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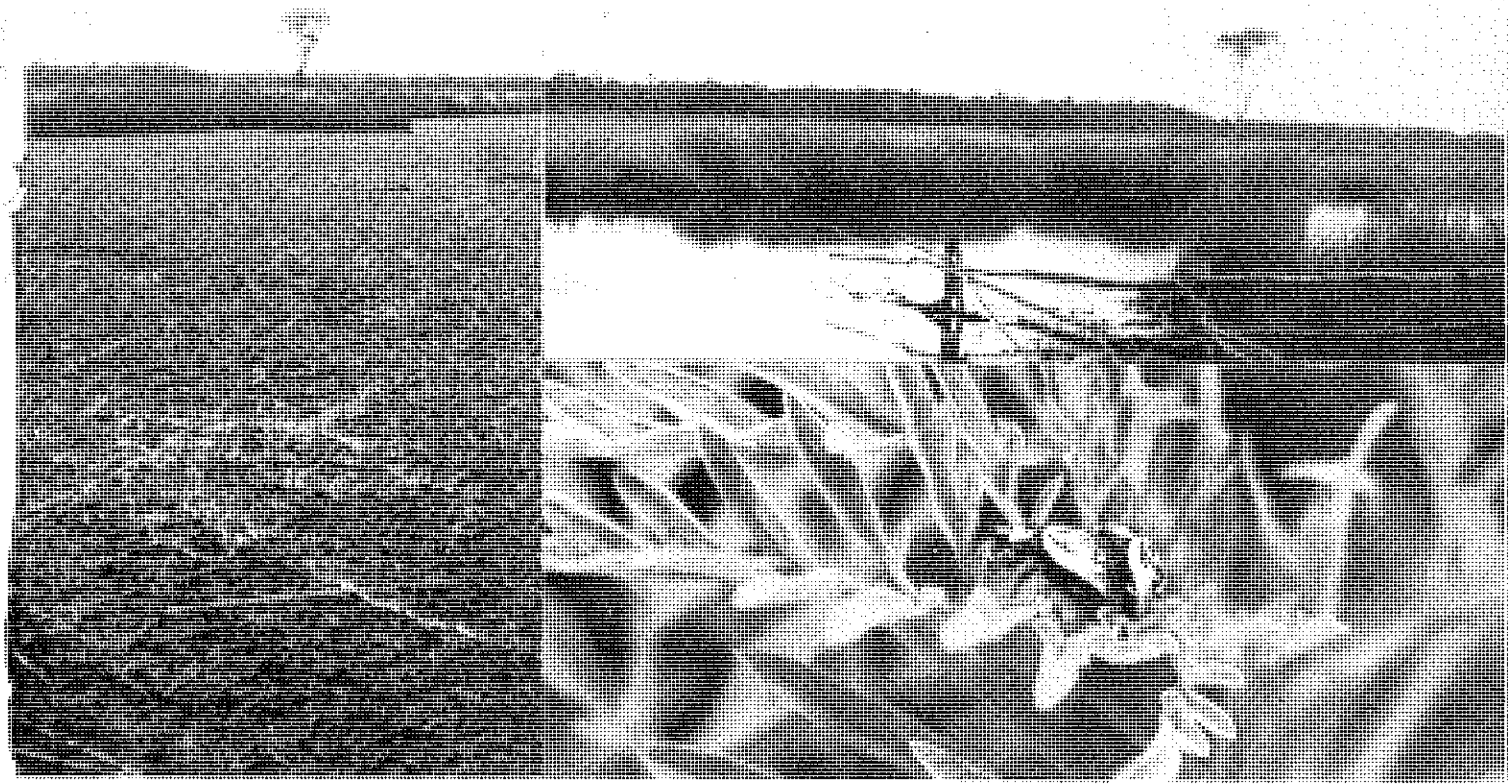

NSW Agriculture & Fisheries

COVER ILLUSTRATION

Before and after effects of *cyrtobagous salviniae* on salvinia.

Zygogramma bicolorata on ragweed.

(Photographs by Robert Dyason - Grafton)

Cover Design by John Hoye, NSW Agriculture & Fisheries, Goulburn

P R O C E E D I N G S

OF THE

5TH BIENNIAL NOXIOUSPLANTS CONFERENCE

"NOXIOUS PLANT CONTROL - RESPONSIBILITY, SAFETY AND BENEFITS"

V O L U M E   I

NORTHERN RIVERS COLLEGE OF ADVANCED EDUCATION

L I S M O R E

17th - 21st JULY, 1989

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CONTENTS

MYCOHERBICIDES

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Introduction

Mycoherbicides are fungal plant pathogens applied to control weeds in the same way as conventional herbicides. The prefix myco derives from the Greek word for mushroom *mukes.*

There are two commercial mycoherbicide products on the market in the USA, Collego and Devine and others in development in the USA, Canada, The Netherlands and Australia.

Mycoherbicides are a form of biological control but differ from classical biological control in a number of ways. Unlike classical biocontrol agents the biological agents used in mycoherbicides do not spread reliably of their own accord and are not normally found in nature in sufficient quantities to cause epidemics. Thus, to be effective, mycoherbicides have to be applied directly to the target plant in a high concentration (typically 10^6 to 10^7 fungal spores per millilitre) water based spray.

Mycoherbicides have been developed from fungi already present in the environment. This is an advantage when compared with the use of imported organisms for biological control. There is always a risk, though often remote, of exotic species infecting non-target species. Although wide scale short range testing is carried out, it is impossible to test a candidate fungus on the entire flora of a country.

Research Project on *Xanthium* weeds

NSW Agriculture & Fisheries has a mycoherbicide research project based at the Agricultural Research & Veterinary Centre, Orange. The current emphasis of research is the control of Bathurst burr *Xanthium spinosum*(L) by the fungus *Colletotrichum orbiculare* (Berk. et Mont.) v. Arx (Walker and Nikandrow, unpublished).

Bathurst burr is an important weed of pasture and summer cropping. The burr is a cause of wool fault in fleeces throughout eastern Australia. In crops such as soybeans, cotton and lucerne, often grown under irrigation, Bathurst burr is a competitive weed reducing yield and contaminating the seed product. In these situations Bathurst burr can often not be controlled by conventional herbicides, such as 2,4-D because of the proximity of susceptible plants. Apart from Australia, Bathurst burr is also a weed of some importance in South America and South Africa.

In 1984 a survey was conducted throughout south eastern Australia to look for possible biocontrol agents. During this survey the fungus *Colletotrichum orbiculare* was found to be causing anthracnose on *X. spinosum* in several locations (Nikandrow, Weidemann and Auld, unpublished). In the field the fungus caused leaf and stem lesions, only occasional plants were found to have been killed by the fungus. In preliminary glasshouse tests isolates of the fungus were pathogenic to *X. spinosum* producing symptoms of seedling blight and anthracnose on older plants.

Assessment began at Orange for the potential of the fungus as an inundative control mechanism.

As one of the criteria for a successful commercial mycoherbicide is inexpensive mass production of the infective propagules, experiments were initially undertaken to assess in vitro fungal production. The fungus grew well in liquid shake culture using standard laboratory media. In excess of 10^6 conidia ml^{-1} were produced after 7 days incubation; the viability of the spores being 93% (Auld, McRae and Say, 1988).

The response of *X. spinosum* to increasing inoculum concentration was determined because inundative biocontrol depends upon the application of the biocontrol agent at high concentrations. All plants inoculated with $\geq 10^6$ conidia ml^{-1} died within 21 days. Sporulation occurred four days after the appearance of stem lesions suggesting the possibility of natural secondary infection.

A series of controlled environment experiments were conducted on *X. spinosum* plants to establish optimal conditions for disease development (McRae and Auld, 1988). The results showed that temperature is not likely to be a limiting factor for this fungus as a mycoherbicide because the temperature range at which maximum disease development occurred was within that which occurs during the growing season of Bathurst burr. Disease development was however increased with increasing dew duration and high relative humidity. In addition, dew within 4 hours of inoculation and a dark period during the dew period significantly increased disease. The absence of these factors although restricting the effectiveness of the fungus as a mycoherbicide can to some extent be overcome by artificial inoculation techniques. The humidity level at inoculation and to some extent during the dew period could be increased using more efficient carrier agents, invert emulsions or applying the fungus as a gel or granular preparation. Such inoculum preparations would also overcome problems associated with a time delay between inoculum challenge and onset of dew conditions. Mycoherbicide application could also be timed to occur when environmental conditions most favour infection. A late afternoon or early evening field application would maximize the effect of natural dew and accommodate the fungal requirement for darkness during infection. Also the fact that effective dew periods for infection were less for high temperatures is encouraging.

For a mycoherbicide the fungal spores need to be formulated into a stable product. A dried powder with at least a six months shelf life can be prepared from a water based slurry of kaolin, an aluminium clay.

Field Tests

Field testing of the mycoherbicide began in 1987. During the past two summers trials have been conducted under a range of climatic conditions on transplanted populations at Orange and Forbes, on a natural population in grazing land at Wellington and Cowra and in an irrigated soybean crop at Yanco.

The results from this work have been encouraging and some general conclusions can be made. The age of the plant, rather than the physiological status was the more important factor in disease development. Younger plants were killed more quickly than older plants. In older plants there was a slower development of disease almost without visible symptoms. Death may seem to suddenly occur six to ten weeks after inoculation.

When inoculating natural field populations at Wellington environmental conditions were not optimal for disease development. In the twelve hour period after inoculation the dew period ranged between 0.3 and 7 hours and the temperature fell below the optimal level. Disease development is slower under such conditions but 8–10 weeks after inoculation 88 to 93% of all plants had been killed.

High plant mortality rates of approximately 88–99% were recorded in soybean crops eight weeks after inoculation. In these irrigated crops the plant continues to germinate throughout the growing season. We have found in glasshouse experiments that the fungus will only cause secondary infection if there is movement of water above the soil surface. Some disease spread does occur between inoculated and non-inoculated plants if there is frequent dew development or rain. It is probable that in irrigated crops the humidity will remain high under the canopy cover and the disease will spread from inoculated plants to provide secondary infections.

The novel use of the fungus as a mycoherbicide is the subject of a patent owned by the Department (Auld, 1988). In 1988 the Department advertised for expressions of interest from commercial firms to develop a product based on research done at Orange.

The Swiss based international firm, Sandoz, which has experience in agricultural chemical formulation and marketing, biocontrol products and fermentation technology was chosen as the commercial partner from several interested companies. They have begun commercial scale fermentation tests and will be co-operating with us in field trials in eastern Australia this coming summer.

Further research is aimed at using the fungus to attack Noogoora and Hunter burrs (*Xanthium occidentale* (Bertol.) and *Xanthium italicum* (Moretti)) which are major weeds in Australia and the USA. The fungus is only weakly pathogenic on these species and techniques to increase its effectiveness are being studied.

Histological work is being conducted for a greater understanding of the interaction between host and non hosts and hence the barriers to disease development. We are currently investigating the possibility of formulating the mycoherbicide with enzymes to help break down the plant's cuticle and so assist the penetration of the fungus. In another line of research we are cooperating with scientists at the USA universities, Cornell and Arkansas, in cloning genes for cutinase in bacterial plasmids for insertion into the *Colletotrichum orbiculare* fungus itself.

Acknowledgements

We thank Mrs K. Radburn for assistance. The project is currently financially supported by the Australian Wool Corporation, Sandoz (Switzerland) and the Cotton Research Committee.

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RAGWEED, PARTHENIUM AND NOOGOORA BURR CONTROL IN THE POST-*EPIBLEMA* ERA

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INTRODUCTION

The stem galling moth *Epiblema strenuana* was introduced from Mexico for the biological control of Parthenium weed in Queensland. After releases in January 1983, it was widespread in Central Queensland by winter 1984. In summer 1984-85 releases were made throughout the Parthenium and Ragweed areas of Queensland, and in coastal NSW as far south as Coff's Harbour. In 1986, releases were made on Noogoora burr on the Victoria, Daly and Gulf Rivers in the NT, and on the Ord River in Western Australia in 1987. The moth now occurs throughout most of Queensland from Cape York south, although in the western half it is only present after general rain has germinated the burr.

The adult moth, about 1 cm long and inconspicuous, lays eggs singly on the leaves. On hatching, the minute larvae feed initially in the leaf, then bore into the stem through a bud, where each larva feeds inside a swelling or gall in the stem. When full grown, they pupate in the gall and the moth emerges through a hole. The life cycle takes as little as 4 weeks in hot weather, and large females can lay over 1000 eggs. Development and increase is much slower however if the weather is cold or the plants scarce or drought-stressed.

PRESENT SITUATION : CONTROL DUE TO *EPIBLEMA*

(1) The most obvious visible effect is a noticeable reduction in plant height. The effect is greater in some areas or seasons and less in others, but is very significant overall, both in parthenium and in ragweed.

Even in this year's ideal conditions, most Parthenium in central Queensland is 50 to 100 cm tall when flowering, and plants over 150 cm tall are rare. Any Parthenium stands over 150 cm tall seen now are plants which have not been attacked by *Epiblema* because of local seasonal conditions, and the extensive areas of 2 metre tall Parthenium, which used to be common on good soils after rain, are now a thing of the past. The same has occurred with ragweed along the coast, and with Noogoora burr in areas with reliable rainfall.

These plants are annuals, and require large quanties of seed each year in order to persist at pest levels. But seed production is a function of the biomass i.e. the volume or possibly the surface area of the plant, considering the plant as half of an ellipsoid. Thus halving the linear dimensions (height, spread) reduces the surface area by 1/4 and the volume by 1/6, i.e. a 1 m tall plant produces not half as much seed as a 2 m plant, but somewhere between 1/4 and 1/6 as much. The same will apply to total pollen production in ragweed.

(2) A less noticeable effect is increased seedling mortality. Particularly in pasture, seedlings attacked by *Epiblema* early in the spring are not killed directly, but will fail to outgrow the grass, and therefore die without flowering. This effect will depend on heavy *Epiblema* attack early in the season, and thus will only be noticeable in favourable years.

(3) Work in Holland with another *Epiblema* attacking spear thistle (*Cirsium vulgare*) showed that although the level of insect attack, and also of seed production in undamaged stems, varied enormously from year to year (probably due to weather etc), nevertheless *Epiblema* attack consistently reduced the number of flowerheads to only 7% of those in undamaged heads, and in some years to much less (Klinkhamer *et al*, 1988).

Spear thistle only produces a single flower stalk, and the effect of damage may thus have been greater, but with ragweed or parthenium it is likely that seed production on each stem attacked is reduced to this extent, and it is common for over 50% of flowering stems to be attacked by *Epiblema*. This study thus confirms that heavy *Epiblema* attack probably reduces seed production to about 1/6 of that in unattacked plants.

