) showed that leachates of fallen leaves of five common trees inhibited various others.

Perusal of the above literature makes it obvious (if it is accepted that the experiments are valid) that allelopathy is not restricted to a few eccentric species, but is a common phenomenon of many if not most of our commercial species.

Obviously, the number of possible combinations of tree species is vast, and only a small number of combinations have been investigated. The logical procedure would be to list the mixtures that are in use or proposed for use in New Zealand (for example: Douglas fir/larch, *Eucalyptus regnans*/radiata pine, *Eucalyptus nitens*/*Acacia melanoxylon*) and to test these for allelopathy. If this is not done the danger is that, unless allelopathy is suspected, reduced growth in a crop species may be erroneously attributed to some other factor.

4. THE NATURAL DISTRIBUTION OF PLANTS

Much effort is devoted to the questions: Why does a tree grow on a certain site? What does this tell us about the tree? About the site? What are the underlying causes of the patterns and processes observed in natural ecosystems? A familiarity with allelopathy may be a prerequisite for this line of research.

For example, Tobiessen and Werner (1980) report that hardwood seedlings do not grow under *Pinus resinosa,* but they do under *Pinus sylvestris* in spite of the former having a higher light intensity and nitrate level. Allelopathy is implicated. Muller (1969) and Whittaker (1970) declare that allelopathy has been demonstrated to be capable of altering the structure, function and diversity of plant communities. Rietveld (1979) describes these general ecological implications of allelopathy.

The definition of a "tolerant" species requires greater precision. If a "tolerant" species is one that grows under a forest canopy, one could ask "but which canopy?" And if an "intolerant" species fails to grow under its own canopy, one could ask "is autoinhibition present?"

Pickett and Baskin (1973) suggest that allelopathy can function to change the rate of plant succession, to determine the compo-

sition of a seral stage, and even to halt succession by producing a "chemical climax".

5. TWO-TIER FARMING

Encouraged by the success of the Tikitere trials, one might assume that two-tier farming would succeed even better with a species that cast less shade than *Pinus radiata*. A deciduous species (for example a poplar hybrid) would allow grass to receive more winter sunlight. Eucalypts cast less shade because of the vertical habit of their leaves. But perhaps allelopathy should be considered first. We have dealt with the effect of grass on trees, and now we will consider the effect of trees on grass.

(a) *Eucalypts*

Del Moral and Muller (1969) noted that *Eucalyptus camaldulensis* inhibited improved grassland species including *Bromus mollis and Lolium multiflorum*. These (especially the latter) are of great importance in our pastures. They noted that there was 64% of full sunlight beneath the eucalypts but only 45% beneath *Quercus agrifolia*, and yet there was more vegetation under the latter. Interestingly, soil moisture in the litter zone was equal to or higher than in the open area, a phenomenon they attributed to the effect of shading and mulching. It is also interesting that Story (1967) quotes two experiments performed with *E. camaldulensis* and pasture species native to Australia. One worker found no reduction in pasture production under this species, while the other found improved production. How does one explain this discrepancy? One explanation would be that the native Australian grasses have developed an immunity to the phytotoxins present, whereas the grass species present in Iraq (*vide infra*) have not.

Al-Mousawi and Al-Naib (1975) observed a pronounced paucity of herbaceous plants in planted forests of *Eucalyptus microtheca* in central Iraq. Investigations revealed that the reduction was not primarily due to soil moisture, nutrient elements and shading. On the other hand, leaf extracts, decaying leaves and soil collected under *Eucalyptus* canopies inhibited seed germination and seedling growth of associated species. The volatile inhibitors were the same as identified for *E. globulus* by Del Moral and Muller (1969). These two researchers found that the absence of vegetation beneath *E. globulus* could not be attributed to competition for essential resources. On the other hand, phytotoxins in fog-drip (similar phytotoxins as for *E. camaldulensis*) appeared to be capable of causing the observed effects. Grasses tested were *Bromus mollis, Lolium multiflorum, Bromus rigidus, Avena fatua, Festuca megalura*, and *Hordeum leporinum*. The first two were highly sensitive to the toxins and the last had greatest tolerance.

The variation in sensitivity of grass species could be of great importance for two-tier farming in a situation where allelopathy is an important factor in pasture suppression.

(b) *Poplars*

Evans (1981) suggests that poplars may (on fertile sites) be a better proposition for two-tier farming than radiata pine. But Del Moral and Cates (1971) found that *Populus trichocarpa* produced a volatile inhibitor, and Younger *et al.* (1980) found that freshly fallen leaf litter of *Populus tremuloides* had a phytotoxic effect on the grasses *Festuca elatior, F. rubra* and *Poa pratensis*. Curiously (in contrast to the previous section for eucalypts), and perhaps of economic significance, *Bromus inermis* and *Lolium perenne* were not affected.

(c) *Willows*

Brown (1967) noted that *Salix pellita* almost completely inhibited the germination of jack pine (*Pinus banksiana*). This may not tell us much about its relation to grass, but it does indicate that even the willow genus is not free from allelopathic activity. Kefeli and Turetskaya (1967) confirm this by observing allelopathy in *Salix rubra*.

(d) *Pines*

Lill and McWha (1976) found that vapour from decomposing *Pinus radiata* is inhibitory to white clover hypocotyl growth, to ryegrass (*Lolium perenne*) and, incidentally, to radiata seedlings. The toxic ingredient was ethylene. They doubted, however, that the effect would be detectable in the field. Chu-Chou (1978) discovered that *Pinus radiata* roots contained phytotoxins, but this does not mean that grass is necessarily affected. Jameson (1961) found that tree litter of Pinyon pine (*Pinus edulis*) was the major factor associated with reduction of blue grama grass (*Bouteloua gracilis*), and that tree cover as such did not influence blue grama or in some cases appeared to be beneficial. Lee and Monsi (1963) found that *Pinus densiflora* extracts markedly inhibited three species not usually found in pine forests.

(e) *Spruce*

Thomas (1974) found that aqueous extracts of blue spruce needles (*Picea pungens*) retarded or prevented seed germination or seedling growth of timothy, oats, wheat, barley and some lawn grasses. Titov (1971) describes continued studies on the growth of plots isolated from spruce roots by trenching and on untrenched plots. Results did not always support the idea that competition for water and nutrients is the main reason for elimination of grasses in spruce forests. Even when soil water and nutrients were maintained artificially at values optimum for the grasses, the spruce roots exerted an adverse effect on the grasses. Isolation from the spruce roots had a greater effect on the grasses than did fertiliser application.

(f) *Robinia*

Matveev *et al.* (1975) and Waks (1936) found that *Robinia pseudoacacia,* through allelopathy, caused a weak development of grass stands in the steppe zone of the USSR. This should cause people to pause who advocate a two-tier regime for *Robinia* for honey-production or for naturally-durable posts.

(g) *Black walnut*

The extremely high value of *Juglans nigra* is causing attention to be paid to the possibility of growing this on very fertile sites in New Zealand. Can we expect to graze profitably under these trees? I suggest that it probably depends on which species we choose for our pasture. Brooks (1951) recorded that juglone actually stimulated *Poa pratensis* growth.

(h) *Sycamore*

Al-Naib and Rice (1971) state that the failure of test species to grow under the canopy of *Platanus occidentalis* was not due to low minerals, water or light. On the other hand, decaying leaves, leaf leachate and soil collected under the sycamore canopy inhibited seed germination and seedling growth of many associated species. The latter included ryegrass (*Lolium multiflorum*) and *Poa pratensis*. Again, they noted that soil moisture was greater under the canopy at all sampling periods, than in the open.

(i) *Others*

Zolotukhin (1980) noted that Siberian pea-tree (*Caragana arborescens*) chemically inhibits couch-grass (*Agropyron repens*).

Jameson (1970) noted that the absence of blue grama grass under *Juniperus osteosperra* was due primarily to phytotoxins in the leaf litter. Buckenau (1883) and von Homeyer (1883) noted that grass in the early spring grew more luxuriantly beneath the spread of linden (*Tilia* sp.), beech (*Fagus* sp.) and maple (*Acer* sp.) than under poplar (*Populus* sp.), willow (*Salix* sp.) and birch (*Betula* sp.) due apparently to leachates from the various species. But were the leachates from the former stimulatory or were the leachates from the latter inhibitory?

Lodhi and Rice (1971) declare that "the failure of herbaceous species to grow well under hackberry (*Celtis laevigata*) was not due primarily to physical factors or to deficiencies in minerals, water or light". Del Moral and Muller (1969) suggest that the fog-drip from *Sequoia sempervirens, Pseudotsuga menziesii,* and *Cupressus macrocarpa* may be partially responsible for the striking paucity of herbs in forests dominated by these species. Oleksevich (1970) reported allelopathic activities in horse chestnut and fir. Podtelok (1972) found water extracts of roots of nine species of *Acer,* also *Quercus robur* and *Fraxinus excelsior,* were inhibitory. Corcoran (1970) reported allelopathy for carob (*Ceratonia siliqua*).

(j) *Discussion*

Note that with six species (*Eucalyptus camaldulensis, E. microtheca, E. globulus,* spruce, sycamore and hackberry) it was shown that competition occurring between trees and grass did not explain the reduction in grass growth. In fact the reduction could be explained wholly or largely in terms of allelopathy. It is therefore premature to explain reduction in pasture production under New Zealand two-tier regimes to the effect of competition. Competition may well be the correct explanation, but trials should be established to settle the point. Note that on page five of the Tikitere research publication previously quoted, one learns that "Ryegrass content of pastures is lower at higher tree densities; there has been no clear pattern of tree density on white clover". Why is this? Do radiata pine and white clover not compete, or is there a phytotoxin from the radiata which is selective to ryegrass?

Plants of the same species appear to vary considerably in their allelopathic potential (Putnam and Duke, 1974; Fay and Duke, 1977). Rice (1979) says "we are on the threshold of breeding crop plants that will inhibit the chief weeds in a given area through allelopathic action, and thus decrease the need for syn-

moisture regime". Howard (1925) showed that aeration of the soil stopped fruit trees dying of "grass poisoning". De Bell (1970) says that "in most cases where phytotoxins have been shown to be associated with decreased germination or growth, soils are characterised by heavy texture, poor aeration, excessive moisture and often cool temperatures. However, these are generalisations and certainly do not apply in all cases. Recent work by Muller has shown that different classes of phytotoxins persist optimally in different soil types."

(d) *Synergistic Effects*

Watanabe *et al.* (1961) discovered a 20-fold increase in scopolin in leaves of tobacco plants that grew in a boron-free solution for 38 days. Dear and Aronoff (1965) found a pronounced increase in caffeic and chlorogenic acids in leaves and growing points of boron-deficient sunflower plants. This illustrates a certain point: it may be naive to attribute poor growth in the Nelson district, for example, to either boron deficiency or to allelopathy. The latter could be caused by the former. It is nonetheless important to pinpoint the precise mechanism involved: applications of boron may be ineffective if the damage has already been done by allowing the accumulation of toxins in the soil.

Del Moral (1972) discovered that increasing water-stress in sunflower plants increased total chlorogenic acid in the roots, stems and leaves. But the greatest increase in chlorogenic acid resulted from a combination of drought stress and nitrogen deficiency: this gave a 15-fold increase. This finding makes one suspect that competition and allelopathy cannot be considered in isolation.

SUMMARY

This review has tried to demonstrate that a knowledge of allelopathy may be essential to all who seek to study the growth of plants. Perhaps only a fraction of foresters have even heard the word "allelopathy". This is not necessarily because the subject is unimportant, but is because the bulk of the research has occurred only in the last decade, and the principles have not yet filtered down to the applied sciences. This paper is an attempt to introduce allelopathy to New Zealanders working with forestry, and to highlight the areas where this knowledge may make significant differences in our attitudes. In particular, changes in our understanding of the "replant problem", competition between plants, and in the ecology of natural forests are postulated. It is suggested that allelopathy may be of vital significance in two-tier farming, especially if new species of tree or grass are considered. The actual implications of allelopathy can only be conjecture at this stage because New Zealand research in the field is as yet non-existent.

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thetic weed killers. Imagine a self-releasing radiata seedling! Alternatively, we may be able to breed strains devoid of any allelopathic action, and thus achieve the maximum potential for two-tier farming.

The situation, however, is by no means simple. There is evidence, as we shall see, that competition and allelopathy interact in subtle and complicated ways.

6. GENERAL OBSERVATIONS

(a) *Nature of the Phytotoxins*

The study of allelopathy is by no means limited to observing the phenomenon in the laboratory and in the field. A large number of phytotoxins have been isolated, and for many of them their mode of action is known or suspected. The following list indicates the scope of the phenomenon.

1. *Phenolic acids.* These have been isolated from a number of soils and plant tissues. Those believed to be associated with phytotoxic activity include *p*-hydroxy benzoic, gentisic, benzoic, salicylic, ferulic, and cinnamic acids.

2. *Aldehydes.* Salicylaldehyde was one of the first toxins isolated and is one of the most toxic. Other toxic aldehydes are benzaldehyde and vanillin.

3. *Coumarins* include coumarin, esculetin and scopoletin.

4. *Glucosides* include several of the phytotoxins of proven importance in woody plants. Juglone, the potent inhibitor of walnut, occurs as a glucoside in plant tissues which is readily oxidised to juglone upon contact with air. Amygdalin and phlorizin, constituents of the bark of peach and apple roots, are glucosides which yield toxic products following transformation or decomposition by soil microbes. These toxins are involved in problems of replanting fruit orchards.

5. *Terpenes.* Terpene compounds such as camphor, cineole and α-pinene may be involved in phytotoxic effects of certain woody plants in the Mediterranean climate of Southern California (de Bell, 1970).

(b) *Most Toxic Part of a Plant*

Del Moral and Cates (1971) analysed 40 plant species and concluded that chemicals leached from intact, living dicot leaves were, on the average, considerably more inhibitory than those

WHAT ABOUT WOOLLY NIGHTSHADE AND GORSE? ARE THEY POSSIBLE CANDIDATES? ED.

leached from either conifers or ferns. In nearly every individual case, litter extracts were substantially more inhibitory than leaf extracts of the same species. Matveev (1980) supports this finding.

(c) *Environmental Degradation*

Rice (1979) says that it is abundantly clear that if allelopathic compounds which are released into the environment were not decomposed, probably no plants could survive. Jameson (1970) says that "frequently inhibitors do not have any apparent ecological effect. If a small amount of material is deposited, or if the natural organic-matter breakdown processes proceed normally, little toxic material is accumulated. In some cases, however, material is deposited more rapidly than it is broken down, and species sensitive to these toxins are thereby influenced".

Rice (1979) continues: "although many species produce and release substances with potential growth regulating properties, few seem to have phytotoxic effects on other plants. The substances often do not persist long enough to accumulate to toxic concentrations . . . Under well-aerated and well-drained conditions may phytotoxins resulting from both plant excretion and residue decomposition are rapidly metabolised by micro-organisms into non-toxic forms".

This would certainly explain Whyte's findings that poor growth in some second rotation radiata pine forests occurred on the ridge tops and generally worse sites. (Whyte 1973). Whyte also found that ploughing the affected areas removed the problem, and in any case the effect disappeared given time (Whyte, 1982, pers. comm.).

If allelopathy is discovered to be a problem in two-tier farming, then this line of reasoning might act as a caution against restricting it to poor hill-country sites, rather than to the best soils.

Where drainage is poor the evidence is clear that phytotoxins accumulate. Del Moral and Muller (1970) say that "anaerobic conditions are not favourable to the metabolism of those micro-organisms responsible for the detoxification of phenolic compounds". Fisher (1978) confirms this by reporting that "on excessively drained sites, *Pinus resinosa* seemed unaffected by *Juglans nigra,* while on imperfectly drained sites walnuts suppressed or even killed the pines". In laboratory studies, he showed that juglone and its inhibitory activity readily disappeared under a "dry moisture regime" but remained under a "wet

BONESEED - A GROWING CONCERN

Chrysanthemoides monilifera ssp monilifera

Ever wondered why this plant is called boneseed ? No.? Then try crushing the black seed in your teeth sometime .

In fact, have you ever noticed this yellow flowering "daisy" shrub growing on, roadsides, beaches or cliffs?

If you haven't, then try looking in Kaitaia, Whangaroa, Whangarei, Hauraki Gulf Islands, Torbay, North Head, Orakie Cliffs, Thames, Hamilton, Whitianga, Gisborne beaches, Napier wharf cliffs, Wellington cliffs, Port Chalmers foreshores.

And of course, Australia, as far as the eye can see on coastlines from Sydney to Tasmania.

During winter months, a sea of glaring yellow requiring sunglasses to protect the beholders eyes. Fishermen often report a "yellow dust" (pollen) wafting off cliff edges into the sea, breathing becomes difficult (who made the comment about plant plankton blooms in the Tasman?).

Allelopathic studies confirmed Boneseed contains Chlorogenic acid which inhibits the metabolic processes of other plant species, enabling pure colonies to establish.

Here in NZ, Boneseed has been sold for many years, (although not popular) and these plantings have acted as seed sources for surrounding "open" areas. The rate of spread throughout NZ has been very slow compared to Australia, but don't forget that in Australia it was planted enmass for 20 odd years to stabilise sand dunes. Once established it rapidly spread throughout that area.

The same rate of spread is also happening on Hauraki Gulf Islands, even under a pine canopy, and now beaches in Gisborne and Napier. (Are there no Surfy N.P.O.'s down there)

The Australian and South African studies showed that Boneseed was "frost tender", so I take it that Dunedin is "frost free", particularly Port Chalmers, where I collected samples at the end of our last National Training Seminar.

Where have all the Australian sand dunes gone? The same way that many inland native habitats are now going.

According to Australian Authorities, in fact the Australians are so worried, they commissioned extensive detailed scientific studies and surveys of Boneseed and Bitou Bush.

Highlighted results are:

- Aerial survey of 650 km of NSW coastline showed 60% infestation in 1981-82.
- Easily controlled by Roundup or Escort, but can have seasonal differences in tolerance.
- Bioclimatic potential distribution of Bitou Bush/Boneseed throughout Australia (refer map).
- Biota Bush/Boneseed out competed native species for Phosphorus proving that after fires, native species will be displaced.

In fact this "plasticity" of climate and habitat range, from Kaitaia to Dunedin, has prompted this article and it is hoped that readers will keep note and report sitings of Boneseed to Regional Councils and samples to National Herbariums.

Don't forget, there is more than one species which may, or may not, be naturalised in NZ, but so far, the samples that I collected this August from Dunedin, Torbay, Piha and Kawau Island, where all confirmed to be *C. monilifera, ssp monilifera* by the Auckland Museum Herberium.

(It would be interesting to know which species are growing near you)

In summary, is Boneseed a growing concern? Can we learn from overseas experiences? Have we got enough lead time to do something now? And which Regional Council or Government Agency is going to make a start in recognising this "potentially" national weed?

Rod Smart
Acting Sub Editor

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Bitou bush

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(with supplement)
J. J. Dellow, Special Agronomist (Weeds)
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Bitou bush, *Chrysanthemoides monilifera,* also known as boneseed, was introduced into Australia in the mid 19th century from South Africa. It is a member of the daisy (Asteraceae) family. The earliest specimens were reported in Sydney in 1852, Melbourne in 1858 and Adelaide in 1892.

Bitou bush is now a declared noxious weed in Victoria, Queensland and South Australia.

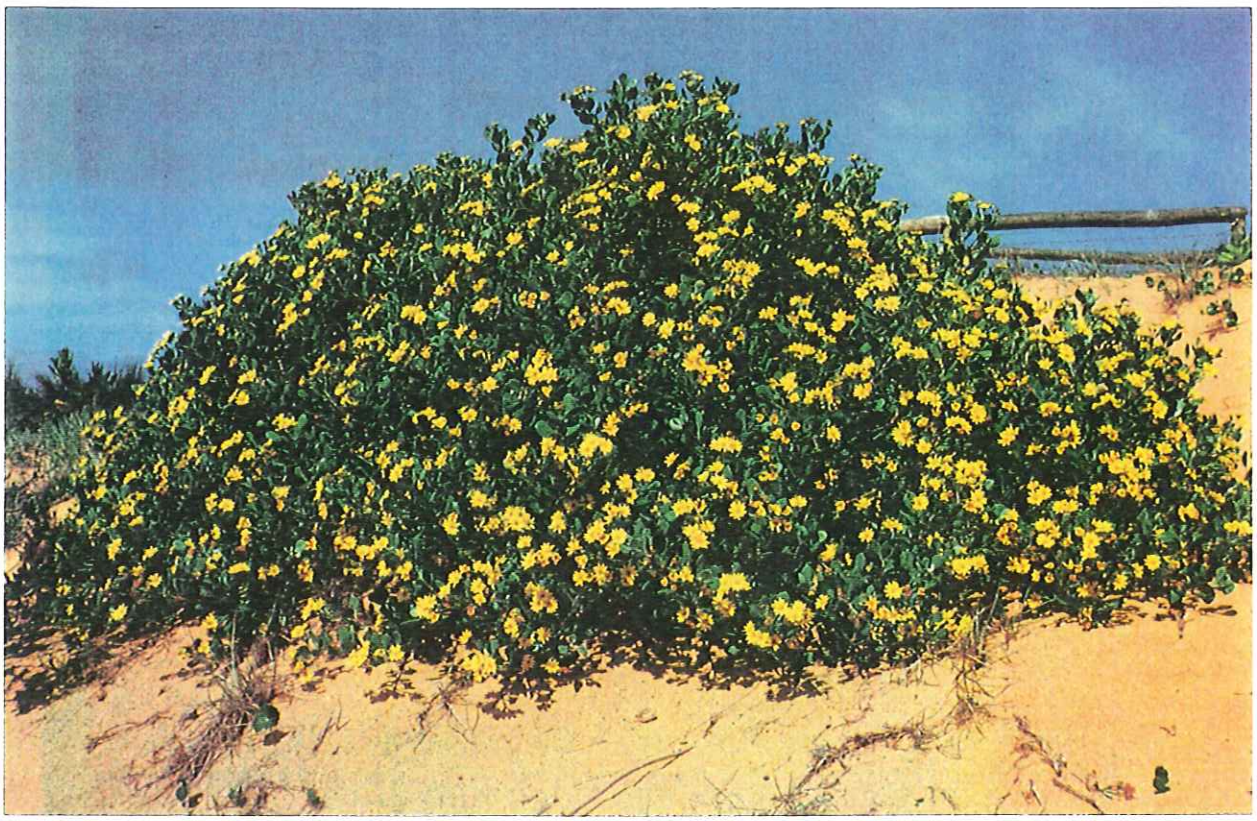
DISTRIBUTION

There are six subspecies of bitou bush in its native South Africa. Only two of these are present in Australia: *monilifera* and *rotundata.*

Subspecies *rotundata* is a large sprawling shrub occurring on the coastal strip of New South Wales and southern Queensland and on Lord Howe Island. It is the more common and widely distributed subspecies in New South Wales. (All the photographs show this subspecies.)

Subspecies *monilifera* occurs both in coastal and inland areas and is declared noxious in Victoria. It occurs to a lesser extent in New South Wales, South Australia, Western Australia and Tasmania. In New South Wales subspecies *monilifera* grows mainly in the Sydney area and on the south coast, and it has been reported in small infestations in western New South Wales at Menindee and Broken Hill.

A mature bitou bush 1.5 m high, showing the sprawling growth habit.



Order no. P7.6.16

Agdex 643

Flowers and fully formed green berries. The berries turn black as they ripen.

A seedling about 15 cm high. Leaves have a cottony down which disappears as the bush matures. At this stage plants can be pulled by hand.

DESCRIPTION

Subspecies *rotundata* is a perennial sprawling shrub which grows 1 to 2 m high and reproduces from seed. Subspecies *monilifera* is more upright and grows up to 3 m high.

Stems are woody, with many branches.

Leaves are alternate, ovate to lanceolate, and usually smooth-edged or only slightly toothed. They are pointed at the tip, 1.5 to 6 cm long and 0.7 to 2 cm wide. They are practically hairless, although young leaves have a cottony down. The leaves of subspecies *monilifera* are always toothed.

Flowers are 2.5 cm in diameter, bright yellow, and have 8 to 12 petals. They are clustered at the ends of branches, and resemble chrysanthemums (hence the botanical name *Chrysanthemoides*).

Flowering time: intermittently all year round; the main flowering is May to July.

Fruit: berries are spherical, 5 to 7 mm in diameter, hanging in clusters at the ends of branches. During ripening the green fleshy berries turn black.

Seeds are fleshy at first, but become very hard and bone-like in both colour and texture when ripe. They are globular or ovoid, 5 to 7 mm long and 3 to 4 mm in diameter. A mature bush can produce 50 000 seeds in one season.

Seeds of subspecies *monilifera* are rounded, being as broad as they are long—6 to 8 mm across.

Life cycle: seeds germinate at any time of the year, but mostly in autumn. Most seeds retain their viability for at least 2 years, with a small percentage remaining viable for up to 4 years. Subspecies *monilifera* has comparatively long-lived seed—4 to 5 years.

During the late 1950s and 1960s bitou bush was used as a secondary stabilising species on sand drift areas of sand dunes and on some areas mined for mineral sands where other stabilising species were thought unable to grow. The use of bitou bush to stabilise sand dunes stopped in 1971.

THE PROBLEM

Bitou bush is an excellent coloniser on bare sand dunes, stabilising large sand drifts. Unfortunately, it also competes very successfully with native species. In many places it has spread from its useful situation into natural bushland, becoming a serious weed.