(4) Records of a light trap run at Sherwood for the last 3 years (Figure 1) show that the *Epiblema* abundance in the area varies greatly from year to year and in ways that we do not properly understand at present. The very mild winter and hot spring last year increased over-winter survival and produced a very large spring emergence peak, which merged into the summer emergence without the usual October/November population fall. However, very hot dry weather in October and November caused heavy larval mortality and numbers crashed. In late summer and autumn this year (February to April), *Epiblema* levels were still well below those in 1987 though not below last year. Seasonal fluctuations of this sort, due we believe to weather conditions, naturally affect the degree of control obtained. Fluctuations will be even more extreme on Parthenium and Noogoora burr in inland areas.

OTHER INSECTS

On parthenium, 2 other insects have been established in Central Queensland, a stem boring weevil, *Listronotus setosipennis*, from Brazil and a very small leaf-feeding moth from Mexico, *Bucculatrix* sp. The moth is widespread and common, the weevil is widespread but still rare; neither have a really significant impact on the plant though every little helps!

On ragweed, the only other insect is the leaf-feeding beetle *Zygogramma bicolorata*, which is common and seasonally abundant throughout the ragweed area. It can cause significant damage in local areas but this is very patchy and its overall impact is small.

FUTURE

We are still actively working on the biocontrol of all 3 plants, with 5 or 6 insects and a rust disease at various stages in the process leading towards field release. It seems unlikely that any one will be the sole and sufficient control agent, but conversely it does seem that the combined effect of insect damage will gradually reduce these weeds until they are no longer a problem. Already, several of the better managed properties, even in the worst affected areas of Central Queensland, have been able to defeat parthenium by reducing stock numbers and thus increasing grass cover. The important fact to note is that after the first year or so, their production figures and therefore income have recovered to previous levels. That is, with more grass the cattle reach sale weight more quickly and the income per hectare is not reduced even with lower cattle numbers. Typically, either no herbicides at all are used or else spot spraying only around yards, dams etc. These results were not being achieved in the pre-*Epiblema* era, and increased attack by new agents should increase this effect in the future.

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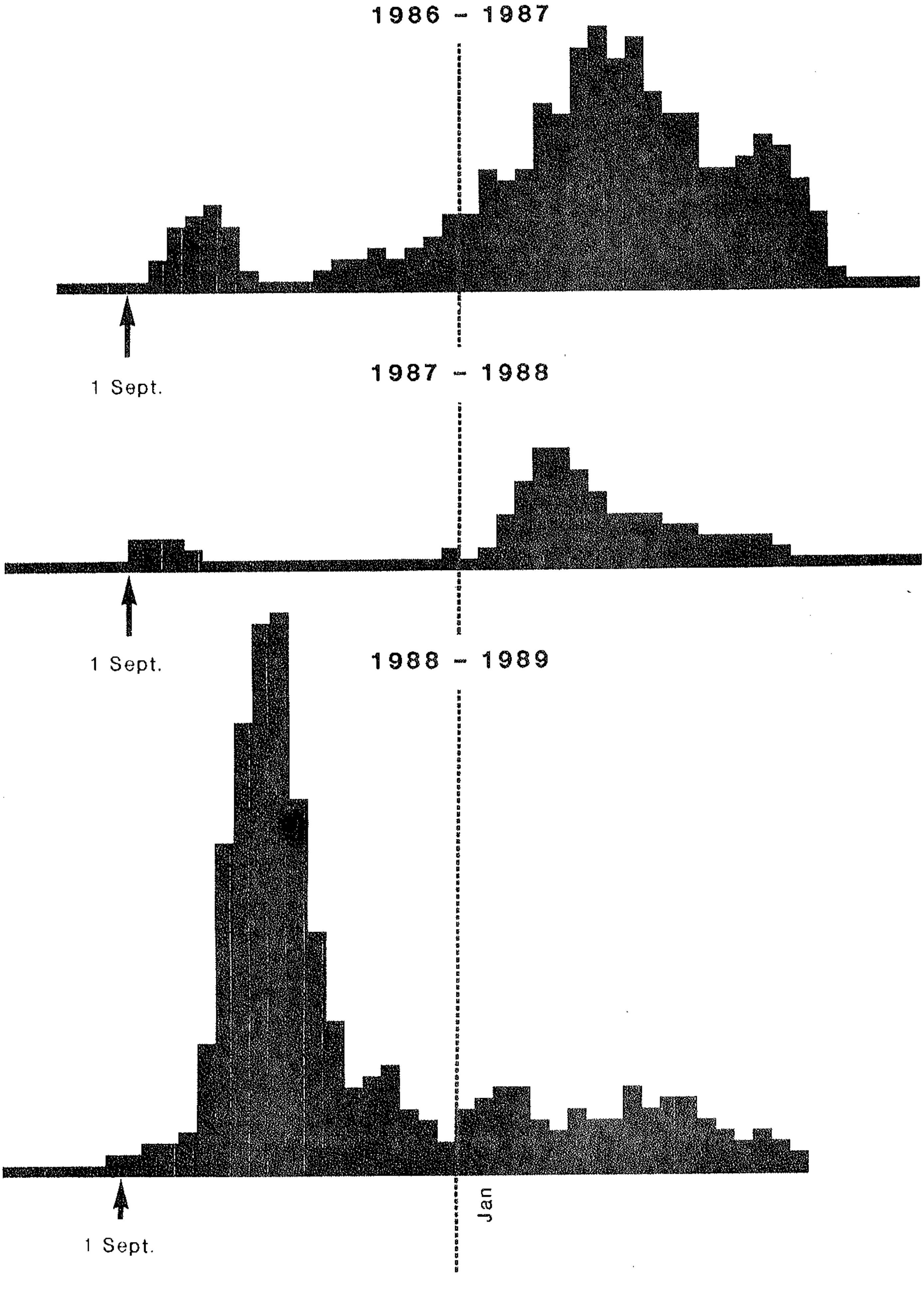
Figure 1 EPIBLEMA moths caught in light trap at Sherwood, Qld



DEVELOPMENTS WITH DODDER CONTROL

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INTRODUCTION

Golden Dodder (*Cuscuta campestris*) an introduced parasitic weed is a threat to lucerne, vegetables, many broadleaf crops and pastures throughout N.S.W.

Despite its declaration statewide as a Noxious Plant in N.S.W., South Australia and Victoria, new infestations are being found, principally in river valleys. Its spread has escalated over the last three years, putting many major crops grown in areas adjacent to infested watercourses at risk.

Golden Dodder has proved to be a difficult weed to eradicate. Its seed can survive for long periods, it grows rapidly and can commence seeding after only a few weeks growth. It will grow on a wide range of host plants including broadleaf crop vegetables, weeds, native vegetation and some tree species. Gaerter (1950) reported 67 species in 24 families as hosts.

To date the main methods of control have been the use of cutting and burning, crop rotation and non-selective herbicides. Several new developments in control including research into selective herbicides and management strategies such as habitat manipulation give hope for the future.

DISTRIBUTION AND SPREAD

Golden Dodder (*Cascuta campestris*) infestations are not new. Infestations were thought to be introduced from North America over 50 years ago. However, an explosion of the weed has occurred over the last three years.

Chilean Dodder (*Cuscuta sauveolens*) was found in three stands of South Australian lucerne in late 1985 and in new lucerne sowings at Hay and Darlington Point in 1987. No further outbreaks have been found.

Chilean Dodder has proved to be just as devastating as Golden Dodder in many ways in Europe and New Zealand. It is a low growing dodder usually not reaching as high as the canopy of a lucerne crop and may not be noticed until the lucerne is cut. It is deeper colour than Golden Dodder and its florets are larger and petals fringed.

Golden Dodder is commonly found in association with rivers and flooded areas, since water-borne seed is one of the main factors in its spread. Dodder seeds can germinate when covered with water several inches deep, and the seed is able to live and grow in water for about ten days (Urton 1945). While mature seed does not float and cannot be transported over long distances, seed is often present on other trash or in capsules that can float in running water. The small size of Golden Dodder seed allows them to be picked up in irrigation suction lines and has been the cause of several infestations in the Hunter Valley.

Golden Dodder is now widespread in many river valleys in N.S.W. The heaviest infestations occur on the Namoi River near Manilla, the Lachlan River at Forbes, Cowra and Lake Brewster, the Bylong Valley and Goulburn River, the Hunter Valley Catchment, Paterson and Williams River and the Murrumbidgee River downstream of Hay. Other isolated infestations occur state wide.

PRESENT CONTROL METHODS

To date control programs have been based on preventing infestations, controlling weed hosts, cutting and burning to destroy seed, herbicide control and crop rotation. A long term approach is essential for success. Regeneration of seed for up to five or six years is likely, so follow up programs have to be implemented, otherwise initial work may have been in vain.

Presently there are only three pesticide orders for the use of the following *non-selective* herbicides for dodder control in N.S.W.

Active Ingredient	Product	Spot spray rate/100 L	Boom spray rate/ha	Order Number
Diquat 200 g/L	Reglone^{R}	100 mL	1.5–3 L	PO-DIQT-1
Glyphosate 360 g/L	Roundup^{R}	1 L	0.5–9 L	PO-GLYP-4
Amitrole 250 g/L + Ammonium thiocyanate 220 g/L	Weedazol^{R} TL	1 L	3–4 L	PO-AMIT-AMOT-1

When using herbicide as a means of control of dodder, it is important to spray to one metre outside the perimeter of the dodder infestation.

There are no selective herbicides registered for the control of dodder in crop or pasture situations which will not affect the host plant, though perennial plants such as lucerne, providing they are at least one year old, are not permanently damaged by the Reglone^{R} treatment.

Widespread control has been hampered by the lack of selective herbicide control. Where dodder occurs in crop or pasture situations the cost of control escalates when the crop or pasture is damaged or destroyed by herbicide treatment of the dodder.

A lack of awareness of the dodder threat by landholders, misconceptions over responsibility for noxious plant control along river and stream banks and the possibility of reinfestation from properties further upstream has further hampered control work.

FUTURE DIRECTIONS FOR CONTROL

Co-operation within a Catchment (A Hunter Valley Example)

Golden Dodder control can only be conducted on a catchment basis once it enters a valley.

To achieve this the combined efforts of landholders, various government bodies, Pastures Protection Boards and councils is required.

Such a scheme was instigated in the Hunter Valley last year.

A concerted effort is being made to help landholders control Golden Dodder within the high bank and river bed areas of the Hunter and Goulburn River systems. Control work is being conducted by the Department of Water Resources from funding provided by the Hunter Valley Conservation Trust and co-ordinated by the Upper Hunter Noxious Weeds Advisory Committee of NSW Agriculture & Fisheries.

This control program aims to:

* protect the viability of Hunter Valley agriculture (principally the lucerne and vegetable industries) by controlling Golden Dodder.

* protect the valuable riverside vegetation and river protection works that maintain the stream bank stability. Willows, Poplars and seedling Eucalypts have been parasitised spraying programs.

* minimise the spread of Golden Dodder seed downstream from upper catchments, providing an incentive for landholders to co-operate and to co-ordinate landholder and government by Golden Dodder.

A total catchment management approach has been developed. It has been necessary to start the program in the upper reaches of the various rivers and streams, and progressively work down over a number of seasons. In the first season (1988/89) control work has been conducted along the Hunter River from Aberdeen (Rouchel Brook confluence) through Muswellbrook and to Denman (Goulburn River confluence). Over 55,000 litres of spray mixture (Roundup at 1% v/v) has been applied to the infestation along this 72km length of river bank. Golden Dodder has been prevented from seeding in the programmed area this year due to the spraying program and high river levels.

This program does not, however, negate the landholders responsibility to control this noxious weed. Without a concerted effort on behalf of all landholders, Golden Dodder could cause irreparable damage to individual farms as well as to the valley as a whole.

To ensure landholders awareness of the problem, NSW Agriculture & Fisheries initiated a **'Dodder Action Group'** who 'saturated' the media with dodder warnings. Press releases, radio interviews, field days, shows, and direct mail publications were all used in this successful awareness campaign. Over 90% of landholders adjoining Upper Hunter river systems are now aware of the dodder threat.

Initial success has been outstanding. Landholders, councils and government departments such as National Parks and Wildlife Service and Department of Water Resources have been enthusiastic and are backing the program with co-ordinated spraying programs. Overall success will however depend on continued efforts to prevent reinfestation and this responsibility will fall more and more on individual landholders.

Herbicide Research

Research over the last three years has indicated that the selective control of Golden Dodder may soon be possible in lucerne crops, grass pastures and non-crop areas.

The herbicide Ally^R or Brushoff^R (metsulfuron methyl), is looking particularly promising for control of dodder in cereals, grass pastures and non-crop situations, with minimal damage to desirable host species in comparison to the current Amitrole, Diquat and Glyphosate registrations.

Large scale trials adjacent to the Murray River near Loxton S.A. have indicated that Ally^R at 1g product : 200 L water plus wetter, will effectively control dodder and Californian burr (*Xanthium californicum*) seedlings, with minimal damage to desired plants (Crocker 1988). Initial studies in N.S.W. suggest similar results on Dodder and Noogoora Burr (*Xanthium occidentale*).

Ally^R at 2.5 g/ha effectively controlled dodder in lucerne when applied within ten days of the last cut (or more preferably within 2–3 days of cutting), however, Ally^R causes high yield reductions in the lucerne cut following application and cannot be recommended (Crocker Pers.Comm).

Herbicides which are translocated but not metabolised are concentrated by dodder (Cooke & Black, 1987). This explains how low concentrations of Roundup^R (glyphosate) can be so effective on dodder.

Glyphosate at 0.075 kg/ha (eg Roundup^R at 208 mls/ha), sprayed onto lucerne foliage will kill almost all visible dodder tissue while the lucerne is not noticeably injured (Dawson & Saghir, 1983). However, some dodder may recover from haustoria (suckers) within the lucerne stems or crowns.

Similarly Crocker (1988) demonstrated that Roundup^R at 250 mls/ha, plus an organo-silicone penetrant Pulse^R at 1:1000 v/v will selectively remove dodder from lucerne with minimal loss of lucerne yield. Roundup^R at 1:1000 v/v plus Pulse^R as a spot spray will control dodder effectively, but is both non-selective and non-residual.

Reinfestation of herbicide treated areas from seed still remains a problem where non-residual herbicides are used. Several recent studies have been conducted to evaluate the effectiveness of herbicides on the viability of dodder seed.

The use of a Amitrole T^R (1.1:100 v/v) and Reglone^R (1:1000 v/v) mixture appears to reduce the number of dodder seeds produced within a given season and may prevent the formation of viable dodder seed if applied prior to dodder flower initiation (Crocker, 1987). But the mixture has no significant effect on the viability of mature dodder seed.

Reduction in the seed set of dodder sprayed while actively growing, and with advanced flower clusters was reported by Milvain (pers.comm). Ally^R reduced seed set better than the Roundup^R treatment.

	Concentration	Reduction in Seed Set
Nil treatment (control)		0 %
Roundup R	1:100 v/v	28 %
Ally R	1:200 v/v	62 %
Ally R	1:100 v/v	55 %

It would appear that Ally R treatments prevented further seed set because of the quick cessation of growth within the host plants after treatment.

Propyzamide (Kerb R or Poakill R) and an experimental herbicide Pursuit R (S.N.106664) have shown great promise for selective control in lucerne. However, all herbicides may have to be re-applied after four weeks, or following each lucerne cut.

This herbicide research will have a significant impact on the cost effectiveness and efficacy of Golden Dodder control in the near future.

Habitat Management

Managing habitats to reduce dodder infestations can be very effective. This year the large 600 ha infestation on Lake Brewster, the irrigation storage area on the Lachlan River, has been controlled by maintaining high water levels during the summer period. A similar management strategy is being considered for the Hay Weir Pool.

Pump Filters

One potential source of dodder contamination is from irrigated water. In districts where pumps are used to initially draw water, it may be possible to 'filter' dodder seed.

The seed is small (1.2-1.7mm in length, 0.8-1.3mm wide and 0.7-1.0mm thick). Seed of this size can be easily picked up in irrigation suction lines and thereby spread onto paddocks.

There are perforated cylinder filters and disc filters that are capable of filtering out these seeds in the pumping mainline, while providing adequate flow rates at pressures common in irrigation systems. The main obstacle to simple filtration is the high sand load carried in river systems such as occurs in the Hunter Region. However, filters should be able to trap dodder seeds while allowing finer suspended sands to pass through. Automatic self cleaning filters are available and depending on flow rate required usually cost less than $1500.

Biological Control

No biological control agent is available in Australia for Golden Dodder. Research has been conducted since 1960 in Pakistan, Hungary and the U.S.S.R. and several potential insects and fungi have been identified (Cooke & Black, 1987). The Smicronyx weevil is the most promising, but there has been no examination of biogents undertaken in Australia.

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PASTURE MANIPULATION/MANAGEMENT FOR CONTROL OF WEEDS WITHPARTICULAREMPHASISONPARRAMATTAGRASS,*Sporobolusafricanus*

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INTRODUCTION

Competitive, healthy well managed pasture is recognised as an essential component for long term weed control in pastures.

As well as competing more effectively with weeds a vigorous productive improved pasture has obvious benefits of better animal performance and yields as compared to unimproved and poorer quality pastures.

Pasture management and manipulation strategies with the grazing animal to encourage desirable species, reduce seeding of undesirables, to prevent seedling regeneration of weeds and to clean up woody weeds have been developed or are being progressively developed.

The use of strategic heavy summer/autumn stocking with wether sheep to prevent seeding and to control wire grass *Aristida ramosa* on the northern slopes, grazing manipulation to encourage seeding and a build up of desirable native pasture species on the northern tablelands, grazing management of pastures to maintain heavy groundcover and prevent seedling regeneration in Scratted Tussock *Nasella trichotoma* control programmes and the use of goats to control woody weeds such as blackberry *Rubus* spp. are good examples of grazing manipulation/management to control undesirable weed or plant species.

Do such or similar strategies have a place in control of giant Parramatta grass *Sporobolus africanus*?

Before addressing this question it is desirable to give a brief background to the pasture situation and giant Parramatta grass problem on the North Coast of N.S.W.

BACKGROUND

Native/Naturalised pastures

The majority of pastures on the North Coast are unimproved, summer growing, grass dominant consisting of native and naturalised species. These are the major pastures on the poorer low fertility soils with species such as Carpet grass *Axonopus affinis*, Blue and Wire grasses, *Bothriochloa* and *Dicanthium* spp., Couch grass *Cynodon dactylon*, Spear grasses *Stipa* and *Aristida* spp. and Blady grass *Imperata cylindrica* being common pasture components.

Native/naturalised pastures in the region are used for extensive beef cattle breeding and grazing for production of store animals which are grown out or fattened on better quality pastures on the coast or more commonly in other regions of the state or interstate.

The level of pasture management on much of this land type is very low with burning in spring, some timber and lantana control, fencing and sometimes dam construction for stock watering being the common management strategies.

At this level of land management and with the types of native naturalised pastures they are no match in preventing invasion of an aggressive weed species such as giant Parramatta grass.

Giant Parramatta grass

Because of its various characteristics giant Parramatta grass poses a major threat to the grazing industries of the North Coast and must be regarded as a most insidious and serious threat to pasture lands in the Region.

Very heavy infestations of the weed now occur on the Mid North Coast in the Coffs Harbour, Bellingen, Nambucca and Grafton areas with rapid spread occurring to the north and south of the heavily infested districts.

Although this grass was first described in New South Wales in 1802 its potential to rapidly colonise a wide area in the summer rainfall areas of coastal N.S.W. and Queensland has only recently been recognised.

On the North Coast giant Parramatta grass first appeared as a problem at Nana Glen in the Orara River Valley in the late 1920s. It was slowly spread from farm to farm by cream and calf lorries and in the late 1960s and early 1970s regular slashing of farms in the area is thought to have extensively spread the grass seed with the resulting dense swards that now exist in the Orara Valley.

The rapid spread in recent years from the Orara Valley is thought to be caused by increased use of road transport for stock, roadside slashing, movement of equipment such as bulldozers, farm machinery, milk tankers, motor vehicles and seed adhering to animal hair or hooves. It is also thought that flooding in the Orara and Clarence River systems may be an important means of seed dispersal.

There appears to be much variation within *Sporobolus africanus* ranging from small, intermediate to giant forms, however it is the giant form that poses most problems.

The giant form is very aggressive and competitive and will grow on a wide range of soil types from fertile alluvial soils to poorer quality hill soils. It also appears to be well adapted to a wide range of climatic and rainfall conditions. The plant is very unpalatable with low digestibility and stock tend to selectively graze other pasture species in preference. However in dry seasons or when feed is scarce cattle will eat it.

Giant Parramatta grass is an extremely heavy seeder and will set seed during the frost free periods of the year with the peak of flowering and seed set in the late summer/early autumn seasons.

Most pastures on the North Coast are not sufficiently competitive to prevent the invasion of giant Parramatta grass. On the better quality more competitive kikuyu and more intensive type pastures Parramatta grass is a lesser problem, dense well managed pastures tend to keep it at a manageable level. However most pastures on the North Coast do not offer this competition and the potential is great for giant Parramatta grass to dominate these pastures if not controlled. Once this grass dominates animal production declines and the cost of control can be high, and in many cases on the poorer lands, uneconomic.

The major consideration to control giant Parramatta grass must be to prevent the further spread of seed on the North Coast and control new infestations as they occur.

Areas already heavily infested, control strategies utilizing an integrated approach involving various combinations of ecological, mechanical, grazing management, competitive pasture and herbicides are progressively being developed.

CONTROL STRATEGIES TO DATE

Control attempts in Parramatta grass infested areas have ranged from chipping out or spot spraying isolated plants and light infestations, to slashing/mulching, burning, cropping, fertilizing, blanket spraying mainly with the herbicide Frenock and more recently 2,2-DPA on heavy infestations. These types of control efforts have met with varying degrees of, or lack of success.

Unfortunately, in most situations due attention has not been paid to the need for competitive pastures to replace Parramatta grass, there has been a perception among the farming community that a herbicide or other treatment alone will solve the problem. However this perception is diminishing rapidly as it is increasingly realised that competitive pasture species are an integral part of a giant Parramatta grass control programme.

A particular problem exists where Frenock is used at the registered rate (2L per ha) on giant Parramatta grass infested pastures which have a high content of carpet grass. The carpet grass is also knocked out. This leaves large bare areas in the pasture in the following summer or two and has been a major reason for rapid Parramatta grass reinvasion from soil seed reserves. See Figure 1.

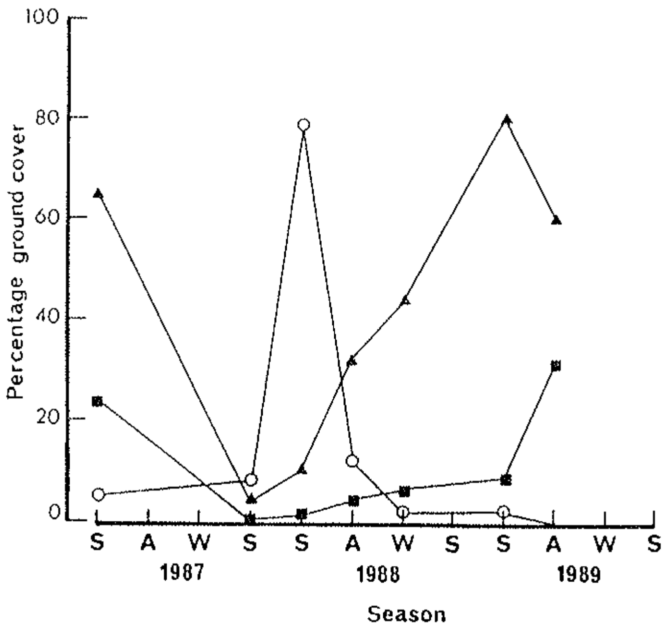
PASTURE MANIPULATION/MANAGEMENT APPROACH

In carpet grass country where giant Parramatta grass infestations are light to medium density (10% to 25% of ground cover) improving the pastures first to encourage a build up of tolerant grass species to the herbicides appears to be a worthwhile approach.

The idea is to fertilise the pasture with superphosphate and oversow or direct drill a suitable legume combination such as Haifa white clover and Maku lotus. A fertilizer and legume sowing programme over a time increases the percentage of grass species such as Paspalum *Paspalum dilatatum* in the pasture, paspalum is relatively tolerant to Frenock or 2,2-DPA at the rates used for Parramatta grass control.

Once the tolerant grass has built up to a high proportion then a decision can be made to use the herbicide as there is sufficient grass and legume to replace the Parramatta grass and avoid the bare soil areas.

Figure 1. Percentage ground cover of giant Parramatta grass ■ , Native/Naturalised grases ▲ and bareground and litter ○ following Frenock(R) application of 2 L per ha in Summer 1986/87.

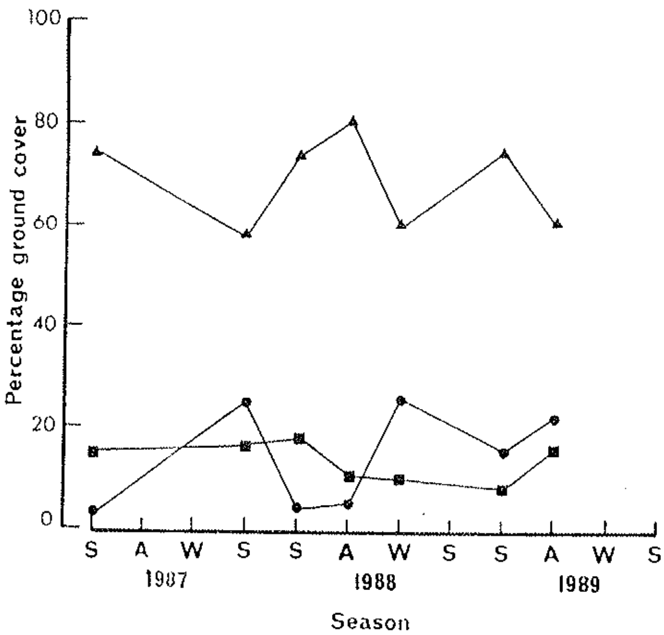


Another advantage of this approach is that dollars spent initially on seed and fertilizer is probably going to give a greater return than the first dollars being spent on herbicides.

Evidence from trial work at Nana Glen has shown that using this approach Parramatta grass has not increased significantly in the improved pasture. See Figure 2.

Figure 2.

Percentage ground cover of giant Parramatta grass ■ , Native/Naturalised grasses ▲ and legumes ● following annual superphosphate application and legume oversowing Autumn 1987.



Another approach along similar lines to rehabilitate heavy Parramatta grass infestations in the lower fertility carpet grass country is to sow "mat forming" competitive grasses that are tolerant to the herbicide rates used. Such grasses could include Bahia grass *Paspalum notatum* or some of the *Digitaria* species. Unfortunately at this stage we do not have reliable technology of establishing summer growing grasses into existing summer grass dominant pastures using no till/direct drill minimal disturbance sowing systems. However our research programme is working on this approach.

Split applications of 2,2-DPA at 5 kg per ha in late summer year 1, grasses and legumes are direct drilled in autumn and a second application of 2,2-DPA at 5 kg per ha applied in late summer/autumn year 2 to take out any Parramatta grass regeneration may be a practical system in this situation.

Currently we have to condition the Parramatta grass through slashing, mulching over the summer months to remove excess growth, cultivate and sow the grasses in autumn and then use either Frenock or 2,2-DPA later in the programme once the grasses are well established and capable of replacing the Parramatta grass. The disadvantage of cultivation is that it can increase the reinvasion of Parramatta grass through competition reduction and soil disturbance.

These types of approaches put far greater emphasis on the replacement pastures than has been the situation to date.

Another pasture manipulation/management approach which doesn't involve the use of herbicides is a nitrogen fertilizer strategy.

NITROGEN FERTILIZER APPROACH

Several dairy farmers in the Upper Orara district are having good success by using heavy rates of nitrogen fertilizer on pastures where Parramatta grass has infested run down kikuyu pastures or pastures which have a scattering of kikuyu.

Heavy application of nitrogen fertilizer encourages the kikuyu to spread and dominate and within two to three years a heavy Parrmatta grass paddock can be converted into a kikuyu dominant pasture. Kikuyu is one of the best competitors against giant Parramatta grass but will only grow well on the better class of country.

Basically the strategy is as follows:

Spring/early summer top the pasture with a mulch mower or slasher.

Topdress with nitrogen fertilizer, 50 kg N plus per ha.

Graze usually 4-6 weeks after N topdressing.

Top pasture again with mower or slasher to remove any Parramatta grass seed heads and growth.

Topdress again with nitrogen fertilizer.

Graze - top - fertilize.

This process may be repeated 3–4 or more times over summer and autumn.

Sometimes in late autumn an annual ryegrass is surface sown into the pasture then mulched or slashed. Nitrogen fertilizer is again used to encourage the ryegrass.

The nitrogen fertilizing, grazing, topping process is again repeated for the next summer or two, the kikuyu rapidly responds and dominates the pasture and Parramatta grass is reduced to isolated plants.

Generally this system is only suitable to dairy farms because of higher marginal returns compared to beef enterprises.