Bitou bush has become a problem because:

- It produces seeds prolifically.
- It can flower and produce seed at any time of the year.
- Its outer seed coating is hard and some seed can remain dormant in soil for up to 5 years before germinating.
- It grows quickly and densely, shading other plants.
- The seed is covered with a fleshy fruit attractive to birds, which spread the seed into previously uninfested areas.

- Although bitou bush is palatable to domestic stock, they are rarely present in infested areas. Native animals either have no preference for it or there are not enough to keep it under control.
- It has no natural predators.
- It has an extensive tap and lateral root system enabling it to survive and compete very successfully with other species.
- Because it is succulent and fleshy, mortality from moisture stress is rare.

CONTROL

Bitou bush will not persist when grazed or trampled by livestock, or when cultivated. It does not appear to be a problem on land used for agriculture.

Pulling

Small plants can be pulled by hand, and large plants grubbed or pulled out by tractor. The shallower nature of the root system allows easier hand-pulling than most other woody weeds.

Ensure that most of the root system is removed with each plant. Slashing does not kill bitou bush as the plant quickly grows again from the cut stump. Plants pulled while seeding should be burnt to destroy the seed.

Bitou bush seed quickly germinates after mature plants are removed. It is most important to follow up by removing resultant seedlings before they produce more seed, preferably before flowering.

It is also important to replant competitive and desired species in the disturbed area.

Burning

In Victoria, burning from July to September has been useful in removing established plants (subspecies *monilifera*) and in improving access to areas to carry out seedling control the following season. Research has shown that fire stimulates almost complete germination of weathered bitou bush seeds in the soil.

Seedlings which establish after fire can be controlled by hand-pulling, or with herbicides near established native plants.

Using fire to stimulate seed germination has unfortunately not met with the same success in New South Wales on subspecies *rotundata*. Fire usually causes mature plants to re-sprout.

Herbicides

Bitou bush is easy to control with herbicides.

The herbicides registered are non-selective where used as large-scale spray applications. They are likely to affect non-target plants such as native species and other desirable plants competing with the bitou bush. The registered herbicides are best applied as spot spray applications to individual bushes or small infestations.

Herbicides must be used in an integrated control program. Make efforts not to harm desirable competing plants, and implement a program of re-establishment and stabilisation.

Refer to the chemical control supplement for details of registered herbicides.

Biological control

A joint project involving the CSIRO and the National Parks and Wildlife Services from each State is investigating the potential for biological control of bitou bush in southern Africa.

Photographs by the author
Edited by Evan Johnstone
Division of Agricultural Services

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D. pluvialis (L.) Moench — Cape Marigold

Annual herb to 20 cm high. Leaves decreasing in size up stem, oblanceolate, 1–6 cm long, 3–20 mm wide, margins very shallowly sinuate-toothed to entire, densely pubescent; sessile. Peduncles robust; heads 10–15 mm diam.; involucral bracts 12–18, 10–12 mm long, glandular-pubescent. Ray florets 12–18; ligules 15–20 mm long, white above, purple below. Disc florets numerous, yellow with purplish teeth. Ray achenes tuberculate, 4–5 mm long. Disc achenes with a broad-ovate, emarginate wing, 6–8 mm long. Flowers Aug.–Nov. Garden escape, grows in disturbed areas of the coastal Sydney area and in the Tamworth district. CC NWS; S.A.

137 *Chrysanthemoides*

J. A. Scott

Shrubs. Leaves alternate, flat, margins entire to toothed, glabrous to woolly. Heads broad-campanulate, in terminal corymbs or corymbose panicles, pedunculate; involucral bracts 2- or 3-seriate, unequal, herbaceous with narrow scarious margins, free, reflexed in fruit; receptacle slightly convex, naked, pitted. Ray florets 1-seriate, female, fertile, ligulate; style filiform with short obtuse branches, glabrous. Disc florets bisexual, sterile, tubular, 5-merous; anthers sagittate at the base, with terminal appendages; style short, branches vestigial. Ray achenes drupe-like with an outer fleshy layer surrounding a bony endocarp; pappus absent. Disc achenes abortive. **World:** 2 spp., E & S Afr. **Aust.:** 1 sp. (naturalized).

C. monilifera (L.) Norlindh — Bitou Bush, Boneseed

Sprawling to erect shrub to 1.5 m high, young growth finely tomentose to white woolly. Leaves alternate, 2–7 cm long, 1–3 cm wide, base ± attenuate, leathery with a distinct midvein. Heads usually 3–12 in branched terminal corymbs; corymb branches 1–3 cm long, finely tomentose with 2–5 reduced subulate leaves, 2–6 mm long; heads 10–20 mm diam.; involucral bracts acute, 3–6 mm long. Florets yellow, disc florets numerous. Fruit 6–8 mm diam., purplish black, ± succulent. Grows mainly in disturbed coastal sites. Native of S Afr. NC CC SC CT NFWP SFWP; LHI, Qld, Vic., S.A., W.A. [*Osteospermum moniliferum* L.]

Subspecies in N.S.W.

1 Leaves obovate to elliptic, 2–6 cm long, 1–3 cm wide, base gradually attenuate, margins toothed with often apiculate lobes; fruit globose to subglobose. Inner involucral bracts broad-ovate to lanceolate, usually with woolly and ± lacerate margins. Ray florets 4–8; ligules 7–14 mm long. Flowers Aug.–Dec. Serious weed in coastal vegetation and cleared land; naturalized south from the Sydney area and from Broken Hill to Dareton district. CC SC CT NFWP SFWP; Vic., Tas., S.A., W.A. Boneseed ..... a subsp. *monilifera*

1* Leaves broader than above, obovate to broad-obovate or broad-elliptic, 3–7 cm long, 1.5–5 cm wide, base abruptly attenuate, margins mostly ± entire or toothed; fruit obovoid to ellipsoid. Inner involucral bracts narrow-ovate to lanceolate, usually with ± glabrous and ± entire margins. Ray florets 5–13; ligules 8–10 mm long. Flowers most of year, chiefly Aug.–Dec. Previously planted as a sand dune stabilizer; grows on sand dunes and forest margins near beaches and poses a serious threat to native sand dune vegetation. NC CC SC SFWP; LHI, Qld, Vic. Bitou Bush ..... b subsp. *rotundata* (DC.) Norlindh

138 *Osteospermum*

J. A. Scott & D. W. Hardin

Annual or perennial herbs and shrubs. Leaves alternate, rarely opposite, entire to deeply lobed. Heads pedunculate, terminal in lax panicles or solitary; involucral bracts 1–4-seriate, ± equal, free, herbaceous with scarious margins; receptacle flat to convex, naked, pitted. Ray

Department of Agriculture
New South Wales

Agdex
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Bitou bush

Supplement to Agfact P7.6.16
February 1988
J. J. Dellow, Special Agronomist (Weeds)
Division of Plant Industries
Orange

IMPORTANT: PESTICIDES AND ALLIED CHEMICALS ACT, 1978

Note that you must use only a registered pesticide, and that it is not to be used for any purpose or in any way contrary to the directions on the label unless a permit has been obtained under the Act.

The herbicides currently registered for bitou bush control are non-selective. The herbicides are best applied as spot spray applications to either individual bushes or small infestations.

An integrated or combined approach to the control of bitou bush is most important. Carry out herbicide control or mechanical and hand removal in a manner that does not unduly harm the native or desirable competing plants. Plan the control program carefully. Take into consideration the time of year which is best to kill the bitou bush, and allow competing and establishing native plants and other desirable species to have the advantage.

A thorough follow-up program is essential, as bitou bush is a prolific seeder and readily re-establishes once the area is disturbed.

Always read and follow the manufacturer's directions on the label.

Herbicides registered for bitou bush control.

Herbicide (Registered as at Feb. 1988)	Spot spray: High volume handgun (product/100 L water)	Spot spray: Knapsack (ml/15 L water)	Comments
Roundup® (360 g/L Glyphosate)	1.0 L	150 ml	Apply to actively growing plants. Complete coverage is essential. Do not apply during periods of drought stress. Re-treatment may be necessary to restrict seedling re-establishment.
Tordon 50-D® (50 g/L Picloram + 200 g/L 2,4-D	1.0 L	—	Optimum treatment stage—flowering to fruiting. Cut stump treatment—treat freshly cut stumps with 1 L Tordon 50-D® per 10 L water at any time.

® Registered trade name.

ALSO "ESCORT" 10 g/100L HANDGUN (NO MENTION OF PULSE)
"SPRAY TO THOROUGHLY WET ALL FOLIAGE.
MINIMISE CONTACT WITH DESIRABLE SPECIES"

DISTRIBUTION OF BITOU BUSH ALONG THE N.S.W. COAST

A. LOVE*

INTRODUCTION

Bitou bush or boneseed (Chrysanthemoides monilifera (L.) T. Norl) has been described by Norlindh (1943) as one of the most plastic and adaptable shrubs in the South African flora where it is represented by six sub-species.

Two sub-species occur in Australia. The first C. monilifera ssp. rotundata native to the south-eastern coastal districts of South Africa is restricted to coastal areas of Southern Queensland, New South Wales and Lord Howe Island. The first recorded occurrence was from Stockton, near Newcastle in 1908.

The second sub-species, ssp. monilifera native to the Cape District of South Africa in N.S.W. occurs in suburban areas of Sydney, the south coast and near Broken Hill. It occurs more extensively in Victoria, Tasmania and South Australia with limited occurrences in Western Australia. It was first introduced into Victoria in 1858. (Gray 1976, and others).

Bitou bush was recognised in N.S.W. in the early 1950's as a useful sand stabilising plant and was used as a secondary stabiliser to control coastal sand drifts (Mort & Hewitt, 1953, Hewitt 1954). It was also reported as used to revegetate coastal areas mined for mineral sands (Barr,1965).

By the early 1970's the invasive ability of bitou bush was beginning to be recognised and its recommendation for coastal planting was withdrawn (Macdonald, 1971, N.S.W. Soil Conservation Service).

In 1976, Gray reported Bitou bush as thoroughly naturalised along the N.S.W. coast. He recommended "the history of the introduction and spread of the sub-species be re-assessed and thoroughly documented and their natural history and ecology studied in some detail, so that hopefully some form of biological control can be achieved before further incursions into natural vegetation occur".

In 1981, Dodkin initiated a systematic aerial survey of the distribution of bitou bush along the Northern N.S.W. coastline. The survey was expanded to the remainder of the N.S.W. coastline in 1982. A section of the Northern N.S.W. coastline was resurveyed in 1984. The results of the survey are presented and discussed in this paper.

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* N.S.W. National Parks and Wildlife Service, Grafton.

THE COASTAL SURVEY

The objects of the survey were to:

(a) determine the density and distribution of bitou bush along the N.S.W. coastline,

(b) establish the distribution in relation to areas of conservation interest, and

(c) provide a basis for identifying priorities and planning control programmes.

During peak flowering time, from April to July, bitou bush is readily distinguished from other coastal vegetation using low level aerial observation. In July 1981, a helicopter was used to survey the coastline from the Queensland border to the Hunter River. The aircraft flew at a generally constant speed of 45 knots and elevation of 200m. A.S.L. The survey team consisted of an observer/recorder and assistant.

The presence of bitou bush on the frontal dune and seaward aspect of headlands was mapped by the following density categories:

1.	Absent:	bitou bush not present.
2.	Rare:	1 or 2 plants per beach or headland system.
3.	Occasional:	scattered plants but not continuous distribution.
4.	Common:	continuous or almost continuous distribution and natural species still predominant.
5.	Very Common:	continuous and dominating or starting to dominate vegetation systems.

In May 1982, the survey was extended to include the central and southern N.S.W. coastline.

Limitations of the aerial survey technique have been made apparent by the subsequent identification of two limited areas of coastline where bitou bush was not identified in the aerial survey. One instance where native vegetation (probably *Hibbertia scandens*) was mistaken for bitou bush has also been identified (Crombie 1984). Nevertheless the technique is considered to provide a accurate indication of broad density and distribution patterns.

In April 1984, a section of the northern coastline between Crescent Head and Seal Rocks was resurveyed by the group which undertook the original survey of that section during 1981. The resurvey sought to identify changes in distribution and the impact of control programmes over the period of three years as well as to assist in further planning of control programmes.

RESULTS

Table 1. Distribution of bitou bush on the N.S.W. coastline As recorded from the 1981-82 aerial survey.

Density Category	Land Use		Total Coastline	
	N.P.W. (*) %	other %	%	(km.)
1. Absent	47.8	37.8	41.3	454
2. Rare	12.6	19.8	17.3	190
3. Occasional	12.9	13.4	13.2	145
4. Common	9.6	5.8	7.1	78
5. Very Common	17.1	23.2	21.1	232
Total (2 to 5)	52.2	62.2	58.7	645

(*) Areas of coastline reserved under the N.P.W. Act, 1974.

Maps 1, 2 and 3 illustrate the recorded pattern of distribution of bitou bush along the N.S.W. coastline. Also identified are the locations of 13 reported bitou bush introduction sites (Weiss, 1982), where planting occurred between approximately 1950 and the early 1960's.

Density and distribution information adjacent to reported introduction sites was combined to establish a pattern of invasion of the coastline. Obvious edge effects from closely located introduction sites were discounted. The established distribution profiles (Figure 1) show more invasion from reported introduction sites north of the Hunter River than from sites to the south.

To provide an indication of the future distribution of bitou bush on the coastline the distribution profiles obtained for each section of the coastline were transposed over the extremities of current distribution. The results obtained and illustrated in figure 2 provide a hypothetical distribution pattern for bitou bush after a further 30 years. The hypothetical pattern does not account for effects of control programmes nor from any effects from further assisted introductions.

THE POTENTIAL DISTRIBUTION OF BITOU BUSH IN AUSTRALIA

S.M. HOWDEN*

INTRODUCTION

Chrysanthemoides monilifera is a southern African species which is very successful in establishing in several vegetation formations in Australia. Two subspecies of C. monilifera have been recorded in Australia both of which are causing concern due to their ability to invade stands of native vegetation.

C. monilifera ssp. monilifera (boneseed) has been recorded throughout the southern half of Australia. This subspecies is recognised as posing a significant problem by Wheeler (1964), Garnet (1965), Pescott (1968), Welsh (1970), Parsons (1973), Lane (1976) and others.

C. monilifera ssp. rotundata (bitou bush) is the other subspecies found in Australia. Bitou bush is now recognised as being a significant weed (Macdonald, 1971a, 1971b; Gray, 1976; Mears et al., 1976; Weiss, 1981; Cooney et al., 1982) in N.S.W. and Queensland - the only states where it is currently found (Gray, 1976).

New infestations of bitou bush have established in recent years, such as those in the Fraser Island region of Queensland. Furthermore, demographic studies of populations in long established infestations such as The Entrance, N.S.W., have indicated that this weed is spreading away from its source areas quite rapidly (unpublished data). As bitou bush is actively colonising new sites it is desirable to have some indication of the area within Australia potentially suitable for infestation.

METHODS

The estimation of bioclimatic limits to the spread of organisms can be achieved by various means. The most rigorous approach is that taken by Meats (1981) in his study of the Queensland fruit fly (Dacus tryoni). Extensive physiological data was gathered in the laboratory about the response of the fruit fly to several climatically based parameters. This information was then combined with climatological data to produce a bioclimatic model. As bitou bush is essentially a previously unstudied species the necessary physiological data is lacking and insufficient resources are avilable to generate this information.

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The second approach is typified by that of van Buerden (1981). In this study of the cane toad (Bufo marinus) the current boundary conditions of aridity and temperature extremes are used to indicate the likely limits to the spread of this species. This type of correlative model should not be used if a species is still expanding its range, as the climatic conditions at the current boundaries are not necessarily limiting its further spread. Furthermore, if taken too literally correlative models of this type show that "species A will be found where species A was found" (Meats, 1981, p. 151). As bitou bush is still expanding its range a purely correlative model is inappropriate.

To avoid the difficulties inherent in both of these approaches a model is developed using information on the distribution of C. monilifera ssp. rotundata in southern Africa, in conjunction with climatic data from both southern Africa and Australia. This model is a modification of that presented in Howden (1982).

In this model three climatic variables are studied. These are frost, temperature and soil moisture. Studies by Fitzpatrick and Nix (1970), Box (1981) and others have shown that these are three of the most important climatic factors in modelling plant/climate interactions. Although each of these factors is treated separately there exist complex interrelationships between them.

The technique used to evaluate the limits to the spread of bitou bush in Australia for each climatic variable is performed in two steps. First, determine the value of these variables which correspond with an appropriate segment of distribution boundary of bitou bush in southern Africa. Next, transfer this limiting value to Australia by a mapping process. Integration of the three maps so produced gives an estimate of the bioclimatic potential distribution of bitou bush within Australia.

This type of correlative model is valid only if certain assumptions are correct. The three basic assumptions in this model are;

1. Bitou bush has actually reached its bioclimatic potential in southern Africa.

2. The distribution of bitou bush in southern Africa is limited by climatic factors.

3. The subspecies is genetically homogeneous.

The efficient dispersal mechanisms possessed by bitou bush coupled with the long time span available for dispersal are considered to have enabled bitou bush to colonise essentially all the suitable areas in southern Africa (Norlindh, 1943, 1946, 1977). Furthermore, Norlindh presents no evidence to

suggest that C. monilifera ssp. rotundata is genetically non-homogeneous. Climatic factors do limit the spread of species when considered on a large scale (Box, 1981; H. Nix, pers. comm) although in many cases the physiological response to these climatic variables is modified by ecological response curves (Mueller-Dombois and Ellenberg, 1974) which occur due to interspecific competition.

RESULTS

In southern Africa C. monilifera ssp. rotundata occupies a narrow belt along the east coast, reaching from Port Elizabeth in the south, north to Beira. The boundary on the western side corresponds with the foothills of the Drakensburg Range (Norlindh, 1943, 1977, Pretoria National Herbarium, unpublished data).

As bitou bush is essentially restricted to coastal areas it is unlikely to have developed strong frost resistance (Howden, 1982). In southern Africa the number of frost days per year increases sharply with distance from the coast. This is due in part to continentality but is enhanced by the presence of the Drakensburg Range which roughly parallels the coast (Schulze, 1972). The western boundary of the distribution of bitou bush corresponds closely with the 30 frost days per year isoline as shown in Schulze (1972). It is hypothesised that the climatic conditions indicated by this level of frost become critical for the long term survival of populations of bitou bush. It is not inferred that there is a causal relationship between this number of frost days per se and the inability of bitou bush to survive. Rather, it is suggested that this level of frost represents a complex set of environmental variables that operate in unison to limit the success of bitou bush. The isoline corresponding to this value of 30 frost days per year is overlain onto a map of the distribution of frost over Australia (Foley, 1945; Fitzpatrick and Nix, 1970).

To study the effects of temperature and soil moisture on the distribution of bitou bush in southern Africa a growth index program has been developed and run for a number of stations in southern Africa. This program uses a temperature response curve modified from Fitzpatrick and Nix (1970) and Edwards (1977) to give temperature indices. The soil moisture indices were derived from a soil water balance model which gives results equivalent to those of Fitzpatrick and Nix (1970). These index values are arranged such that zero represents estimated nil dry matter production due to a limiting environmental variable and unity represents the potential dry matter production attainable under optimum levels of the variable under study. The growth index itself is a multiplicative function of the temperature and soil moisture indices as this approach, originally taken by Fitzpatrick and Nix (1970), has recently been validated by Williams and Probert (1984). Thus a growth index of zero

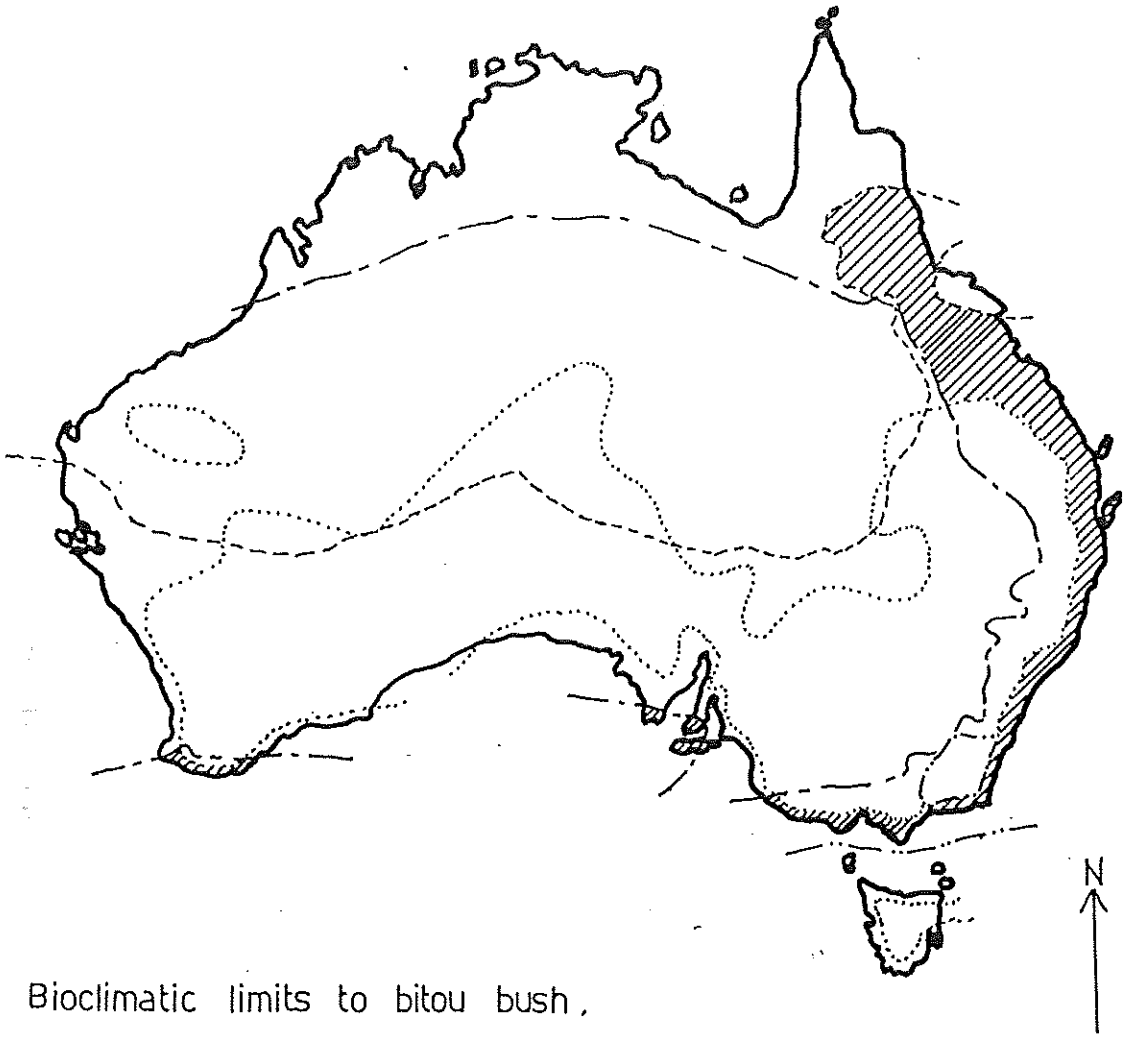
means that both temperature and soil moisture are unsuitable for dry matter production whilst a growth index of one indicates that growth is not limited by either of these environmental variables.

The growth indices generated by this program show that at the southern limit of its range in Africa (Port Elizabeth) bitou bush is limited by suboptimal temperatures in winter and inadequate soil moisture levels in summer (Fig. 1). Towards the northern limit of its range (Beira) bitou bush is limited by supraoptimal temperatures in summer and by insufficient soil moisture in winter (Fig. 2). Climatic stations located between these two extremes display intermediate values but emphasise these trends in both temperature and soil moisture.

In southern Africa bitou bush is not found in areas where the summer soil moisture regime is less mesic than than at Port Elizabeth. This limiting index value of 0.4 is derived directly from the soil moisture graph for Port Elizabeth (Fig. 1). The supra optimal temperature limit to the spread of bitou bush in Southern Africa is found at Beira. This limiting value of 26.7^{o} is derived from the summer portion of the temperature index graph for Beira (Fig. 2) and from the temperature response curve of bitou bush used in the growth index program. The suboptimal temperature limit of 16.8^{o} is also derived from this temperature response curve (Howden, 1982). The areas of Australia which are unsuitable for the growth of bitou bush are delineated using these limiting values for supraoptimal and suboptimal temperature and soil moisture. The transfer of these results requires maps of the distribution of temperature and soil moisture in Australia. A computer contouring program is used to show the spatial variation over Australia of the mean temperature measure used in the growth index program. The summer soil moisture index map of Australia from Fitzpatrick and Nix (1979) is used for the soil moisture aspect of this study.

The bioclimatic potential distribution of bitou bush within Australia is gained by overlaying the three maps showing areas limiting the spread of bitou bush due to frost, inadequate soil moisture and supraoptimal and suboptimal temperature. The area jointly enclosed by these limiting boundaries is considered to be climatically suitable for the survival of bitou bush (Fig. 3).

Fig. 3 The bioclimatic potential distribution of bitou bush.



Bioclimatic limits to bitou bush.

..... Frost

—— - —— - —— Soil moisture

---------- Supra-optimal temperature

—·—·—·— Suboptimal temperature

Bioclimatic potential distribution of bitou bush.