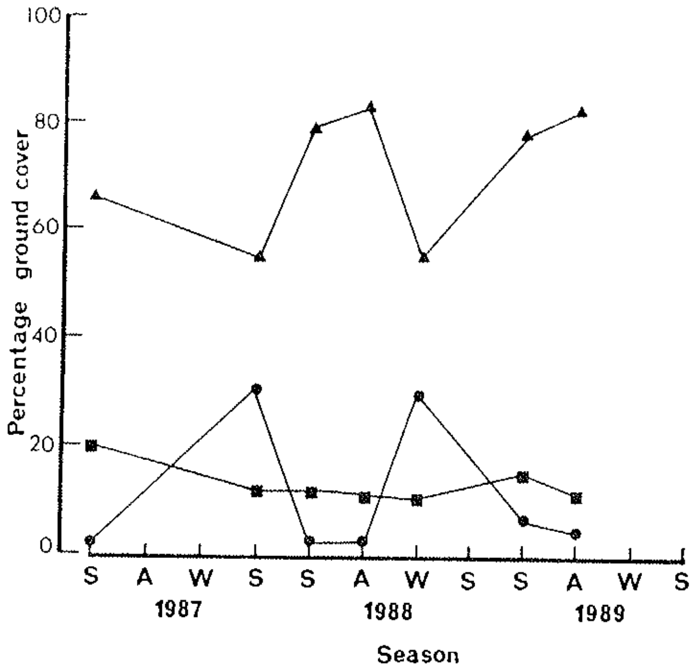
MULCHING

Mulch mowers are increasing in popularity on the North Coast and tend to be replacing slashers. Much of the sales hype for these mowers has been exaggerated as to their effectiveness in controlling giant Parramatta grass.

Farmer experience and trial work show that although they are a good machine in reducing rampant growth and cutting much lower and cleaner than slashers, mulching by itself does not kill Parramatta grass. See Figure 3.

Figure 3.

Percentage ground cover of giant Parramatta grass ■, Native/Naturalised grasses ▲ and legumes ● mulched on average two times per year. Annual superphosphate application legumes oversown Autumn 1987.



However they appear to be a useful machine in conditioning Parramatta grass for a more favourable environment for the other pasture components and for topping to reduce Parramatta grass seeding.

If a mulching strategy is used it also must be in conjunction with a pasture improvement programme to encourage desirable legumes and grasses.

GRAZING ANIMALS AND MANAGEMENT

Sheep are not grazed on the coast so systems utilizing strategic very high stocking rates with sheep to prevent seeding and for control are not applicable. Even if they were it is doubtful if sheep would eat Parramatta grass anyway.

Browsing animals such as goats may have application in some situations. There is some evidence from observations that they may have a role as they will eat Parramatta grass. They may be useful in reducing seeding but it is doubtful if they would kill Parramatta grass out through grazing. Goats grazed in association with cattle certainly improve the appearance of the pasture however the effect may be largely cosmetic. Other problems such as internal parasites, fencing, handling facilities and predators limit the use of goats on the coast.

Apart from the odd situation cattle will remain the most important grazing animal on the coast.

Cattle tend not to eat Parramatta grass selecting other pasture species in preference. The affect of this in infested areas is to overgraze between the Parramatta grass tussocks further reducing the pastures ability to compete.

The maintenance of heavy pasture ground cover is particularly important in Parramatta grass control programmes. Therefore grazing management must aim to maintain heavy ground cover particularly over the spring and summer months, the Parramatta grass seedling regeneration period.

This can be often difficult as spring/early summer can be the period with greatest feed shortages. Heavy grazing at this time can reduce the pastures competitive ability when summer rains arrive.

In summary grazing management to maintain heavy ground cover is important to prevent seedling regeneration and spread of giant Parramatta grass within a pasture provided that the pasture consists of competitive grass species. Carpet grass pastures do not keep Parramatta grass out unless they are grossly undergrazed.

Most of the coastal native and naturalised pastures are not competitive under normal grazing levels; therefore giant Parramatta grass control must rely on prevention of infestation, early detection and control, and in the event of heavy infestation, managing those pastures by encouraging or sowing more competitive species.

Once competitive, herbicide tolerant species (at the rates used) are well established then the decision to use a herbicide or not can be made.

As with most weed control programmes giant Parramatta grass control will rely on a combination of strategies with competitive pastures and grazing management being an integral part of the programme.

USE OF GRAZING STOCK TO MANIPULATE WEED POPULATIONS

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What is weed control? – For the average producer it probably means the elimination of an undesirable species, however in reality it usually amounts to some level of minimum population of an undesirable species which is acceptable in the longer term – that is we have to learn to live with a low level of infestation, the level of which has to be specified for each individual situation.

The natural reaction of a producer to the presence of a weed is usually attempted eradication, that is "how can I kill it?", and nowadays he usually thinks of spraying it with a herbicide. Although this may remove the undesireable species in the short term, there is seldom any thought given to its replacement by alternate plants or planning for the long term stability of the community. In this context the development of herbicides has probably oversimplified the initial process of the control of weeds so that the initial appearance of control makes the need for long term studies less obvious. Nevertheless, such studies are necessary in order to determine subsequent management plans.

The important role of alternative options including utilization by grazing animals must be recognised. Nevertheless, such options often require an increase in the knowledge of both the target species and the other species within the community. Data concerning grazing value, growth patterns and grazing reaction are of particular importance. For example we need to know when the target species is most palatable and/or least damaging to stock (eg. young plants in comparison to flowering plants – St. John's Wort. Campbell 1986). In order to sustain high levels of production from the pastures we must pay increasing attention to the factors that control both individual plant productivity and the potential for changes in the botanical composition of the sward.

Grazing management can relate to the maintenance OR change to the balance of the species that exist in the pasture at a particular time. Maintenance requires the prevention of invasion, while change is achieved by encouraging invasion. Thus pasture invasion can be of two types, firstly it can be by undesirable species deemed to be weeds, or it can be by desirable species to improve the composition of the pasture (eg. legumes). Invasion requires a suitable gap (Medd *et al.* 1987) in the community to enable the new plant to become established, thus invasion control requires the prevention of gaps where the pasture is already of the desired composition, or the creation of gaps at the appropriate time to enhance existing species or introduce new species to the sward.

Even where maintenance is the main aim the pasture composition can be manipulated by the planned use of grazing animals. This was demonstrated in the classic work of Martin Jones in 1933 working on both old pasture and newly established swards; he was able to change the dominant species within the sward by simple variations in time of grazing. Nevertheless, such an exercise requires a knowledge of the characteristics of the individual species which make up the sward. Examples from the Australian literature include the control of barley grass in irrigated pastures (Myers and Squires 1970) and the interaction of thistle populations and livestock in pastures grazed by sheep (George *et al.* 1970; Bendall 1973).

Where the plan requires a change of species within the community it would also be desirable to know the competitive ability of the individual species and other components of the community in order that the compostion can be manipulated accordingly. In this context it is as well to remember that botanical change occurs naturally as a result of plant succession – parts of the process are dependant on the ageing of some components which become moribund (eg ungrazed pastures) and allow plants from later stages of the succession (eg trees) to become established. Succession can usually be reversed, for example the progress towards trees can be prevented by burning. This is because the growing points of young trees are elevated and exposed, while new growth of grasses arises from basal buds which are protected. Many management factors such as burning, fertilizer application and grazing management can influence the competitive relationships between species. The timing of these operations can also be of critical importance to the effect that they induce.

It is a basic principle that "The use of competing pasture plants is the cheapest and most effective method of weed control" (Whittet 1964). In order to apply this principle most appropriately we should know the survival and competitive characteristics of each component of a particular community so that the competition between species can be manipulated. Where new sowings are being established it is important to include species with the most appropriate competitive abilities.

The requirements for the development of a successful a grazing management programme include the provision of periods of reduced grazing intensity to ensure that desirable established plants can recover from defoliation, this enables them to regain vigour, produce seed and where appropriate additional resting may be needed to encourage seedling establishment.

Successful grazing management strategies are usually based on the reproductive biology and growth pattern of individual pasture components. The needs of plants are matched to grazing and deferment periods so that the desired pasture components are given the greatest opportunity to develop. These may be simple procedures; for example, substantial beneficial changes in pasture composition were achieved in a *Triodia* grassland by a short deferment of eight weeks (Suijendorp 1969). Similarly the wiregrass control programme on the northern slopes of New South Wales is based on the growth pattern of the two main grass components. The main management activity is aimed at reducing the vigour of the undesirable component during its period of active growth and creating opportunity for alternate species during another season of the year (Lodge and Whalley 1985). Both these examples relate to pasture situations where an endemic plant is the undesirable component in a relatively extensive grazing enterprise. The preferred option in this case is to live with and minimise the effect of the less desirable species.

It can be argued that in areas with a better environment the management of undesirable species becomes more difficult and there is thus less opportunity and less inclination to "live with" undesirable species. This situation together with the increased number of options available (e.g. ploughing) has tended to reduce still further the attention given to studies of the growth pattern and competitive ability of individual pasture components. For example, very little information is available on the management requirements of the introduced species most commonly used in sown pastures in areas suited to pasture improvement.

An example of pasture manipulation in a better environment is presented using *Eragrostis curvula* (African lovegrass), a species which is regarded as an undesirable pasture component on the Northern Tablelands of New South Wales because it is not readily grazed by sheep (particularly as a mature stand) and has been a strong invader of pastures on the Northern Tablelands, particularly at lower stocking rates. Nevertheless, at higher stocking rates stock can be induced to graze African lovegrass and under continuous heavy grazing it can even be killed out.

In a demonstration at Shannon Vale, an invaded sown pasture was grazed continuously at two stocking rates (10 and 20 wethers ha^{-1}) by two flocks of sheep rotated between stocking rates. At the high stocking rate the ground cover of lovegrass was significantly reduced while other components including annual summer grasses, wallaby grass and dandelion increased. The sheep became accustomed to the lovegrass and even at the low stocking rate it was subsequently well utilized and was very seldom able to flower and as a consequence further invasion was prevented. Of the sown grass component fescue survived at the high stocking rate while phalaris failed.

Although wallaby grass (*Danthonia racemosa*) increased it was often unable to compete satisfactorily with lovegrass during the warm summer months when dry conditions prevented growth. Thus to determine the most appropriate species to compete with lovegrass a competition experiment was conducted. Briefly *E.curvula* was planted in varying proportions (25%, 50%, 75%) with competing sown species in swards with a constant density. Of the species tested fescue proved the most competitive while phalaris proved the least suitable species. The suppressive effects of competition were most evident on lovegrass during spring and least during the warmer months. A management plan to combat African lovegrass would therefore require severe defoliation during the warmer months (grazing, slashing, even burning initially). During the cooler winter and spring months the competitive species should be encouraged by such practices as lenient grazing and by fertilizer application e.g. the use of nitrogen at this time where fescue is present.

We also need to know more about the rumen flora of animals used to graze our pastures. The suite of rumen micro-organisms present in the digestive system of animals is known to influence the ability of the animal to digest the forage ingested (Leng 1987) and have also been shown to be a means of overcoming the toxic effects of some species (eg. *Leucaena leucocephela*, Culvenor 1987). Similarly, animals which habitually graze on *Eragrostis curvula* use the forage much more efficiently than those which graze on other species. These aspects of ruminant physiology appear to offer an important area for future development for both improved digestibility of individual species and to reduce the deleterious effects of individual plants.

In summary, weed invasion is an ecological problem and requires an ecological solution. Therefore, unless complete elimination is essential, we need to determine the level of infestation that is considered acceptable. What inputs can be used to maintain this level? If the level is exceeded, how should it be reduced? It is important to remember that the elimination of a plant creates a gap and unless this gap is filled by a desirable species the job should be considered a failure.

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PRICKLY PEAR INTO THE 1990'S

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Prickly pear has had a long history in this country. One species was brought to Australia from South America 200 years ago. Prickly pear has probably had a bigger impact on rural eastern Australia than any other weed.

Common pest pear (*Opuntia stricta* variety *stricta*) and spiny pest pear (*Opuntia stricta* variety *dillenii*) forced hundreds of people to abandon their properties - it made others rich because they were able to buy the land for a song before cactoblastis ate its way into the history books.

While common pest pear and spiny pest pear attracted all the attention, other varieties became firmly established over large areas of land. The worst one, tiger pear, still infests some 200,000 hectares of land in New South Wales (see Figure 1).

LEGISLATION

Legislation covering control of prickly pear in New South Wales began with the Prickly-pear Destruction Act of 1886. In 1924 the Prickly-pear Destruction Board, later replaced by a Commissioner, was formed. Minor ammendments to the Prickly-pear Act, 1924, took place until 1988 when the Prickly Pear Surveillance Unit of NSW Agriculture and Fisheries became the group responsible for administering the Prickly Pear Act, 1987.

CHANGES IN ATTITUDE

Significant changes occurred within the Prickly-pear Destruction Commission during the 1980's. The adoption of the major biological control programs, a rationalisation of inspection programs to better utilise staff and other resources, and the acceptance, finally, of the fact that prickly pear was here to stay. It is a part of the environment and there is no need to bash our heads against the wall trying to eradicate the last plant.

Staff levels in the Commission were reduced during this period, as work programs were wound down. When the Commission was disbanded in December 1987, the remaining staff were formed into two new groups within the Department of Agriculture: the Prickly pear Surveillance Unit and the Biological Control Unit (see Figure 2).

PRICKLY PEAR SURVEILLANCE UNIT

This unit is responsible for enforcing the Prickly Pear Act of 1987, the field staff of 18 are located at Mudgee, Dubbo, Singleton, Scone, Tamworth, Bingara, Ashford and Moree.

The Surveillance Unit monitors prickly pear infestations throughout the State by regular inspection of some 4,450 properties. The Unit's main role is advisory first, regulatory second.

Contract spraying and insect distribution are no longer carried out by the Prickly Pear Surveillance Unit for private landholders or Government departments. Nor does the Unit supply subsidised chemical sprays to landholders.

However, the Prickly Pear Surveillance Unit, with help from the Biological Control Unit where applicable, does provide the following services:

* Initial establishment of biological control agents for cactus on any property
* On-farm demonstrations of prickly pear insect distribution methods
* On-farm demonstrations of chemical treatment methods
* Free loan of spraying equipment
* Free supplies of cochineal and/or cactoblastis insects
* Participation in agricultural shows, field days etc. utilising the Department's mobile Advisory Caravan/Display
* Field trials of chemicals for prickly pear treatment

BIOLOGICAL CONTROL UNIT

The Biological Control Unit breeds weed biological control agents and conducts research on their impact. In addition to undertaking work on weeds such as Paterson's curse (*Echium plantagineum*) it assists the Surveillance Unit with the supply of biological control agents (types of cochineal and cactoblastis).

BIOLOGICAL CONTROL

Biological control of cactus was undertaken when it was realised that graziers and government could no longer afford to control cactus infestations chemically and mechanically.

The Queensland Prickly-pear Travelling Commission was responsible for the introduction of the first biological control agent for cactus control. They sent monacantha cochineal, *Dactylopius ceylonicus*, to Queensland in 1912. These insects were successful in controlling *Opuntia vulgaris* (previously *Opuntia monacantha*). Since that time many insects have been introduced for biological control of cactus in Australia. The Commonwealth Prickly Pear Board was appointed in 1920 and was responsible for most of the introductions. The latest introductions, for control of harrisia, *Eriocereus martinii*, were carried out by the Commonwealth Institute of Biological Control for the Queensland Department of Lands. This work was conducted during the late 1970's and early 1980's.

This section will summarise the main biological control agents for the major cactus species in New South Wales. Information will also be included on which insects are recommended for use in various areas of this state. The cactus species and their biological control agents will be listed in decreasing area occupied in New South Wales. For further information on biological control of cactus in New South Wales the review by Hosking, McFadyen and Murray (1988) should be consulted.

Opuntia stricta varieties

These include common pest pear (*Opuntia stricta* variety *stricta*) and Araluen pear (*Opuntia stricta* variety between *stricta* and *dillenii*). Cactoblastis, *Cactoblastis cactorum*, is the main biological control agent for *Opuntia stricta* varieties in Australia. In areas where cactoblastis cannot complete two generations per year it is not a successful biological control agent. In these areas, as well as hot dry areas, prickly pear cochineal, *Dactylopius opuntiae*, is the recommended control agent.

Opuntia autantiaca

This cactus is called tiger pear in Australia and jointed cactus in South Africa. This is the major cactus problem in New South Wales and South Africa. In both countries tiger pear cochineal, *Dactylopius austrinus*, is the main biological control agent. This insect causes most damage in hot dry conditions but is suitable for tiger pear control throughout New South Wales. Two moths, cactoblastis and *Tucumania tapiacola*, can also cause considerable damage in some years in some areas.

Opuntia tomentosa

This cactus is called velvety tree pear. Prickly pear cochineal causes the most damage to this cactus in Australia. In New South Wales felling of large plants infested with this cochineal increases the level of contol achieved.

Opuntia imbricata

This cactus is called rope pear. Another species of cochineal, rope pear cochineal, *Dactylopius tomentosus*, is the insect which causes the most damage to rope pear in Australia. Felling of large plants, once cochineal is established, improves the level of control achieved by this insect.

Opuntia humifusa

This cactus is called creeping pear. Cactoblastis appears to cause the most damage to this cactus.

Eriocereus martinii

This cactus is called harrisia. Harrisia mealybug, *Hypogeococcus festerianus*, is the main biological control agent for this cactus.

Opuntia vulgaris

This cactus is called smooth tree pear. The main biological control agent is monacantha cochineal. As for velvety tree pear and rope pear, felling of large plants, once cochineal is established, improves the level of control achieved by this insect.

SUMMARY

Prickly pear is still a significant pest in New South Wales. Important policy changes and improvements to control programs have permitted a reduction in staff of 45 down to 18 in the Surveillance Unit. The Biological Control Unit of 14 also assists, but is moving away into other biological control of weed programs.

Extensive biological control programs are in existence throughout the State's major cactus infestations. Adverse weather conditions can see quantities of cactus increase. The need to monitor these infestations, and to restrict movement of pear, will exist into the 1990's and beyond.

FURTHER INFORMATION

If you would like advice or further information on cactus control, contact the authors or staff of the Prickly Pear Surveillance Unit and Biological Control Unit of NSW Agriculture and Fisheries located at Mudgee, Dubbo, Singleton, Tamworth, Bingara, Ashford and Moree.

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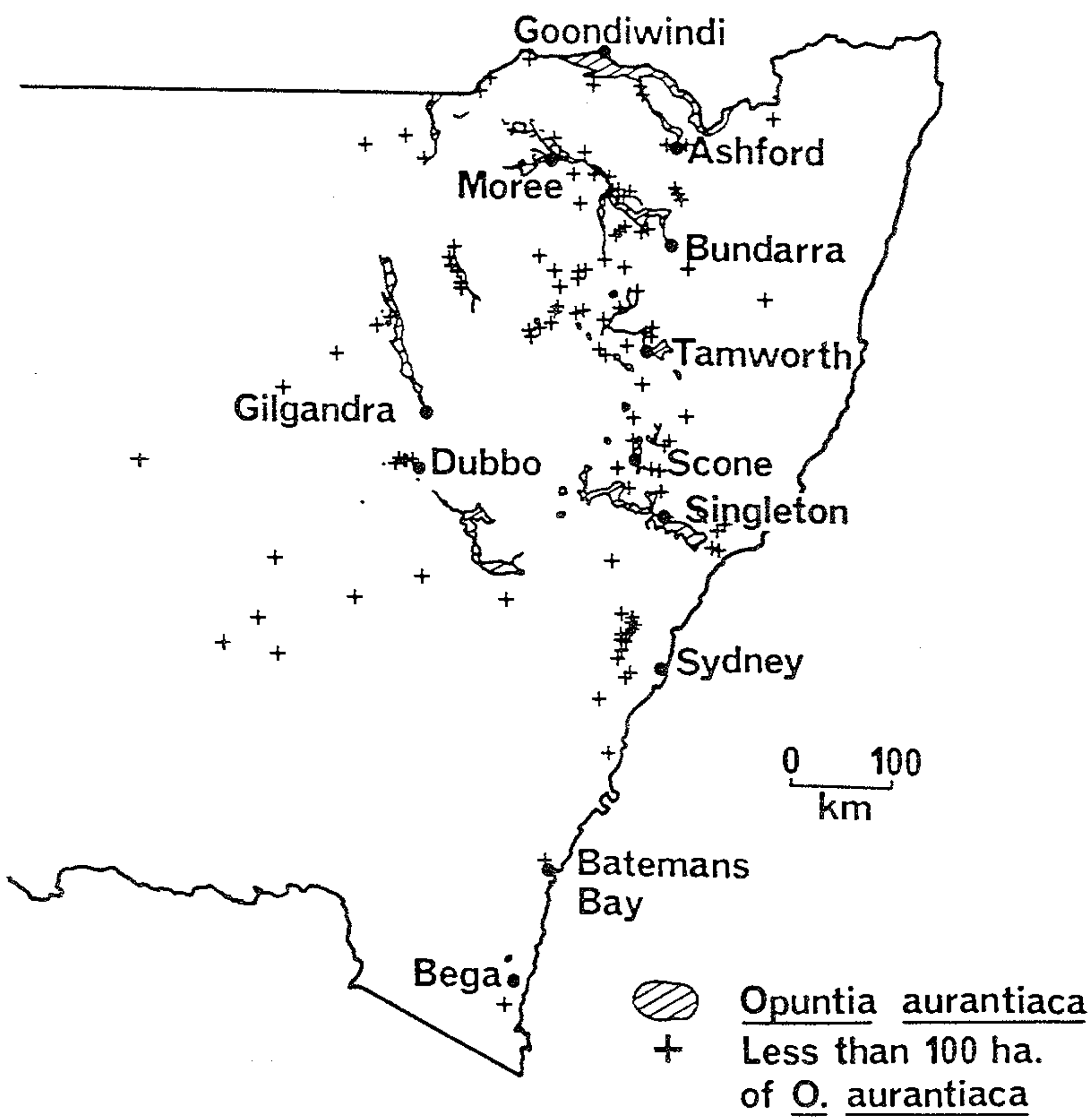

Figure 1. Distribution of tiger pear in New South Wales.

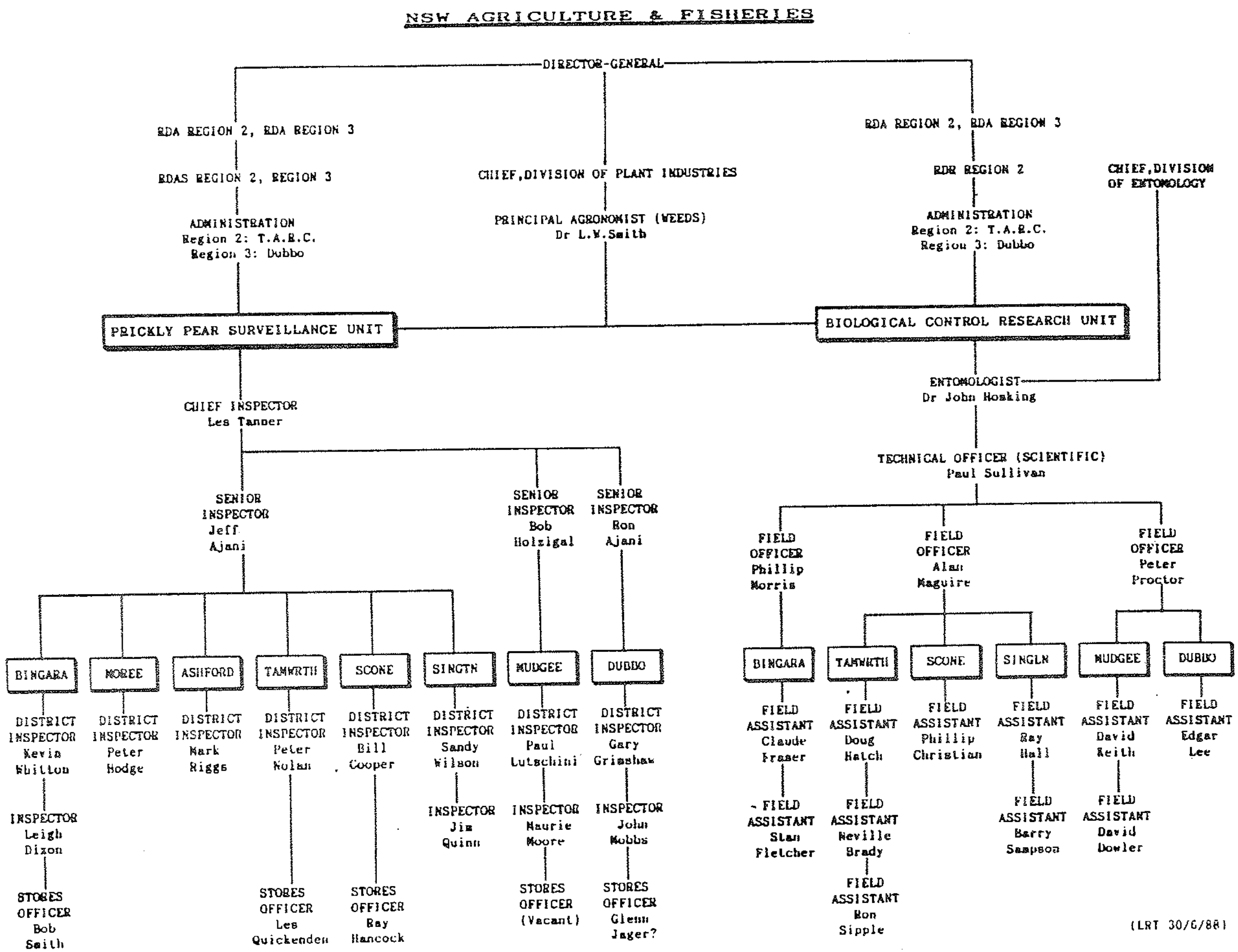

Figure 2. Organisation chart for the Prickly Pear Surveillance Unit and the Biological Control Unit.

EFFECT OF ENVIRONMENTAL FACTORS ON HERBICIDE EFFICACY

Deirdre Lemerle,
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The weather is a major cause of unreliable herbicide performance, and this is especially important in Australia because the climate is so variable. Herbicide recommendations for the rate and timing of application include a safety margin that allows weeds to be effectively controlled while maintaining crop safety in all the envirouments likely to be encountered. Farmers have tended to lower herbicide application rates in "good" growing conditions to cut costs. If the application rates are reduced and the conditions for activity are not ideal, poor weed control will result leading to repeat applications and additional costs. Conversely, crop injury from recommended application rates of herbicides have been shown in wheat (Lemerle *et al.* 1985), especially in cold, waterlogged soils (Papalia *et al.* 1984), and in barley (Lemerle *et al.* 1986) in susceptible varieties in some seasons and not others. The increasing cost of herbicides and widespread concern for environmental quality make it imperative that herbicides are used more efficiently, and with more precise rates of application than those currently used.

The manufacturers realize that herbicide performance depends on suitable conditions at the time of spraying, hence most of the herbicides registered in Australia have "application restraints" on their labels. These labels may have warnings that certain "adverse" conditions such as drought, frost or waterlogging, should be avoided at spraying e.g with dicamba, bromoxynil or 2,4-D. Certain conditions such as moist soil improve the efficacy of control root absorbed herbicides eg. simazine, hexazinone. Rain-fastness of foliar absorbed herbicides is also important eg. with 2,4-D, methabenzthiazuron, diuron or dicamba. These conditions are generally vague since they are not based on sound research, but rather on farming experience, casual observations made from field trials, or extrapolation of the results obtained from experiments conducted in other countries.

Comprehensive literature reviews of the important environmental factors influencing the performance of herbicides are given by Muzik (1976) and Gerber *et al.* (1983). The significant factors are temperature, relative humidity, light, rain, disease, wind and the characteristics of the soil.

The interception, retention and penetration of the herbicide through the plant shoots depends on the characteristics of the foliage eg. leaf orientation and size, waxiness. Environmental conditions prior to spraying influence absorption of foliar applied herbicides because of their affect on leaf structure (Gerber *et al.* 1983). Plants "hardened" by stress conditions (drought, cold, nutrient stress) prior to spraying are more resistant to herbicides than plants grown under favourable conditions (Nelson and Ashley, 1978). For example, dry, hot conditions increase the waxiness of leaves and reduce herbicide uptake. Whereas heavy rainfall before spraying can reduce this waxiness and lead to increased herbicide uptake.

Conditions at the time of spraying will affect interactions between herbicides and plant growth. For example, high relative humidity during spraying is closely linked to increased absorption (Coupland and Caseley, 1981; Ritter and Coble, 1981). There is generally greater foliar uptake and translocation of herbicides with increases in light, temperature and relative humidity, because of faster transport of assimilates in the phloem to the young leaves. Therefore, warm, moist and sunny conditions at spraying will lead to greater herbicide uptake than cold, dry conditions. If conditions are warm and dry, a water soluble herbicide may dry before it has penetrated the foliage. The period between spraying and the onset of rain can also have an important influence on herbicide performance. The optimum environment for translocation and lethal effect depends on the individual herbicide/species combination. For example, high temperatures improve control of wild oats with difenzoquat (Miller *et al*, 1984) and MSMA (Miller *et al*, 1981), but low temperatures are better for diclofop-methyl (Chow, 1978). Donn and Bieringer (1980) have reported different temperature optima for the activity of diclofop-methyl against several grass species. Moisture stress and low soil fertility can reduce the control of wild oats obtained with difenzoquat (Miller *et al*,1978) and diclofop-methyl (Dortenzio and Norris, 1980). Paech *et al*, (1987) demonstrated the importance of available soil moisture on the efficacy of glyphosate in controlling a wide range of summer and winter Australian plant species.

The ability of plants to recover from injury by herbicides will depend on the environmental conditions after application; conditions that favour active plant growth will generally help recovery.