PRELIMINARY STUDIES OF CHRYSANTHEMOIDES MONILIFERA SSP. ROTUNDATA ECOLOGY; COMPETITION FOR PHOSPHORUS AND ALLELOPATHIC POTENTIAL

C. COPELAND*

The study was carried out in Awabakal Nature Reserve, approximately 15 kilometres south of Newcastle. The nature reserve is coastal and contains a variety of vegetation; eucalypt woodland, swamp areas and in the southern portion, a large area of dry closed heathland. The study area was set up within heathland. In the southern portion, the study site is completely dominated by bitou bush and moving northwards equi-distant from the coastline there is progressively less and less bitou bush, with a tendency to see more native species growing.It was assumed that native vegetation was present uniformly over the entire study area before bitou bush invasion and hence a gradation of bitou bush invasion was able to be studied.. The two forms of analysis which were I conducted, showed a reduction and displacement of the native species. There were several species affected, the main ones being **Hakea dactyloides, Casuarina littoralis,** and **Leptospermum laevigatum.** A number of the smaller plant species were also affected and are mentioned elsewhere in the literature.

COMPETITION FOR PHOSPHORUS

Phosphorus is a soil nutrient which is regarded by most researchers as a limiting plant nutrient for growth of heath plant species. For bitou bush to invade a heathland it must in some way compete with the native species for this limiting nutrient. The experiments which were conducted to examine this phosphorus competition were established under glasshouse conditions in the following manner. Four species were used; bitou bush and three native species; **Hakea dactyloides, Casuarina littoralis** and **Leptospermum laevigatum. Each were grown singly, and in competition with bitou bush at a 1:1** ratio in pots.

They were grown under low phosphorus regimes; 0, 0.1, 1 and 10 ug of phosphorus were added to the soil. The lower levels 0 to 1 ug are comparable to levels of phosphorus within heath soils. The 10 ug treatment was added as a luxury level of phosphorus and similar to that which might be found after fire. After fire in fact, there is probably slightly more than 10 ug of phosphorus. There are a number of interesting points which arose from these results.

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Firstly, at the low levels of phosphorus comparable to that found in heath soils there is no significant response of native species to the addition of phosphorus. (See Fig. 1). However, bitou bush does respond to every increment of phosphorus added to the soil. It is interesting to note that at low levels of added phosphorus the shoot/root ratio (which is the dry weight of the shoot compared to the dry weight of the root) of the native species declines (that is they were putting more of their dry weight into root exploration).

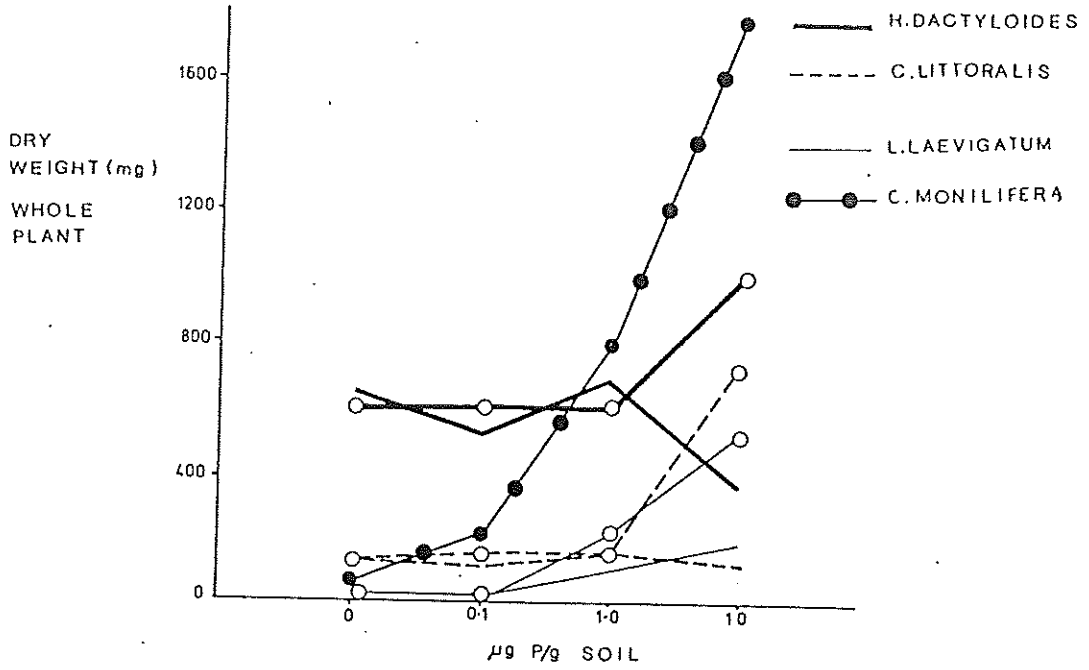

Figure 1
Dry Weights of Native Species and C.monilifera Not in competition (—○—) and Native Species in competition with C.monilifera (——) at Different P Treatments

For bitou bush, it remained constant at all levels. In competition with the native species bitou bush was unaffected. Analysis of the data showed that bitou bush was unaffected by competition with the native species at all levels of added phosphorus. The major point arising from the phosphorus pot trials is that at the 10 ug level of phosphorus added to the soil, there was, for two species, a dry weight reduction compared to 1 ug of added phosphorus. That is, with more added phosphorus plants lost weight compared to the 1 ug added phosphorus treatments. Therefore, bitou bush was actually taking up so much of the added phosphorus that there was very little for the native species, and this is important with regard to fire. When heathland is subject to fire, available nutrient levels particularly phosphorus, will increase. Therefore the potential of bitou bush to compete with native species will be dramatically

increased after fire. This causes displacement of native species after fire.

ALLELOPATHIC POTENTIAL

Allelopathy is the harmful effect of one plant on another through the production of chemical compounds which are released into the environment. Many weed species are assumed or have been shown to be allelopathic. Allelopathy is very difficult to establish and would have taken some years of investigation to assess. With limited time available, investigations were confined to an attempt to examine whether bitou bush has the potential to be allelopathic through the presence of chemicals that would be required for some allelopathic effect.

Two experiments were conducted. The first was a bio-assay involving leaching the chemicals from bitou bush and imbibing seeds of native species within this fluid for two minutes, then placing them on petri dishes and assessing their germination. (See Tables 1 & 2). The species tested were **Hakea dactyloides, Casuarina littoralis** and **Eucalyptus viminalis.**

Table 1

Effect of Decaying Leaf Litter Leachate of Chrysanthemoides monilifera on Germination & Growth of Test Species in Sand

Species	Parameter	Treatment	Control
E. viminalis	Leaf Area	18.02 cm^2	17.56 cm^2
Casuarina littoralis	Height	28.088 ± 0.835+ (n=125)	31.9757 ± 0.56+ (n=204)
H. dactyloides	% Germination	30.357%	33.85%
	Mean root length (cm)	3.665 + 0.29+	4.965 + 0.478+
	Total dry weight (mg)	192	454

\+ Mean ± S.E.

Table 2

Effect of Fruit Leachate of Chrysanthemoides monilifera on Germination and Growth of Test Species on Filter Paper

Species	Parameter	Treatment	Control
E. viminalis	% Germination	37.5%	38.6%
	Radicle length (mm)	11.0 ± 1.14+	10.96 ± 1.011+
	Hypocotyl length (mm)	6.77 ± 0.7814	9.25 ± 1.06
Casuarina littoralis	% Germination	19.10%	31.58%
	Radicle length (mm)	8.265 ± .727+	8.646 ± .570+

+ Mean ± S.E.

Once the seeds were imbibed in leachate, both Hakea and Casuarina failed to germinate. Only a small number of Eucalyptus seeds germinated.

The second experiment used two way chromatography to compare the leachate against reference compounds known to be allelopathic.

A close correlation between a test and a reference compound was found. One of the components of the bitou bush leachate was found by this technique to be chlorogenic acid which has been shown in several experiments to inhibit the metabolic processes of plant species.

CONCLUSION

The response of bitou bush to high soil phosphorus levels which similar to those occurring after fire will confer upon it a competitive advantage vis-a-vis native species. Since fire is a frequent occurrence within heathlands, the higher potential growth rate of bitou bush will facilitate further invasion of the heath. After the early growth period further competitive advantage may possibly be gained by the allelopathic potential of that plant.

CONTROL OF BITOU BUSH *(Chrysanthemoides monilifera* (L.) T Norl)

by J. Toth, Senior Research Agronomist (Weeds),
N.S.W. Agriculture & Fisheries

Bitou bush was introduced to Australia from South Africa. In Australia two sub-species occur:-

- *C. monilifera spp. rotundata* commonly known as Bitou bush.
- *C. monilifera spp. monilifera* commonly known as Boneseed. — ALSO NZ, E).

Bitou bush mainly invades coastal areas of South Queensland and the Northern and Central coast of N.S.W. The other sub-specie, Boneseed, is more prevalent on the South coast of N.S.W., Victoria, Tasmania and South Australia.

To assess the extend of spread of Bitou bush, an aerial survey of the N.S.W. coastline was undertaken by the National Parks and Wildlife Service in 1981-82. The survey recorded infestation on 60% (approx 650 km) of the length of the coastline (Love, 1984).

Control measures were taken with various degrees of success. In small isolated areas physical removal was effective. For larger infestation it was inpractical because of labour requirements. Chemical control is quite successful but access to the infested areas is a problem.

High volume application is possible only where there is a vehicular access. The LPG powered spray gun application technique is very useful to control scattered infestation in difficult terrain with no vehicular access and under the trees, but its not suitable for very large and dense infestation.

The aerial application technique would suit large open areas.

The aim of this research was to:-

(i) select a suitable herbicide (trials in Moruya & Port Kembla, 1985);

(ii) select the most suitable application technique and rates (trials in Moruya, Port Kembla and Jervis Bay, 1985-87);

(iii) compare the performance of herbicides when sea water or fresh water is used (trials in Moruya and Port Kembla 1985);

(iv) test the effect of a wetting agent (Ultra wet(R)) and a penetrant (Pulse(R)) on the two most promising herbicides (trials in Jervic Bay 1987); and

(v) evaluate the selectivity of candidate herbicides on native species commonly growing in association with Bitou bush (trials in Jervis Bay, 1987-88).

Two herbicides (glyphosate and metasulfuron) showed considerable selectivity to the native species. The problem was that it was not clear, if the apparent selectivity was due to inadvertently avoiding spraying of desirable

species. It was extremely important, to clarify this, if aerial application was to be considered. I established that the low volume and high concentration application with LPG powered spray gun is similar to an aerial (helicopter) application. The LPG powered spray gun was therefore used in all later experiments. In the first trial a rate higher than the minimum needed to control the Bitou bush was used. The following native species were treated with the same rate and volume as the Bitou bush:-

- Casuarina

- Coastal Tea Tree

- Coastal Heath

- Coastal Wattle

- Banksia

- Beard heath

- Lanandra

The results indicated that most native species in this experiment had some degree of tolerance to one or other herbicides, only Coastal Heath was killed by metasulfuron. Some other species were severely damaged but regrew.

In the second experiment casuarina, Coastal Heath and Beard Heath was left out. These are not so frequent on open sandunes and are mainly below the tree canopy on secondary dunes and hence inaccessible to aerial spraying.

Lower rates of herbicides, still sufficient to control the Bitou bush, wer included to reduce the damage to native species.

To test these findings on a broad scale an aerial application (by helicopter) has been set up. If this trials confirms that the damage to native species is low then we will be able to selectively remove Bitou bush from open areas where aerial application is sociallu acceptable. In other areas the LPG spray gun could be a useful technique.

Location: Port Kembla
(Date: 20.11.1985)

Control after 13 months

Treatment	Ratio (herbicide) to water)	Control (%)	Comments
Roundup(R) (glyphosate)	r :20	90	Verylowvolume(LPGgun)
	1:30	100	–"–
	1:40	95	–"–
	1:50	79	–"–
	1:50*	69	–"–
	1:100	91	–"– * (sea water)
	1:200	100	–"–
Brush off(R) (metasulfuron)	1.0 g/L	100	Verylowvolume(LPGgun)
	0.5 g/L	99	–"–
	0.5 g/L*	100	–"– * (sea water)
	10.0 g/L	100	High volume
Lontrel(R) (dichloropicolinic acid)	1:20	98	Verylowvolume(LPGgun)
	1:30	91	–"–
	1:50	71	–"–
	1:50*	84	–"– * (sea water)
	1:200	93	High volume
Garlon(R) (triclopyr)	1:20	77	Verylowvolume(LPGgun)
Krenite(R) (fosamine)	1:10	3	–"–

SEASONAL DIFFERENCES IN TOLERANCE OF GLYPHOSATE AND METSULFURON BY BITOU BUSH AND FOUR PLANT SPECIES INDIGENOUS TO COASTAL N.S.W.