In order to predict the effects of the environment on herbicide activity Caseley (1987) highlighted the need to evaluate the relative importance of these factors before, at, and shortly after spraying. For example, information on the environmental factors that allow glyphosate to exert maximum control of *Agropyron repens* (Caseley, 1983) has been collected in controlled environment experiments and from field experiments. Using this data and meterological records he can predict when glyphosate is likely to be most active, and hence at reduced rates of application.

There is little information in Australia on the importance of the environmental factors specific to our weed species. In order to reliably predict the effects of the environment on herbicide performance and reduce application rates more information is needed in our conditions.

In the future this will become even more important as concerns about contamination of the environment by pesticides (e.g. toxicity to animals, residues in the soil and water) is causing pressure on farmers to reduce pesticide use. This trend is gaining momentum in Europe, America and Australia. As herbicides are important to maintain the current levels of crop productivity, it is essential that they are used as efficiently as possible. This will minimize the risk of useful products being removed from the market. Legislation is already in progress overseas to ensure that pesticide use is reduced e.g. in Denmark pesticide use must be reduced by 50% by 1992. The trend toward foliage active herbicides away from residual herbicides is mainly because of fears of residues in the soil and ground water. In addition, the development of herbicide resistant weeds is favouring greater use of foliage-active herbicides, because they exert less selection pressure on weeds than residual herbicides. In the future, it is likely that the development of herbicide-resistant crop plants will be restricted to herbicides which penetrate through the leaf for the same reason (van Rensen 1988). Therefore, herbicide use may be restricted to post-emergence application in the future. The effects of the environment on foliar absorbed herbicides is easier to predict than for residual, soil active herbicides.

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DRUG ENFORCEMENT AGENCY

New South Wales Police Force
4th Floor
Remington Centre,
169 Liverpool Street,
Sydney, N.S.W. 2000

Telephone: 265 5733

Reference:

FIFTH BIENNIAL NOXIOUS PLANTS CONFERENCE '89'

SUBJECT : CONTROL AND IDENTIFICATION OF DRUG PLANTS.

SPEAKER : DETECTIVE SENIOR CONSTABLE J.W.DOLAN
PLANTATION UNIT, DRUG ENFORCEMENT AGENCY.

INTRODUCTION

The investigation of Cannabis and other illegal plant cultivations can be complex depending upon the size of the plantation, the geographical area in which they are located and the extent of the grower's operation.

In New South Wales, the Plantation Unit of the Drug Enforcement Agency, amongst other duties, undertakes the following responsibilities:-

- Providing a professional law enforcement approach to the investigation of the organised cultivation of cannabis and other illegal plants.

- The co-ordination of investigations in all major plantations. (Cannabis - 250 plants or more)

- To assist regional police in an advisory, operational and intelligence gathering capacity.

- To co-ordinate aerial / ground party support searches for Plantations.

- The collating and disseminating of ALL reports of cultivations.

- To maintain a close working relationship with other co-operative agencies involved in cannabis detection, investigation and prosecutions.

It is accepted that a mature cannabis plant will yield about 1 pound of Cannabis leaf and with high grade cannabis selling on average for $2500 per pound, the profits from this illegal activity can range into the millions of dollars and have a severe impact on the health of those that use the illegal drug. Police Intelligence has shown that persons involved in these organised illegal ventures, have close links to other aspects of organised crime.

New South Wales Police have identified the problem and the Plantation Unit and Regional Police are putting pressure on the persons involved by locating areas used for cultivations and by making arrests and vigorously prosecuting those who have been apprehended and in many cases, seizing assets including properties and other forms of wealth. New South Wales Authorities have provided for heavy custodial sentences and pecuniary penalties for those found to be involved in these illicit growing enterprises which are not only occuring in New South Wales but Australia wide.

These measures have encouraged many of the diverse groups and individuals involved in the cultivation of Cannabis to move their operations into remote areas including forest and publicly owned land where they believe the risk of detection to be lower due to the isolation and limited public access lessening the likelihood of accidential detection. Illegal Cultivation Operations have been conducted and detected on lands of all ownership. In addition, some individuals/groups prefer to cultivate in a green house enviroment.

REPORTING INFORMATION

The Plantation Unit is responsible for receiving and acting on any report of a cannabis or other illegal plant cultivation. For the purpose of this lecture, I do not propose to address the various methods by which an investigation is carried out by the unit or other Regional Police Investigative body.

The Unit receives information from various sources and Regional Police have an obligation to inform the unit of any report made to them. The Unit is then able to compare the information with any other similar informations concerning suspects or properties in the area or in the event of numerous informations being recorded in an area, plan and instigate a co-ordinated Aerial/Ground Support Search for plantations.

When selecting an area to set up a cultivation, Illicit growers often depend upon remoteness or inaccessability to avoid detection and as such, members of the public do not generally come in contact with the growers or cultivations.

Because of the nature of the work carried out by persons employed by the Department of Agriculture / Fisheries and also Noxious Plants Inspectors employed by Shire Councils etc, the chances of these persons detecting an Illegal Plant Cultivation are far greater than that of the general public. Experience has also shown that this Officer often has an indepth knowledge of local identities and properties and in recent operations conducted by the Plantation Unit, this information has proved invaluable.

Ideally, when such a cultivation is detected or suspected the Officer should report such an incident direct to the Plantation Unit in Sydney on 02-2655466 or make the report direct to the Regional Police responsible for the area who will inturn, notify the unit. Any information will be treated with strict confidentiality. Attached to these papers is an annexure marked 'A' listing the locality and phone number of Regional Drug Investigative bodies.

There are many things the Officer might watch for which may indicate that cannabis or other illegal plant is growing in your area. You are the best judge of what may be unusual or suspicious about a property or land that is possibly being utilised for this purpose. Police would be interested if any of the following signs are detected in an area:-

- The erection of tents or the utilization of camper trailers or other recreational vehicles on land with no evidence of recreational activities.

- A pattern of vehicular traffic or a particular vehicle seen in the same isolated area on a regular basis.

- **Unusual amount of vehicular traffic** (especially at night) carrying unknown individuals in and out of an area.

- **House or Property** where men are constantly going in and out and women and children are never seen or where 'Keep Out' signs, high fences, heavy chains and lock on gates appear for no apparent reason.

- **Large purchases by individuals** of fertilizer, garden hoses, plastic PVC pipe, Jiffy Pots, chicken wire, camouflage netting, pumps and garden equipment, camping equipment or any item which may be used in the cultivation of illicit plants.

- **The use of guard dogs** and alarm systems or fencing (electric) especially in certain isolated areas on the property.

- **Unusual structures** erected in remote areas with buckets, garden tools, fertilizer bags, etc.

- **Signs of Cultivation** / soil disturbance in unlikely areas.

Cannabis and other Illegal Plant Growers can be dangerous and on discovering or suspecting an illegal cultivation, the following procedures should be adopted:-

DO your best to know your exact location by use of existing landmarks or maps. This will be helpful when relating the location of the cultivation to Police.

DO make a note of any vehicles or persons in or around the area.

DO exit the area on the same route you entered.

DO notify the Plantation Unit or Local Regional Police body immediately.

DO keep this information to youself after notifying the proper authority.

DON'T enter the cultivated area or go any closer than is necessary to identify the plants.

DON'T look around the area for additional plants or cultivated sites.

DON'T take a sample plant or segment of a plant.

DON'T leave any unnecessary sign of your presence in the area.

DON'T return to the area unless accompanied by Police.

RELATIONSHIP OF POLICE WITH AUTHORISED / APPOINTED PERSONS

The independence of the Authorised / Appointed Person is at all times recognized and maintained by the Police investigating the cultivation of Cannabis and other Illegal Plants. Police are instructed to co-operate with and ensure the safety of that person and any person assisting him. Police will ensure that at no time will the Authorised/Appointed Officer be present at the site when suspects / offenders are present. Police appreciate that in the initial stages of embarking upon an investigation, the Officer might be of valuable assistance in respect to local knowledge and terrain and as such request assistance or information.

DUTIES OF THE N.S.W. AGRICULTURE AND FISHERIES DEPTARTMENT.

Amendments have been made to the Drug Misuse and Trafficking Act to provide for the appointment (by the Director General of NSW Agriculture and Fisheries) of suitably qualified persons who will be able to give certificates which may be used as evidence in the identification of **cannabis plants**.

In any legal proceedings under the Drug Misuse and Trafficking Act, the production of a certificate issued by an **Analyst or Appointed Person** is Prima Facie evidence of :_

- the identity of the plant analysed; and
- the quantity or mass of that plant.

but only if the plant identified is Cannabis Plant or Cannabis Leaf.

For the purpose of the Act, an **Analyst** means 'any pereson employed by the Government of New South Wales as an analyst (Botanists / Govt Analysts etc.)

Appointed Person means a person appointed under sub-section 5. The Director General of N.S.W. Agriculture and Fisheries may appoint a person to give certificates for the purpose of this section if the Director-General considers the person to be suitably qualified and such person has been gazetted as an 'Appointed Person.' These persons include gazetted Agronomists Horticulturists and Agricultural Inspectors etc.)

For the purpose of the Act, **PLANT** includes any part of a plant, the achene and seed of a plant.

Departmental Officers authorised by the Director-General have two basic roles under the Drug Misuse and Trafficking Act. These are:-

(i) To act as **Appointed Persons** (where previous qualifications are met) for identification of Cannabis Plant .

(ii) To act as **Authorised Officers**

  (a) To assist Police establish evidence that the plants in question have been cultivated;

  (b) To assist Police with destruction of cannabis plants at the relevant premises or property (or at some placed removed from that property) and prevent re-growth of plants.

Gazetted **Appointed Persons** will be called upon to identify cannabis plant(s) and to issue a certificate to this effect. Both the Appointed Person or the Authorised Officer may also be served with a warrant for destruction of Cannabis Plants.

In certain circumstances, an Authorised Officer may be called upon by Police to take samples of the cultivated plants and give them to the Police Exhibit Officer for the purpose of future identification.

Where-ever possible Police will notify the Agronomist as soon as is possible of their requirement. It should be understood that it is difficult to give considerable notice, in most cases it is not until Police actually locate the plantation and determine what course of action is to be taken i.e. surveillance or destruction that a decision can be made as to when the appropriate Appointed / Authorised Person will be required.

The Operations of Police are confidential, frequently local police may not be aware of these operations, not because of integrity but to ensure the confidentiality of the operation as at times innocent conversations with relatives and friends may alert persons involved.

This course of action should not be taken as an insult or sign of distrust.

WARRANT OF DESTRUCTION

Where Police have identified a property on which they believe cannabis is being grown (including Crown Land) they will obtain a warrant of destruction from a Magistrate, prior to proceeding on the investigation. However, in the majority of cases Police are not aware of the exact location of the Plantation. On occasions, when cultivations are located in remote areas, there is difficulty with communications and the availability of a Magistrate sitting at the Local Court to issue such warrant. In these cases, Police will arrange to have a warrant issued at the closest court or in Sydney. The warrant will be either 'facsimilied' to or served on the Director General of Agriculture.

The warrant authorises and directs the Director-General to enter premises, sample and destroy plants. In procedure, the Director General will serve the warrant on the Authorised / Appointed Officer (as the Director Generals Representative) closest to the location of the Cannabis Plantation. The Agriculture and Fisheries Department sets out certain internal procedures to be adopted by the officer when served with a Warrant for Destruction.

It would be advisable for the Authorised Officer to be in attendance when the Council/Board destroys the plants or the area is to be treated with Herbicide.

At times the warrant may not be available for sighting by the Appointed/Authorised person either prior to attending the scene or upon his arrival at the scene. In these instances the Officer in Charge of the investigation will undertake to determine the issue of the warrant by radio (which is logged) and undertake full responsibility of it's verification for the information of the Destruction Officer. In certain circumstances, the appropriate Shire, Municipal or County Council will be requested by the Director General (or representative) to carry out the destruction of the plants by the method approved by the Director-General.

Upon notification by Police of the requirement of the attendance of the Destruction Officer, such person should ascertain from the Police the location and terrain of the cultivation so as to make an assessment for their needs in destroying the cropsite. They should also make arrangements for suitable assistance in their duties. At times Police resources may be stretched due to the many tasks they have to initially undertake (Interviews, Exhibits etc) and Police personnel may not be available to assist in the destruction.

Police are anxious to destroy the plants as soon as possible to prevent the possibility of having to place over-night guards on the crop and to enable them to proceed with the investigative side of the cultivation. On being requested to attend a cultivation, expeditious actions by the Authorised Officer are greatly appreciated.

A SAMPLE WARRANT OF DESTRUCTION IS ATTACHED TO THESE PAPERS MARKED ANNEXURE 'B'

INSPECTION OF THE SITE

Upon arrival at the site the Authorised Person should speak to the Officer in Charge of the Investigation, determine the existence of a warrant of destruction or sight the warrant. Police where possible will take the Authorised Person on an inspection and assesment tour of the cultivation. The Police Officer in charge of the investigation should have at this time appointed Police personnel who are responsible for the recording and continuity of exhibits. **(EXHIBIT OFFICER).** The Authorised Person will liaise with the Exhibit Officer during his presence at the site.

OBSERVATIONS OF SITE

The Authorised Person should make note of his observations relating to the following:-

- Time and Date.
- Police in charge / Police present.
- Number of Plants.
- Access to area.
- Describe outward appearance of the Cultivation area.
- Describe irrigation equipment present and source of water.
- Method of cultivation.
- Presence of Fertilizers etc.

  Appearance of Plants.
- Measurement of Cultivated Area.
- Presence of other equipment at site.
- Presence of drying areas or accomodations areas.
- Presence of vehicular or foot tracks.
- Method of destructionand who was present / and or assisted in the destruction.

THE APPOINTED / AUTHORISED PERSON WILL BE REQUIRED TO GIVE EVIDENCE AT COURT RELATING TO HIS OBSERVATIONS, PROCEDURES AND EXPERTISE.

IT IS IMPORTANT THAT THE OBSERVATIONS, PROCEDURES ETC BE RECORDED AT THE TIME AS HE MAY BE CALLED TO GIVE EVIDENCE AT SOME CONSIDERABLE TIME IN THE FUTURE.

THE EVIDENCE OF THE APPOINTED / AUTHORISED PERSON IS IMPORTANT AS BEING AN INDEPENDENT VIEW OF THE CULTIVATION.

IT IS IMPORTANT THAT THE OBSERVATIONS BE COMPREHENSIVE AS SUCH PERSON CAN EXPECT COMPLEX CROSS EXAMINATION IN COURT PROCEEDINGS.

Where the Authorised Person is requested to take a sample plant(s) from the cultivation to give to the Exhibit Officer for the purpose of identification by an Analyst or Appointed Person, The Authorised Person should make detailed notes of where the plant(s) were taken from and to who they were given. He should also indicate the number of plants seized to be identified and indicate whether or not the bulk of the plants were retained or destroyed.