John Toth, Paul Milham and Michael Maguire
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INTRODUCTION

John Toth previously reported the use of glyphosate and metsulfuron to control Bitou bush (*Chrysanthemoides monilifera* (L.) T Norl, subspecies *rotundata*) on sand dunes at several locations on the South Coast of NSW (Toth, 1989). The report also documented the herbicide tolerance of a group of seven native plant species which are important components of the invaded dune communities.

The experiments were undertaken to test the hypothesis that herbicides could selectively control Bitou bush in such plant communities. If this proves correct it will provide an environmentally acceptable, cost-effective means of controlling much of the extensive Bitou bush infestation along the eastern seaboard of NSW (Love, 1984).
Since that report we have continued experiments at Jervis Bay Nature Reserve using the rates of application of glyphosate (Roundup, 1:30) and metsulfuron (Brush-off^{R}, 1 g/L) which previously controlled Bitou bush when applied in the summer. Again the chemicals were sprayed onto the foliage of individual plants using an LPG powered handgun; however, the time of application was changed from summer to winter.

EXPERIMENTAL

The native plant species studied were Coastal Tea Tree (*Leptospermum laevigatum*), Coastal Wattle (*Acacia longifolia*), Banksia (*Banksia integrifolia*) and Lomandra (*Lomandra spp.*). Casurina (*Casurina glauca*), Coastal Heath (*Leucopogon lanceolata*) and Beard Heath (*Monotoca elliptica*), which had been examined in some previous experiments, were excluded because they occurred rarely on the site.

Herbicide damage was assessed by comparing the density and appearance of the foliage of treated and untreated plants. A score of 0% was given for 'no effect' and 100% for complete defoliation with no regrowth.

RESULTS AND DISCUSSION

The results confirm the large interspecific differences in herbicide tolerance reported previously, i.e., for both herbicides tolerances typically increase in the order: Bitou bush (Fig. 1) < Banksia (Fig. 2) ~ Coastal Tea Tree (Fig. 3) < Lomandra (Fig. 4) < Coastal Wattle (Fig. 5). Since biochemical tolerance of the two herbicides is unlikely to be so highly correlated, the correlation is presumably caused by physiological factors. This suggestion is supported, at least for the native species, by the fact that their tolerances rise and fall in concert between winter and summer.

The seasonal differences in interspecific herbicide tolerance are also particularly interesting: the tolerance of the native species being much higher in winter, while that of Bitou bush is not (Figs. 1-5). This seasonal effect is of immense practical significance; however, it remains to be confirmed.

The data clearly support the hypothesis that selective chemical control of Bitou bush is possible using either glyphosate or metsulfuron. Furthermore, it appears that winter applications may prove more selective than those made in summer and that lower rates of application may be effective during winter. The optimal combination of these factors could reduce the damage to native species to environmentally acceptable levels, opening the way to aerial control of Bitou bush.

Acknowledgments

We thank Du Pont (Australia) Ltd. and Monsanto Australia Limited for supplying chemicals and the management of the Jervis Bay Nature Reserve. Without their support continuation of this program would be impossible.

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Why Use Trounce rather than Roundup herbicide?

M Willocks
Product Development Manager
Monsanto

This question is valid and it is one that is often asked. After all, more people have Roundup and therefore may find it more convenient to use than Trounce. In addition, the active ingredient of Roundup and Trounce is the same, however their activity on brushweeds is different.

From the day Monsanto introduced Roundup into the New Zealand market, we had a goal of making it effective on brushweeds, particularly on gorse. We succeeded with a handgun application but the cost of application was relatively high and acceptance was low. Aerial application of Roundup onto gorse gave variable results. Sometimes, a high level of control was achieved, while other times the bushes would hardly change colour.

As we developed the concept of mixing glyphosate with metsulfuron we were not able to remove this variability when Roundup was in the mix. This variability was enhanced by the relatively low use rates used in the mixture. The reason for the variability was partly due to the surfactant and partly due to the salt in the formulation.

A number of formulations were tested with the goal of improving the reliability of our recommendations. Trounce proved to be the most reliable and a decision was made to progress this formulation instead of Roundup. This decision was not taken easily because introducing a new formulation and establishing a brand in the market is not a cheap exercise.

If the same level of control and reliability could have been achieved using Roundup, then this would have been the preferable option, even though other suppliers could have participated in this market.

As Monsanto gets more experience in the brushweed market we are getting an even greater understanding of the value of the Trounce formulation. Results are superior to those achieved with Roundup on many brush and woody weed species.

Field experience has also shown the variability that results from using Roundup instead of Trounce. Some results are acceptable and the user is very happy. Other results are less than acceptable showing the variability exists.

Trounce is the better formulation of glyphosate for brushweed control. Trial work and field experience demonstrates that for reliable long term control of brushweeds always use Trounce in preference to other glyphosate formulations.

TROUNCE®
By Monsanto
Rips through gorse like nothing else.

GORSE CONTROL WITH TROUNCE® PLUS METSULFURON AERIAL APPLICATION

Gorse is a persistent and invasive weed. Left uncontrolled it can quickly infest large areas of land rendering it unproductive.

To return large areas of dense gorse infested land to productive pasture it is advisable to start your development programme with a suitable herbicide to control the gorse and open up the area to allow oversowing and/or grazing. This treatment is best applied using helicopters or fixed wing aircraft.

Trounce with the addition of metsulfuron has been shown to be very effective for the control of gorse whether applied using handgun or aerial application methods. Trounce provides rapid brownout and drying of plants followed by stick breakdown opening up the sprayed area for grazing or oversowing.

Recommended Rate for Gorse Control

Two application rates of Trounce plus metsulfuron are recommended depending on the intended gorse control programme planned.

The level of control expected from either treatment is similar but the second recommendation will require a followup programme to gain a high level of longer term control of the treated gorse.

A. Where a single treatment is required to give a high level of control without followup management use:

7 kg Trounce plus 260 gm metsulfuron per hectare.
Add Pulse® at 750 ml per 100 litre of spray solution.

B. Where it is intended to embark on a programme of gorse control where management practices such as crushing, burning, slashing or followup herbicide applications are planned then use:

4 kg Trounce® plus 160 gm metsulfuron per hectare.
Add Pulse at 750 ml per 100 litres spray solution.

Field experience indicates that the level of control gained with this application is similar to other commonly used herbicides. Some regrowth should be expected within 12 months of application and this regrowth can be controlled with followup treatments of crushing, burning, slashing or handgun spraying with a suitable herbicide.

Time to Burn or Oversow after Application

Burning can take place 2 months after spraying, but it is best to wait between 4 and 6 months to allow time for thorough dehydration of the gorse.

Oversowing should be delayed until the residues of metsulfuron have declined. Under most conditions this will be 6 months after spraying. Plan your aerial spraying to occur 6 months prior to your usual pasture oversowing period.

Limitations of Aerial Application

When applying herbicide from the air it is very difficult to ensure full coverage of the plants. Type of terrain, nature of the target bush and difficulty with flying even swaths limits the final level of control whatever the herbicide used. As a result some regrowth from treated bushes can be expected. Handgun spraying with Trounce will control this regrowth.

Trounce with the addition of metsulfuron provides cost effective long term control of gorse and is effective on a wide range of other brushweeds.

TROUNCE®
By Monsanto
Rips through gorse like nothing else.

Control of Broom using Trounce® Herbicide.

Broom is of European origin, being introduced by early settlers as an ornamental plant and for hedgerows. It is now a widespread, troublesome weed in many areas of New Zealand, becoming established in less intensively farmed hill country and riverbeds. Broom spreads rapidly, restricting stock access and grazing, making land unproductive.

Trounce, when applied using handgun equipment or helicopter, will effectively control broom and open up areas for grazing or tree planting.

Handgun Applications.
Trounce can be applied throughout the year for the control of broom using handgun equipment.
For every 100 litres of spray mix add:

170gm Trounce
3gm metsulfuron 60% ai
100ml Pulse® Penetrant.

Apply using No 6 tip or greater at a pressure of 1500-2000kPa. Spray to cover the entire plant using the "jet in, fan over" technique. That is, spray into the plant with a jet spray pattern, covering the stems and central parts of the plant. Then adjust spray pattern to a fan and cover the outer portions of the plant. Any parts of the plants that are not fully covered will not brownout. Misses can be treated when they become evident, usually from 3-4 weeks after treatment.

Aerial Applications.
For control of broom from the air apply Trounce at 4kg/hectare from October through to May. Add Pulse Penetrant at 0.5% (500ml/100 litres of spray mix). There is no need to add metsulfuron when treating broom from the air. A water rate of around 200 litres/hectare is recommended.

Other broom herbicides require the plants to be in full leaf at the time of treatment. This is not necessary with Trounce as sufficient herbicide will enter the plant through the stems, providing more flexibility of application timing and improving the reliability of weed control.

Broom Control Programme.
Broom is a prolific seeding plant and like gorse these seeds are stimulated to germinate following a fire. Where broom is present in large blocks it is recommended to spray the area with Trounce at 4kg/ha plus 0.5% Pulse. After spraying leave the block to brown out and then burn. Wait 2-3 months to allow seeds to germinate and establish. Then spray with Trounce at 2kg/ha plus Pulse at 0.25%. Pasture or tree establishment can take place immediately after spraying.

In pastoral situations it is possible to control any further seedling establishment with stock grazing, especially sheep.

Monsanto
Proven Technology

Aquatic Weed Control using Roundup® G^{II}

Weeds growing in waterways can restrict the flow of water, promoting the build up of silt leading to flooding problems in periods of high rainfall. Left unchecked, weeds will eventually lead to waterways becoming blocked, requiring expensive clearing using mechanical methods.

Roundup G^{II} will effectively control emerged weeds in waterways, ensuring efficient flow of water and extending the life of the drain. Roundup G^{II} will control a wide range of weeds from grasses and broadleaves to willows and brushweeds. Roundup G^{II} can be used over water without affecting fish and other aquatic life.

Application.

Roundup G^{II} may be applied using gun and hose equipment, ground booms and helicopters. Use the application method that best suits the situation. For rates to use consult the Roundup G^{II} product label.

Apply Roundup G^{II} to weeds that have emerged above the surface of the water. Ideally 3/4 of the plant should be above the water surface. Delay treating plants covered in silt, until rainfall or flooding has washed the silt off.

When applying Roundup G^{II}, spray upstream to reduce the concentration in the water.

Environmental Fate of Roundup G^{II} in Water.

On contact with the water Roundup G^{II} is rapidly diluted into the body of water. It is then attached to soil particles in the water or on the bottom of the waterway where it is tightly bound and becomes biologically inactive. Naturally occurring bacteria break Roundup G^{II} down into compounds such as nitrogen, carbon dioxide and phosphate.

Roundup G^{II} that remains free in the water, because it does not contact soil particles, will be broken down by bacteria in the water. The half life in water under most conditions is 14 days. In conditions where microbial activity is lower, such as sphagnum bogs, the half life may be longer (7 weeks).

Toxicity of Roundup G^{II} to Aquatic Species.

Roundup G^{II} is of very low toxicity to fish species. Studies on indicator species show that Roundup G^{II} can be applied at very high rates without affecting fish life.

Table 1: Toxicity of Roundup GII to indicator fish species. Measured as LC_{50}

Rainbow Trout	>989mg/l
Daphnia	676mg/l
Carp	>895mg/l

LC_{50} is the concentration of the product required to kill 50% of the test population.

To put these numbers into perspective, if Roundup G^{II} is applied at a rate of 10l/ha to a body of water 1 metre deep, then the concentration in the water immediately after spraying will be 1mg/litre. This is approximately 1/1000th of the LC_{50} value for fish species. In other words there is a 1000 fold safety margin. When the rate at which Roundup G^{II} becomes biologically inactive in the water is allowed for, then the safety factor is even higher.

Summary.

Roundup G^{II} is the ideal tool for weed control in aquatic situations. It will reliably control a wide range of weeds very cost effectively. Roundup G^{II} is of low toxicity to fish and marine life, so apply it with the confidence that only the weeds will be controlled.

Note.

Application of herbicides to water is subject to conditions of the Resource Management Act. Check with your local council regarding local regulations relating to this use before treating weeds.

Monsanto
Proven Technology

September 1995

Roundup® G^{II}; What's the Difference?

Roundup herbicide has been available in New Zealand since the late 1970's. During that time it has been used by most farmers, foresters, home gardeners, local authorities, in fact anyone involved in weed control.

Roundup has a well earned reputation of reliably controlling even the toughest weeds while not having an adverse effect on the health and safety of the user, society or the environment.

Some may say it is difficult to improve on a product such as this, but at Monsanto we have been working to improve Roundup, to make it even better for our customers. This product improvement programme has resulted in the introduction of Roundup G^{II}, a product that has all the characteristics of Roundup with some important added features.

How does Roundup G^{II} differ from Roundup?