Many persons employed by Government Departments including the Department of Agriculture and Fisheries, Councils and other bodies, are governed by various Acts of Parliament in the performance of their duties. Specific powers in some instances, enact such persons to enter properties and carry out certain tasks relating to their work. This lecture does not address such issues and Police do not rely on the powers of other persons to carry out their duties. Where it is appropriate that a Search Warrant or Warrant of Destruction be issued, Police will not by-pass this requirement by utilising the powers of another Governement Officer.

The powers of the Appointed/Authorised Person in so far as the Drug Misuse and Trafficking Act are concerned relate to Cannabis Plants and Leaf. The acts also provides an offence for the cultivation of the Coca Plant (Erythroxylum Coca) and in some circumstances, the Opium Poppy (Papaver Setigerum). It is possible in New South Wales to legally cultivate Cannabis, Coca and the Opium Poppy with the Authority of the Minister for Health however, this exemption is rare and relates mainly to Doctors and Botanists.

There is no evidence on hand to suggest that large scale illicit Coca/Opium Poppy Plantations are taking place in New South Wales however this is not to suggest that such a cultivation could not take place.

Coca Plant

There are three known Australian Native Coca Plants growing in N.S.W.. These are:-

(i) E Australe (found in NSW/QLD)

(ii) E Ellipticum (N.T. & N.Qld - Origin Brasil)

(iii) E Ecarinatum (Qld - N.G. Origin Solomon Islands)

E - **ERYTHROXYLUM** - Shrub or small tree. Reddish Brown branchlets with numerous lenticals.

The alkaloid content (of which cocaine is the principal component) of the above three species is presently being tested by the Division of Analytical Laboratory. It is not thought to compare highly with the species grown in Coloumbia, Peru and Brazil which are renowned for the current level of cocaine production.

The plant grows better in higher altitudes and away from the coastal areas but in a tropical climate. The small leaves are harvested and steeped with kerosene, sulphuric acid and an alkali to form a coca base from which after further process, cocaine is made. The leaf is also chewed. Annexures 1 & 2 depict parts of the coca plant.

It is often described as a small to large tree or shrub up to 35-55 cm diam. Bark noted to be grey to brown often with vertical grooves, inner bark reddish to yellow brown. Branches 1-4mm diam brown to black when dried. Leaves very variable in size and shape but mostly obovate, elliptic or oblong, dark green to greenish brown often shining above dull light green undercover.

As an indication of the scale of cultivation needed to obtain significant amounts of Cocaine, Botanists at the Royal Botanic Gardens have estimated that 1 acre cultivated under perfect conditions would yield about 2 kilograms of Cocaine. Hence very large areas of cultivation would be needed to achieve traffickable quantities of Cocaine. The processing of both the Coca plant and Opium Poppy are very labour intensive.

OPIUM POPPY

The Opium Poppy has been found under illicit cultivation in New South Wales but not of significant quantity. It is similar to the Garden variety of Poppy perhaps rounder in the bulb. (See annexure 3) It is often grown as a garden flower and does produce a bloom similar to it's garden variety. Prior to seeding, the bulb is often scored to yield a sap which is the primary product used in the process of making morphine and Opium. Once again large areas of cultivation are needed to produce a significant quantity of sap to be used in the process of producing the Opium and Morphine.

Where an Officer believes that an illicit cultivation of Opium Poppy or Coca Plant is taking place, he should immediately contact the Plantation Unit of the Drug Enforcement Agency and arrangements will be made for a botanist to identity the suspect plant. Botanists have indicated that it is extremely difficult to identify both the Coca and Opium Poppy plant and and only an expert should attempt such action. Again the Officer should use common sense when making an assessment as to whether the cultivation is of an illicit plant. Many of the warning signs evident for cannabis cultivation would also be used in conjunction with the cultivation of the Opium Popply or Coca Plant.

CONCLUSION

It is of paramount importance that Police and other bodies involved in the investigation of illicit plant material carry out their duties in a professional manner to ensure satisfactory presentation of evidence at Trial. Persons involved in the cultivation of cannabis go to great lengths 'covering themselves' in an endeavour to avoid arrest making often protracted investigations extremely intricate. At Trial, a minor technicality often becomes a major issue and to avoid such a situation arising, Police and other persons carrying out duties in respect of a cultivation should at all times adhere to adopted procedure and guidelines.

Officers at the Plantation Unit are on call at all hours to advise or assist with any matter relating to illicit plant cultivations.

ANNEXURE A

STATION	CONTACT OFFICER	PHONE NO
NEW SOUTH WALES		
PLANTATION UNIT	All Personnel	02-2655466
NORTH REGION		
BALLINA	Det Sgt Charlie HALLORAN	066-864740
COFFS HARBOUR	Det Sgt John QUINN	066-520276
GOSFORD	Det Sgt Wayne EADE	043-259532
MANLY	Det Sgt Maurie NIELD	02-9777724
NEWCASTLE	Det Sgt Maurie DOUGHAN	049-290645
TAREE	Det Sgt Athol EDMUNDS	065-521044
NORTH WEST REGION		
ARMIDALE	D/S/C Peter MOSS	067-726140
PARRAMATTA	Det Sgt Neville HILL	02-6897758
SOUTH WEST REGION		
CAMPSIE	Det Sgt Brian BANNISTER	02-7896185
SOUTH REGION		
BERKELEY	Det Sgt Garry KERR	042-714444
QUEANBEYAN	Det Sgt Brett BELLIS	062-980508
SYDNEY POLICE CNTR	Det Sgt John HANDBIDGE	02-2654783

ANNEXURE 'B'

WARRANT UNDER SECTION 38 OF THE DRUG MISUSE AND TRAFFICKING ACT 226/1985

New South Wales

to wit ....

TO: The Director-General of Agriculture and any person authorised by him.

WHEREAS
(hereinafter called the informant), a
of Police of in the said State, appeared before me, the undersigned, one of Her Majesty's Magistrates in and for the said State, and upon oath informs me that he, the said informant, suspects (or believes) that certain prohibited plants, to wit,

are on premises situate at

in the said State.

Reasonable grounds having been shown by such informant for so suspecting (or believing), I, the undersigned, Magistrate, grant a Warrant authorising the Director-General himself, or any person authorised by him, to enter the said premises and take such steps as he thinks necessary for the purpose of destroying the said prohibited plants on the said premises and preventing any regrowth of those plants and subsequently from time to time to again enter the said premises and to take steps for those purposes until he is satisfied that the said prohibited plants have been completely destroyed and their regrowth effectively prevented, and for so doing this shall be your Warrant.

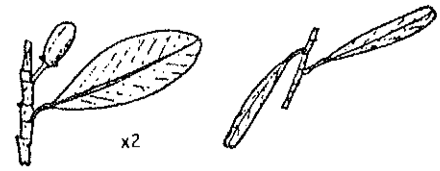
Given under my hand and seal

this day of 19
at in the said State

....
MAGISTRATE

GROUP 13.9 (CONTINUED)

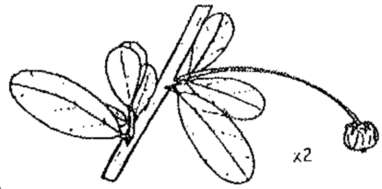
2B. LEAVES SMALL



ERYTHROXYLUM

Erythroxylum australe

Shrub or small tree in DRf and vine thickets north from Acacia Creek, McPherson Range. Branchlets reddish-brown with numerous lenticels. Prominent stipules enclosing terminal buds, soon shed, their scars encircling the twigs. Leaves small, hairless, thin, 1½-3 cm long, elliptic to obovate, blunt or rounded at the apex, dull green above, paler below with prominent lateral veins; margins thickened and bent under. Fruit a red drupe, to 7 mm long. Family Erythroxylaceae

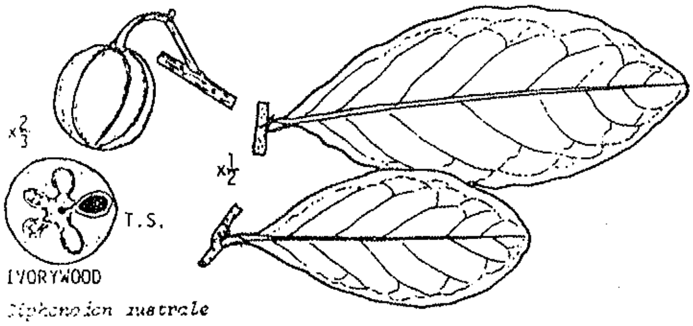


BRUSH SAUROPUS

Sauropus albiflorus ssp. *microcladus*

Shrub in disturbed STRf, rare, recorded in NSW only from the Tweed Valley and Tweed Range. Very small leaves borne in clusters of 2 to 4 along branchlets, stipules minute, brown. Leaves 2-9 mm long, obovate to oblanceolate or elliptic, with a rounded apex, hairless, petioles very short. Branchlets stiff but not spinose. Fruit a greenish capsule, small Family Euphorbiaceae

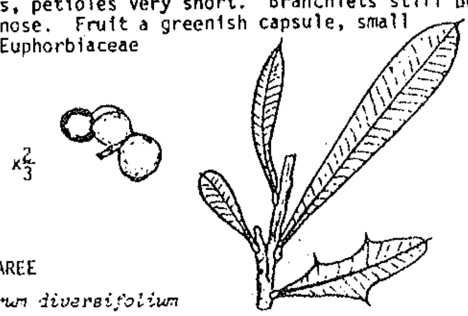
2C. LEAVES FIRM TO STIFF



IVORYWOOD

Siphonodon australe

Medium-sized tree in DRf and STRf north from Mallanganee, west of Casino. Leaves hairless, rather thick and leathery, obovate, narrow-obovate or elliptic, very obtuse or bluntly pointed, 5-13 cm long, tapered to the short petiole, glossy above, paler green below. Lateral veins few, 5-8 pairs. Fruit yellow, globose, fleshy, 2-5 cm diam., several-seeded. Family Celastraceae



SCRUB BOONAREE

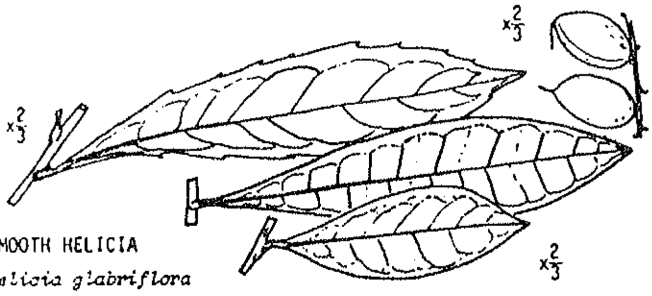
Heterodendrum diversifolium

Shrub or small tree in vine thickets and rarely in DRf, north from Yallaroi. Leaves often clustered on short branchlets, stiff and leathery, hairless; very variable in shape, leaves on young bushes irregularly lobed with spinose teeth, those on adult plants often entire or with 1-3 teeth; apex obtuse, usually with a spinose tip; lateral veins prominent, making wide angles with the mid-vein. Fruit a 2-lobed capsule, seeds black with a red aril. Family Sapindaceae

FIREWHEEL TREE

Stenocarpus sinuatus

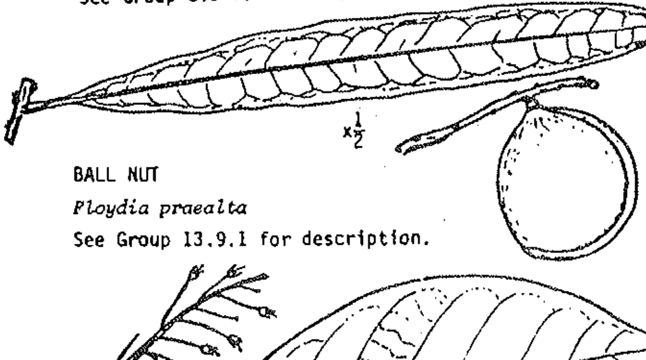
See Group 8.3 for description.



SMOOTH HELICIA

Helicia glabriflora

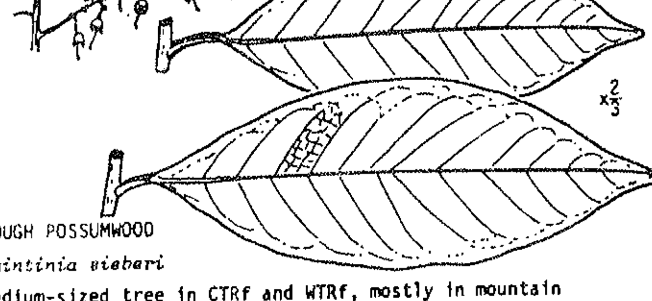
Small tree in STRf, WTRf and CTRf north from the Illawarra. Leaves narrow-elliptic to oblanceolate, 5-13 cm long, glossy, hairless, tough to stiff, margins varying from entire to coarsely toothed, the main veins distinct and with looping connections. Petioles very short. Fruit fleshy, blue. Family Proteaceae



BALL NUT

Floydia praealta

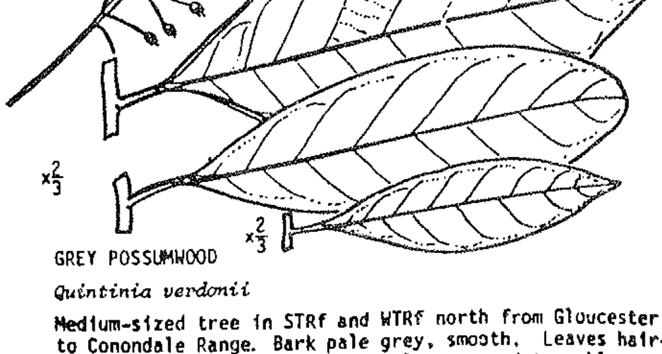
See Group 13.9.1 for description.



ROUGH POSSUMWOOD

Quintinia sieberi

Medium-sized tree in CTRf and WTRf, mostly in mountain areas, north from Mt Budawang to the McPherson Range. Bark red-brown, rough and fissured, hard. Leaves hairless, elliptic or oblong-elliptic, shortly pointed, 7-12 cm long; lateral veins slightly raised below. Petioles thick, green or reddish, 1-2 cm long. Leaf undersurface, petioles and young stems with numerous minute reddish surface glands. Fruit a very small capsule borne in terminal panicles. Family Escalloniaceae



GREY POSSUMWOOD

Quintinia verdonii

Medium-sized tree in STRf and WTRf north from Gloucester to Conondale Range. Bark pale grey, smooth. Leaves hairless, elliptic to obovate, shortly narrowed to a blunt point, 7-15 cm long, main lateral veins strongly raised and prominent below. Petioles thick, green or reddish, 1-2 cm long. Leaf undersurface, buds and young stems with numerous minute pale surface glands. Fruit a very small capsule, borne in simple racemes. Family Escalloniaceae

PLATE 13

Plate 13. *Erythroxylum novogranatense* var. *truxillense*. Flowering branch of Trujillo coca at Collambay, Dept. La Libertad, Peru (*Plowman 5606*). Photograph by T. Plowman.