1) Formulation: Roundup G^{II} still contains the same active ingredient, glyphosate, at the same rate as in the old formulation. The difference is the surfactant system used in the formulation. Surfactants are used to stick and spread the spray droplets on to the leaf of the plant, so that the active ingredient can get into the plant and do its job. The selection of surfactant is very important, especially with a broad spectrum herbicide like Roundup, because surfactants can have different effects on different types of plants. The surfactant in Roundup proved to be very good under a wide range of conditions but could be improved upon.

A new proprietary surfactant has been developed which is effective over a wide range of weeds but offers some new features that users have indicated they would prefer.

Roundup G^{II} is also a distinctive green colour meaning it can be clearly differentiated from other glyphosate formulations.

2) Time from spraying to rainfall: With Roundup G^{II} it has been possible to reduce the minimum time between spraying and rainfall from 6 hours to 2 hours if application is made to dry plants. If Pulse is added then the rainfree time is reduced to as low as 30 minutes. If wet plants are treated then the rainfree time increases due to slower uptake of the product.

3) Foam production: Foaming in the spray tank can be a problem especially when Pulse® Penetrant is added to the spray mix. Roundup G^{II} minimises this problem as it produces less foam and the foam produced is less stable, meaning it doesn't last as long.

4) Effect on fish: Roundup is one of the few herbicides that has Pesticides Board approval for application over water. With the advent of the Resource Management Act the criteria for using any chemical over water is becoming even more stringent. Roundup G^{II} is in the order of 100 times less toxic to fish than the old formulation, meaning it is more suited to control of weeds in or around waterways than any other herbicide.

5) Eye and skin irritancy: Surfactants are generally eye irritants and to some people they can also be skin irritants. The surfactant in Roundup G^{II} has been shown in studies to be non-irritating offering the user even greater safety and comfort.

6) Mixtures with other products: When tank mixing with other herbicides or surfactants there can be a reaction between the products. In certain situations this can result in reduced weed control. Roundup G^{II} has been shown to be more compatible than other formulations with tank mixtures, including Pulse Penetrant, therefore increasing the reliability of weed control.

Summary

Roundup G^{II} is a new formulation which offers many benefits to users. The high level of control across a large number of weed species is maintained while rainfastness, foaming characteristics, fish safety, user safety, and compatability have been improved.

Forest Friendly award winners are Geoff Wightman (left) and Steve Brajkovich (second from right) with Far North Forest and Bird Protection Society official Linda Winch and Northland Regional Council noxious plants officer, Ken Massey. Others who received the award were Kohukohu Nurseries and Mitre 10.

Northern News Tuesday 14 June 1994

Nurseries judged Forest Friendly

Far North Forest and Bird Protection Society and the Institute of Noxious Plants Officers presented Forest Friendly awards to nursery owners from Kaikohe, Hokianga and Waimate North last week.

The awards are for nurseries in the area which have agreed not to stock plants considered to endanger the native environment.

Awards were given to Geoff Wightman, of Puririlands Nursery at Waimate North, Steve Brajkovich, from Rankin Street Glasshouses, Kohukohu Nurseries and Mitre 10.

Forest and Bird official Ian Wilson said the other nursery business in Kaikohe was in the process of changing hands and the new owners had expressed interest in joining the scheme.

He said that if this happened the society would have all the nurseries in the Kaikohe/Hokianga area agreeing not to sell the danger plants.

SPRING GARDENING

Beware invasive ornamentals

NORTHLAND garden centre owners will now get a pat on the back if they refuse to sell plants which are invasive and a threat to native vegetation.

The Royal Forest and Bird Society and the New Zealand Institute of Noxious Plants Officers have introduced a new Forest Friendly award, which will be handed out to garden centre owners who don't stock potentially invasive plants.

Northland Regional Council noxious plants officer Jack Craw says many so-called "ornamentals" like jasmine, Mexican daisy, lantana, privet, blue morning glory, cotoneaster and ladder fern are commonly available in garden centres, but when they get loose in the wild they choke out native plants. Environmental organisations are keen to see sales stopped.

Noxious plants like wild ginger were introduced to this country as ornamental garden plants, and ginger is now on the march, suffocating huge areas of native forest and regenerating scrub land. Now other "ornamentals" have also escaped the confines of domestic gardens and are threatening native species.

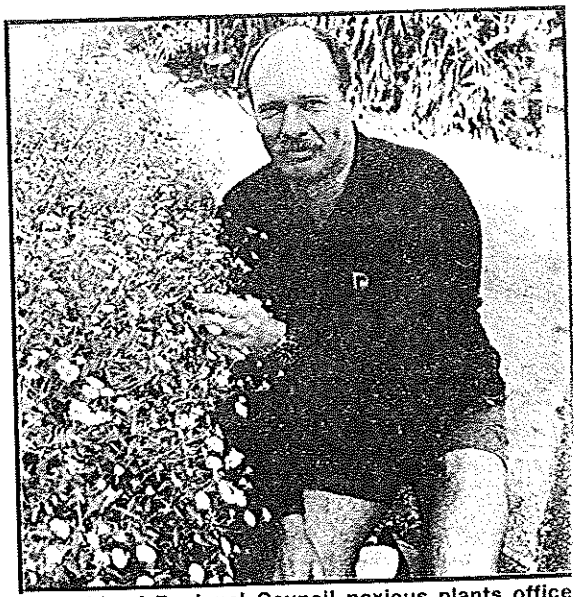
Mr Craw says 30-odd species of garden escapes are currently threatening Northland's native vegetation.

"Native plants are in grave danger throughout New Zealand. A major weed infestation like wandering jew or climbing asparagus can totally replace the existing native vegetation or open the door to other weeds.

"Once the forest floor is covered with invasive plants, the regeneration of native seedlings is halted and when mature trees die off the forest disappears forever."

Mr Craw says the garden centre award is a giant stride in the right direction.

"For years these plants have spread steadily through Northland and given the chance they'll change the appearance of the region forever," he says.



Northland Regional Council noxious plants office Brett Miller with Mexican daisy, one of around 3('ornamentals' which are threatening native flora.

24D spraying restrictions soon in force

August 23 1995
Times

From the end of this month, the Northland Regional Council will require spray operators to apply for a Resource Consent before they apply the herbicide 24-D ester using other than hand-held equipment.

This restriction will apply until May 1 next r, in recognition of the c that the spray is more effective in controlling broadleaf weeds during the mid-winter period.

After the end of August, the weeds are generally past their most vulnerable growth stage, no stronger or larger doses of spray are required to achieve the same level of control. Sensitive crops, such as squash and deciduous trees, are also more susceptible to spray drift from the beginning of September.

The Regional Council considers the need to spray outside the May-August time period should be carefully jus- d, and encourages farmers to talk to the council's noxious plants officers regarding an efficient and cost-effective spray programme.

The Proposed Regional Air Quality Plan, which is currently open for public submissions, sets out a number of Regional Council. restrictions designed to limit the environmental impact of pesticide spraying.

As well as taking account of the limits on the time of year 24-D ester can be sprayed, operators must consider a number of factors when preparing to apply pesticides. These include wind direction, location of sensitive areas and the methods used to apply the spray with the aim to "avoid or mitigate any actual or potential adverse effects on off-target sensitive areas."

At least 12 hours before beginning spraying, the operator is required to notify neighbours and any other people who may be affected.

It is proposed that by the end of 1997, all commercial users and operators, including farmers, must undergo "Growsafe" training or gain any other nationally recognised qualification in safe spraying procedures.

Check out those poisonous plants

A book on poisonous plants which will be distributed widely throughout the region was published last week by the Northland Regional Council.

Titled "Poisonous Plants and Fungi in New Zealand", the book includes a colour photograph of every significant poisonous plant and fungus found in Northland, symptoms of poisoning and an easy-reference guide to remedies.

The author, Regional Council land management officer Jack Craw, s ome gardeners will be rprised at the range of plants on the list.

For example daphne, valued as a sweetly scented harbinger of spring, is in the "top ten". All part of the plant are highly toxic, and have sometimes been implicated in poisoning farm animals when clipping have been dumped over the fence.

Foxglove, a popular "cottage garden" plant is also highly toxic, causing headaches, diarrhoea, delirium and death. Over the years, quite a number of New Zealanders have become seriously ill with foxglove poisoning.

Two ornamental trees which feature high on the list are the rhus tree and the castor oil plant. Both these plants trigger violent allergic reactions in 10 to 20 per cent of the population.

The rhus tree causes large open weeping sores on susceptible people who come in contact with the sap or cut wood. An Auckland gardener died a few years ago after cutting up and removing a tree without wearing protective clothing.

Regional Council chairman Michael Gross says the Regional Council's environmental responsibilities include making Northland safer and more pleasant for its residents.

"Over the last five years, the Regional Council has received an ever-growing number of enquiries regarding poisonous or suspected poisonous plants. It is important that as many Northlanders as possible can identify toxic plants and remove them from their gardens if they wish," he said.

THE SUNDAY MAIL July 31st 1994 Ken Massey

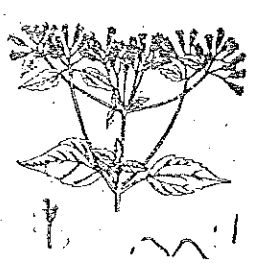
North on alert for weed

NORTH Queenslanders have been asked to watch out for the highly noxious shrub Siam weed, recently discovered in Australia.

North Queensland Department of Lands regional director, Ian Anders, said in Cairns last week identification would help an eradication program.

Siam weed is a serious pest of Asian plantation crops and experts fear it would cause havoc in northern sugar, papaws and bananas if not curtailed.

Mr Anders said Siam weed discovered recently at Bingle Bay was similar in appearance to Bluetop or Billy Goat weed.



Siam weed . . . crops threat

The strategic and preventive weed team moved into action in the north in an effort to quickly eradicate the pest.

Siam weed grows in hot, wet tropical regions and requires 1000mm of rain. It is found from sea level to a 1500m altitude.

It is a perennial free-branching shrub that can form bushes 2-3m high or grow to 20m as a scrambling climber.

It has a white or pale lilac flower and after flowering forms large numbers of small brown seeds with parachutes of white hairs.

Information on identification or any inquiries regarding Siam weed can be directed to the North Queensland Eradication Office based at Mission Beach, telephone (070) 687 237.

New water net battler

The Department of Conservation has been testing an airboat in the hope of adding a new weapon to the battle against water net.

The locally owned and built airboat is powered by a 150hp aircraft engine and was recently trialed on a large weed bed off the Awahou Stream mouth on Lake Rotorua.

"It looks like something out of the Florida Everglades but it has real potential as a spray craft in the future," said senior conservation officer, Mr Gavin Williamson.

It will continue to be tested by its builder.

DOC last weekend began spraying about 60 hectares of weed between Kawaha Point and the city.

"In trying to ease the water net problem we are working on the same principle as last year," said Mr Williamson.

"This is to reduce the habitat available for water net by collapsing the existing beds."

Water net has already formed dense mats on top of weed beds and while the current spraying programme should help the problem, it looks like it could be another bad year, Mr Williamson said.

"Difficult areas are again likely to be inshore shallow waters such as just north of Kawaha Point. At these sites the water net does not rely on weed beds for support or shelter so spraying will not solve the problem."

Spraying will be carried out on Lake Rotoiti during November and DOC is recommending that water in affected areas not be used on gardens for 24 hours after spraying.

Residents in the areas of Otaramarae to Te Pohoe Bay and Ruato Bay to Gisborne Point should try to fill their water tanks before the end of this month, said Mr Williamson.

NZ HERALD 8/9/95

Patience call in war on ragwort

Farmers are going to have to be patient in their wait for ragwort eradication, says the Auckland Regional Council's biosecurity officer, Mr Lance Vervoort.

He told Auckland Federated Farmers that the council was looking at zoning lower land so it had to be free of ragwort, but higher areas would have to be cleared for only 10m from boundary fences and stream beds so the seed did not spread.

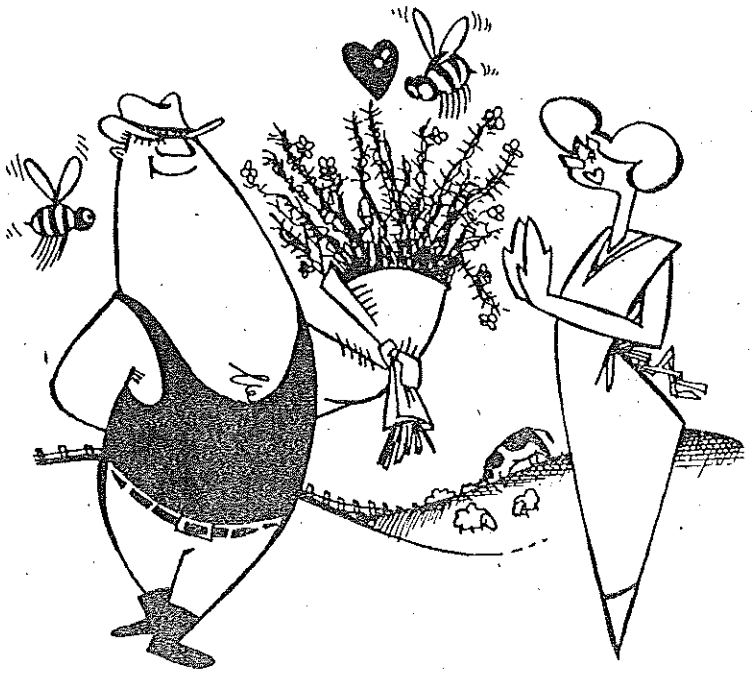
Control inspections in South Auckland last year had worked to some degree, "but 17.25 per cent of the noxious weeds budget is spent on ragwort and whether we are getting a benefit is questionable."

"Ragwort has adapted itself and is flowering and seeding for 11 months of the year.

"It can come up and flower within a month but seed doesn't blow more than 10m.

"But farmers need to be patient for six or seven years,"he said."They will still see yellow flowers on the hills."

The ragwort flea beetle had given a 95 per cent kill over the past 25 years in Oregon, in the United States,and it had yielded good results here.



Prickly customer defended

New Zealanders need to stop hating gorse, says the Auckland Regional Council's biosecurity officer, Mr Lance Vervoort.

"You can hate it in a pastoral sense," he told Auckland Federated Farmers this week.,"but in other areas it does a good job.

"It puts nitrogen in the soil and holds land up."

It should never have been cleared under the Government-funded farm development schemes in the 1980s because much of this land was now seriously eroded.

And Mr Vervoort said beekeepers loved gorse flowers as a source of nectar.

"We are not going to chase gorse in urban areas, but push biological controls,"he said.

However, an area of gorse where thrips which control gorse were being encouraged on Waiheke Island had recently been destroyed by the landowner.

GRAHAM MILNE
EX CHAIRMAN,
NORTH SHORE JNPA.

Wild rabbits to be a gourmet export

New processing company to launch its prospectus

By Virginia O'Leary

Wild rabbits notched up the second-highest export earnings for this country in 1919, and if a North Shore man has done his homework right they could again prove a money spinner.

Wild rabbits need not be the money drain the anti-rabbit lobby would have us believe, says Mr Graham Milne, of Birkenhead. And there are not as many out there as that same lobby tells us, he says.

Mr Milne will launch next week the prospectus for his company, Landcare Resources, with 500,000 shares allocated to the company's contract rabbit hunters and participating farmers, and one million shares to be offered to the public.

The company will be listed on the second board of the New Zealand sharemarket. It was registered "long before the Government agencies came up with a similar name."

Mr Milne, a North Shore City councillor and a former Northland farmer, was "born into rabbits." He was brought up in Central Otago with uncles who were rabbiters, and his research into the history of the rabbit industry is impressive.

Equally sound is his research into the present market potential of wild rabbits, as distinct from farmed rabbits.

Mr Milne's premium wild rabbit cuts, branded Centago, will target the low volume, high-priced segment of the European market — initially in France, Italy and Spain. Italy has the highest consumption of rabbit meat in Europe, most of it farmed rabbits.

Wild rabbit is a delicacy to Europeans. Wild rabbit meat, either imported or local, can be sold only in the hunting season, from September to January, to dissuade illegal hunting.

One market that Mr Milne quotes prices its wild rabbit cuts at about $60 a kg. Each wild rabbit yields about a kilogram of meat, with 800 grams reckoned as an average working weight. Centago cuts will include boneless rabbit meat, fillet, back steaks, legs, hindquarters, forequarters — "We'll provide whatever the market wants."

The meat will be frozen and chilled. Barrier bags will be used for the chilled cuts. Dehydrated rabbit meat, for ration packs, will also be produced as will gourmet pate and frozen TV dinners.

Mr Milne expects the company's Queenstown pack house to process two and a half million rabbits a year.

He says quality control "starts with the hunters. The kill will be crutch gutted in the field within a time frame. The carcases will be hung in certain ways and into a cool store also within controlled time frames."

Every stage of the processing will be quality controlled, with a second stage including a fully operational laboratory.

The 600 or so hunters would be licensed to supply the plant, and would work specific areas. Mr Milne says they would be paid well.

"We will have a schedule price and pay a bonus on that dependent on the market," he says.

Hunters would receive training in carcase handling before they were permitted to supply the company.

Killing is due to start in four to six weeks.

Most shooting areas would be accessible by cool transporters, but where accessibility was a problem helicopters would be used.

"We will have depots all over the place," Mr Milne said. "We'll be working closely with district councils and the Government about 1080 poison drops. We'll be in constant communication with them. Poisoning is expensive, so it would be reasonable to assume we'd go in first and clean the rabbits up."

Stringent control would guarantee rabbits were not from poisoned areas. Rabbit supply would be from the South Island, mainly Central Otago and Southland.

"I'm determined to do it well," Mr Milne said. "There is no room for mistakes.

"There has been some mild hysteria from the high country. Some view it with disdain. I've had to chip away to get there.

"I've had fantastic reaction from a lot of farmers. Surprisingly some are becoming open about it (supporting the company). Before they were afraid to speak out. Several have asked to be shareholders."

Mr Milne says he has put 27 years into his new business, lobbying to change the rabbit laws. He believes the rabbit problem has peaked into disaster only three times — during the First and Second World Wars, when rabbit shooters were overseas, and during the 1980s when the pest boards were discontinued.

His only possible competition in the wild rabbit supply to Europe could have come from Australia, he says. But Australian wild rabbit product is banned from Europe because of myxomatosis.

Coast to Coast

Courier 4-10-95

Of gorse. Don't get the pricker write a poem

When Wellsford resident Peter Grace got sick of looking at the gorse on council-owned land next door, he put his literary talent to work and complained to Rodney District Council in the nicest possible way - with a poem.

Peter was surprised and delighted when general services manager Geoff Ward replied in kind, even if the poem's message wasn't quite what he had hoped for. Peter's poem and the council's reply verse is.-

TO THE COUNCIL

I stand and lean upon the fence
that separates my land from yours,
and all I can see is two
hectares of yellow gorse.
For twenty years and more it seems
that noxious weed has caused me pain.
I nag, I growl until it's sprayed,
then in months it grows again.
Owners come and owners go,
the fence falls down and gorse grows tall.
Now we hear the council owns it,
broken fences, gorse and all.
You must admit that such a sight
makes Wellsford town look very rough.
I ask, I pray, I humbly beg,
won't you come and spray the stuff!

GORSE

Although you stand at your own fence
gazing forlornly at gorse so dense,
I hasten to say with unkind glee
the weed you see does not belong to me.
The land you view is privately owned
by people we'll talk to I'll be bound.
A consolation in this is conceived,
gorse flowers and such are attractive to bees.

Northern Advocate 21/4/95

Tough measures proposed for pests on hit list

By Matt Johnson

A hit list of the baddies of the animal and plant kingdom is detailed in a draft plan for pest management in Northland.

The 113-page Northland Regional Council strategy document looks at which species pose threats to Northland's economy, environment or cultural values and how best to control them.

The paper suggests tough measures to protect the region — going as far as proposing bans on keeping possums, ferrets, and chinchillas as pets, prohibiting goat farming in certain areas and looking at ways of keeping out some species not yet here, for instance rook and wallaby.

The council screened 19 animals and 73 plants nominated as pests during public submissions made in July and August last year, examining the economic, environmental and cultural impacts of each.

Animal pests singled out are (in no particular order): feral cats, ferrets, stoats, weasels and Norway rats, feral deer, feral goats, possums, rabbits and hares, magpies and mynas, wasps, rook, chinchilla and wallaby.

Plant pests are: African feather grass, Bathurst bur, broom, gorse, lantana, Manchurian ricegrass, nasella tussock, nodding thistle, pampas grass, privet, ragwort, spartina, wild ginger, eelgrass, hydrilla, nardoo, old man's beard, Port Jackson fig, rhamnus, Senegal tea, skeleton weed and water poppy. There are also five species of aquatic weeds and 32 "forest invader plants".

Two plants nominated — salvinia and water hyacinth — were not considered because they are expected to be covered by a national pest management strategy.

NRC land operations manager Bob Cathcart said today the pest strategy had taken about six months to compile and would be released for public comment toward the end of next month.

The 39 submissions which helped shape the draft strategy came from individuals, ratepayers, farming and environmental groups, local authorities, government departments and Northland Health.

Mr Cathcart said the council hoped as many Northlanders as possible would make submissions on the proposed strategy, which was designed to last no more than five years and could be modified as needed as the council gained a better understanding of each pest.

He said that under the plan action could range from simply monitoring a pest and offering advice on how to deal with it — myna, for example — through to active control of pests like possums.

RURAL ROUND UP

TUTU WARNING

Rodney noxious plants officer Des Trafford shows the poisonous native plant tutu, responsible for two stock deaths this month.

Mr Trafford says the new shoot (right) is particularly lethal and liable to be eaten by stock searching for alternative food sources while normal winter feed is in short supply.

Plants are sometimes blamed for stock loss when no other cause can be found, says Mr Trafford. He says some plants may be toxic only at certain times of the year, stages of growth or in a particular soil.

"Travelling stock or stock made ravenous by drought or winter food shortages may eat hungrily on plants they would normally refuse," says Mr Trafford.

Such plants may be less of a risk if eaten with other fodder or consumed slowly, he believes.

Mr Trafford says tutu is one of the worst, although pasture weeds like fox glove, hemlock, variegated thistle, some buttercups, and ragwort can also cause problems.

He suggests owners keep their stock away from bush areas and hedges while also keeping pasture weed-free.

Rural viewpoint

Pest management

By Martin Workman,
CEO Northland FF

Federated Farmers has been asked to comment on the Northland Regional Council's Pest Management Strategy. This strategy considers how best to manage every pest imaginable, other than those of the two legged variety.

The animal pests to have a Regional Management Strategy include:

* wild cats, ferrets, stoats, weasels and Norway rats
* wild deer
* wild goats
* possums
* rabbits and hares
* magpies and mynas
* wasps
* rook, chinchilla, and wallaby

Over 50 plant species are also to be managed as pests.

Notable omissions from the pests to be managed include, wild cattle, pigs, dogs, paradise and mallard ducks, and Australian sedge and blackberry.

These pests were not considered to have serious adverse effects on the region's economic well-being or its environmental or cultural values. They were considered harmful but not serious pest and it is believed regional intervention would achieve little more than can be achieved by individual action.

The council needs to know whether landowners agree or disagree with this.

The majority of the pests will be managed through the council providing advice and publicity to encourage people to control the pests. The council will be involved directly in the control of wild deer, goats, rabbits and hares, and possums.

Possum control is the biggest priority with council spending $1.4 million in the next 12 months. A key issue in the Pest Management Strategy is who pays for the work. The general thrust is that the beneficiaries of the pest management strategy pay for the control.

In the case of possums the whole community benefits from protected forests and coastal pohutukawa after possum numbers are reduced. It's appropriate that the community funds initial control and maintenance in public areas. However, the council believes the direct benefits rural landowners gain from increased production following possum controls means they should carry the cost of maintenance on their land. This is disputed by some farmers. They argue they are forced to protect native forest on their own land for the benefit of the community, and now they must pay for the maintenance of that community resource.

A positive aspect of the strategy is a requirement on district councils and Transit New Zealand to plan for the eradication of gorse, broom, privet, pampas grass, and wild ginger from road reserves under their jurisdiction.

Pests cost us dearly to manage. Yet we are still importing pests. MAF control over seed importation and the garden plant importation industry is woefully inadequate. Many plant species being imported into the country are related to species which have already established themselves as weeds in New Zealand.

It appears the past mistakes of importing gorse, possums and rabbits are still to be learnt from.

Franklin's rural scene

Airboat attacks alligator weed

☞ **Manu Daji in the airboat with Geoff Angell and Graham Coote, during a spraying session on the Waikato River.**

Environment Waikato has engaged an airboat to help in the spraying of alligator weed at Port Waikato.

"The initial work will be conducted during mid-April on the smaller, scattered sites within the island delta system of the river," says noxious plants officer Manu Daji.

The airboat sprayer is the brainchild of Rotorua engineer Geoff Angell.

"It is the ideal craft for spraying alligator weed in this situation, where the water is very weedy and shallow, and difficult for normal boats to operate in," says Manu.

"It is similar to those used in the Florida Everglades in the United States," says Geoff. "It has a flat boat hull and is pushed along by a 150hp Cessna engine propeller. The craft literally flies over the water."

"Alligator weed poses a serious threat to the delta stream of the lower Waikato River," says Manu. "If left unchecked, it will spread quickly into drains, tributaries and wetland areas causing blockage, sedimentation and flooding problems."

From field observations he has made in the area, Manu also feels alligator weed could destroy the major whitebait spawning sites on the river, if it is allowed to grow uncontrolled.

Spring