PLATE 14

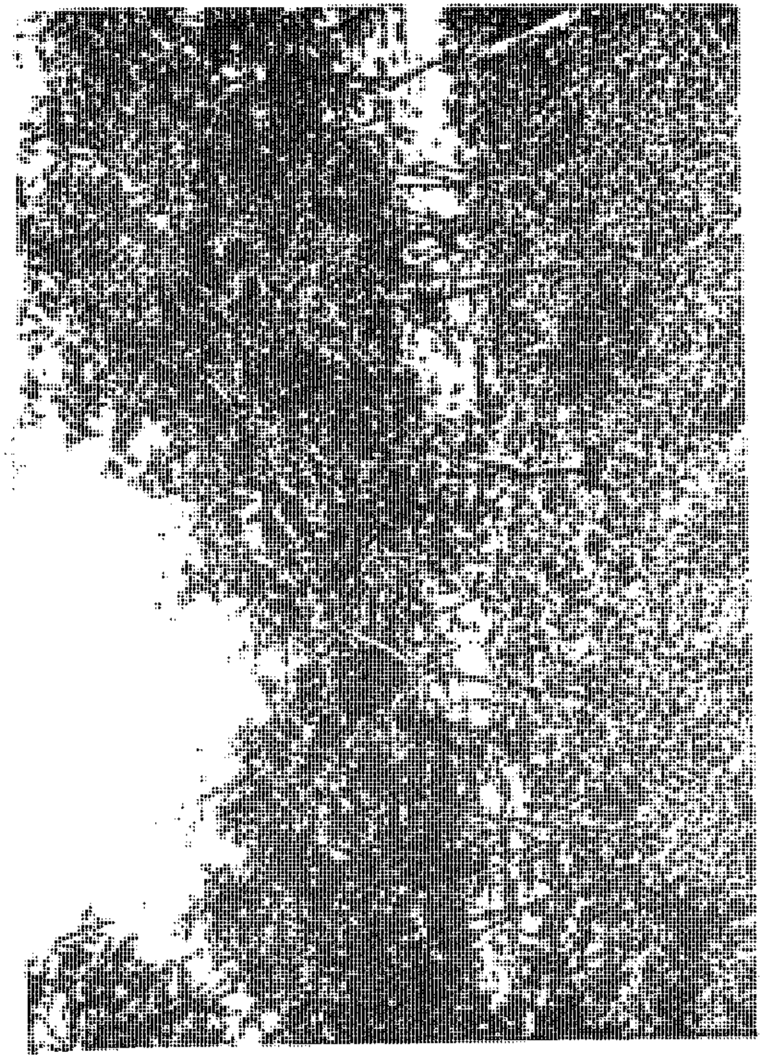
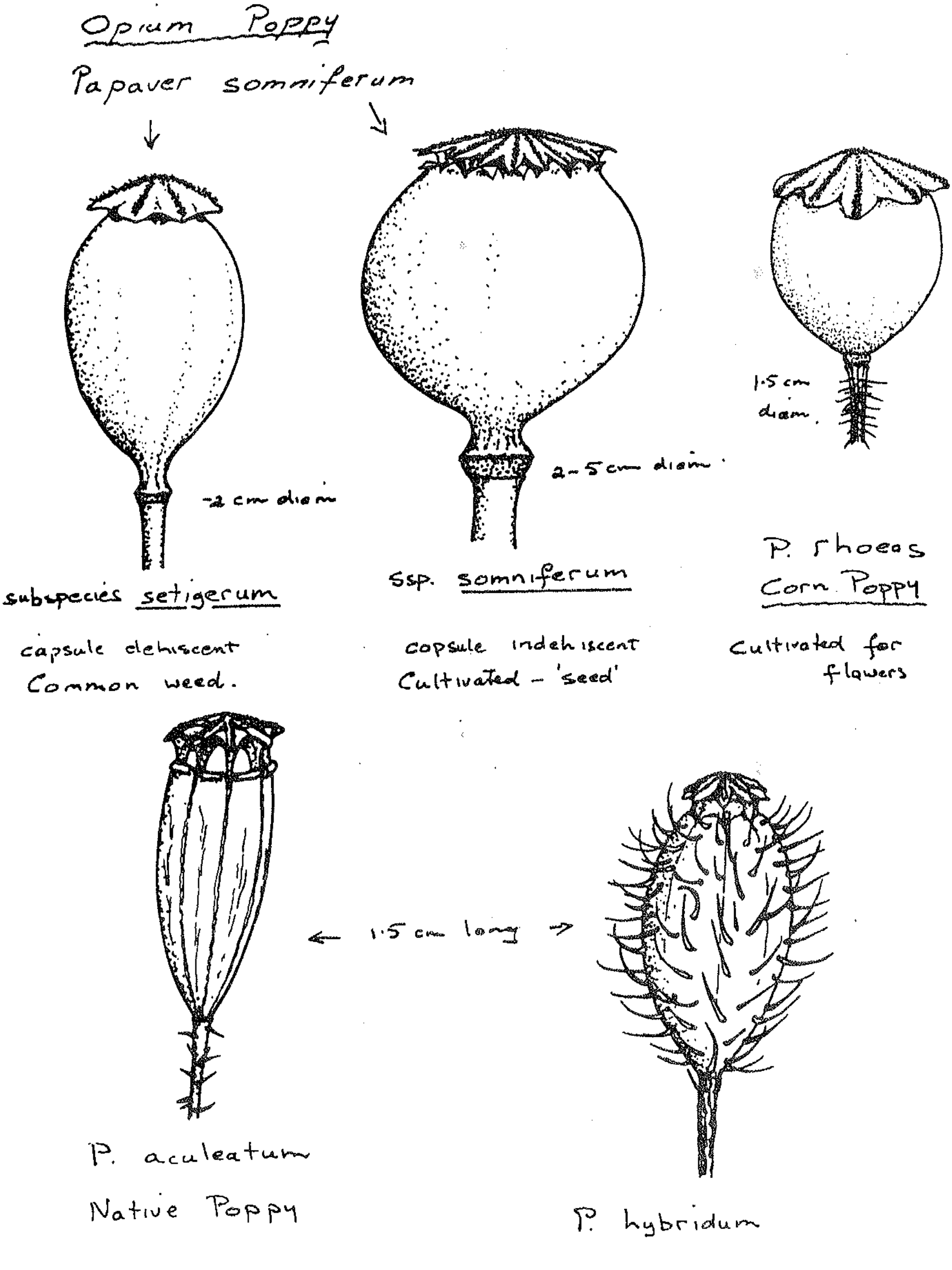


Plate 14. *Erythroxylum novogranatense* var. *truxillense*. Plantation of Trujillo coca showing the use of *pacay* (*Inga Feuillei*) as a shade tree. Simbal, Dept. La Libertad, Peru (*Plowman 5600*). Photograph by T. Plowman.

ANNEXURE (iii)



TROPICAL WEEDS RESEARCH CENTRE

B.J. Wilson
Tropical Weeds Research Centre
PO Box 187
Charters Towers, Qld. 4820

The Alan P. Dodd Tropical Weeds Research Centre (TWRC) at Charters Towers, was constructed during 1984 and staffed during 1985 and 1986. The total staff of 13 includes four scientists, four technical assistants and three casual assistants.

TWRC is one of two weed research facilities of the Biological Branch, Queensland Department of Lands, the other being the Alan Fletcher Research Station at Sherwood in Brisbane. The branch, directed by Mr G. Diatloff, also has overseas staff doing biological control investigations.

The area of operation for TWRC is the northern half of Queensland, with regions varying from the wet tropical coast to arid grazing lands.

The primarily responsibility of TWRC is research on introduced weeds, many of them being woody weeds. However, Australian native plants which are specific weed problems, are also included. In all cases, the weeds threaten the productivity of grazing in major areas of northern Australia and/or they affect National Parks, rainforests, waterways or public lands (roadsides, stock routes). Thus, the beneficiaries range from the grazing to the tourist industries.

Our research is aimed at achieving weed control using any one or a combination of biological, chemical, mechanical, or managerial control. Biological control work currently involves mass-rearing, aiding distribution, or monitoring of insects already released on giant sensitive plant (*Mimosa invisa*), rubber vine (*Cryptostegia grandiflora*), prickly acacia (*Acacia nilotica*), parthenium weed (*Parthenium hysterophorus*), lantana (*Lantana camara*) and salvinia (*Salvinia molesta*).

Herbicide research includes developing effective herbicide recommendations by screening products, developing new formulations (e.g. for 2,4-D), evaluating additives, evaluating application methods, and studying the effect of environmental factors and plant growth status on herbicide efficacy. Experiments are in progress on rubber vine, prickly acacia, chinee apple (*Ziziphus mauritiana*), parkinsonia (*Parkinsonia aculeata*), currant bush (*Carissa ovata*), milkweed (*Euphorbia heterophylla*), wild tobacco tree (*Solanum mauritianum*), calotrope (*Calotropis procera*) and fanwort (*Cabomba caroliniana*).

Weed ecology research covers mainly long term monitoring of woody weed populations and distribution mapping. Monitoring techniques are quantitative and well suited to assessing spread and thickening as well as the medium to long term impact of biological control agents and other control methods. The longevity of seedling regeneration following complete control of an original population is being studied. The ecology staff maintain an herbarium and do some weed identification.

In addition to research, TWRC has important extension and educational roles.

NOXIOUS PLANT CONTROL ADMINISTRATION IN QUEENSLAND

J. Cummings
Project Officer (Plant Pests)
Rural Lands Protection Board
Brisbane.

Introduction

The central feature of the administration of control of all major pest species in Queensland is one piece of legislation, The Rural Lands Protection Act (1985-1988). This Act contains provisions for the control of declared plants and declared animals in all situations throughout the State as well as for the management of stock routes and water facilities. So the Rural Lands Protection Board is seen as the single pest authority for the State.

The Act is administered by the Minister for Land Management. The Rural Lands Protection Board is the name loosely given to the administrative body, as well as to an actual Board constituted under the Act. The administrative body is, in fact, a Division of the Department of Lands, albeit a fairly autonomous one.

The Board

Membership of the Board is as follows:

* A Chairman, recommended by the Minister and appointed by Governor in Council;

* An Executive Director, who is a Public Servant or qualified to enter the State Public Service, and appointed by the Governor in Council (ex Officio);

* The Chief Commissioner of Lands or his nominee (ex officio);

* The Director-General of the Department of Primary Industries or his nominee (ex officio);

* Two nominees of the Local Government Association of Queensland; and

* Eight landholders as follows:

  - Two nominees from the United Graziers' Association;
  - One nominee from the Cattlemen's Union;
  - One nominee from the Queensland Graingrowers' Association;
  - One nominee from the Queensland Cane Growers' Association;
  - One nominee from The Council of Agriculture;
  - One nominee from the Queensland Dairymen's State Council;
  - One nominee from the Committee of Direction of Fruit Marketing.

The Board's functions include making recommendations to the Minister regarding:

1. Declaration of plants and animals;
2. Promotion of control and establishment of programs;
3. Establishment of research programs;
4. Education;
5. Expenditure on equipment and materials for control programs;
6. Establishment and maintenance of stock routes and facilities.

The Board is required to meet at least three times per year.

Organisational Structure

The Executive Director is responsible for carrying out the policies and decisions of the Board, with the approval of the Minister. He is also charged with the supervision of the day–to–day operations of the organisation.

Whilst he is an officer of the Department of Lands, he reports directly to the Minister and not to the permanent head of the Department. However, the permanent head exerts controls in the areas of personnel and finance.

The overall structure of the organisation is shown in Appendix 1.

General Operations

Under the Act, Local Authorities are charged with ensuring that declared plants are controlled within their areas and, where necessary, are to enforce the relevant provisions of the Act in so doing.

Local Authorities, landholders and Government Departments are responsible for the control of declared plants on land under their control. Furthermore, Local Authorities are empowered to enforce the control of declared plants on private land. This involves the issue of notices and possible entry onto land to control declared plants.

Local Authorities have no such control over 'public land' other than by notifying a Government Department of the existence of declared plants on the land. The Board can assist in resolving problems occurring on public land. Furthermore, the Board accepts responsibility for the control of declared plants on vacant Crown land.

Board Regional Inspectors monitor progress of Local Authorities, Government Departments and, at times, individual landholders in regard to declared plant control and report back where necessary. They maintain close contact with the relevant Local Authority and Government officers.

Project Officers receive Inspectors' reports, inspect specific situations where warranted and take up necessary matters with Local Authorities and Government Departments, either in writing or in person, usually at high levels, sometimes by addressing the Local Authority Council. They are also involved in development of programs for the control of declared plants. All 'field' staff carry out extension activities aimed at landholder and Local Authority education.

Funding and Expenditure Arrangements

Under the Act a Local Authority is required to submit to the Board its annual budget of expenditure on activities in pursuance of its responsibilities in accordance with the Act.

As far as declared plant control is concerned, a Local Authority's expenditure may involve wages (inspector/s, spray gang members), purchase and maintenance of plant and equipment, contract spraying, purchase of herbicides and other expenditure.

Local Authorities are each required to pay their budgeted amount as well as an on-cost prescribed by the Board into a trust fund operated by the Board. The total amount paid by a Local Authority is called a 'precept'. In applicable areas of the State the precept includes levies for rabbit control and dingo barrier fence protection.

A consolidated revenue grant is also received and paid into the trust fund. At present Board funds consist of approximately 50 per cent Local Authority levies, 30 per cent consolidated revenue grant and 20 per cent self-generated funds. This means that Queensland is actually one of the lowest government-funded pest authorities in Australia ($3-million in 1987-88).

The level of precept imposed on Local Authorities depends on the amount of money to be raised for Board operations on top of that received from Consolidated Revenue, sale of herbicides, property, stock and watering fees, and other income.

Board expenditure on Plant Pest activities mainly involves purchase of herbicides for resale to landholders and Local Authorities, as well as for specific Board programs, wages of Regional Inspectors, purchase and maintenance of vehicles, purchase of plant and equipment, and biological control agent research and propagation.

As Local Authorities carry out their operations they claim reimbursement of their budgeted expenditure from the fund, and are entitled to reimbursement for approved expenditure up to the value of the budgeted amount. There is no reimbursement of on-cost levies of course.

Local Authority Performance

Local Authority functions imposed by the Act vary according to geography, that is, whilst coastal Local Authorities are predominantly concerned with declared plants, western Local Authorities tend to be more involved with travelling stock, maintenance of water facilities and to some extent, animal pest control.

The more coastal Local Authorities thus employ 'Weeds Supervisors' or 'Noxious Plants Inspectors' whereas more western Local Authorities employ 'Stock Routes Supervisors'. Whilst the generalisation that the western areas have less weed problems than the coast is reasonable, this overlooks some of the special declared plant problems that occur in the western areas (not least of which is Parthenium).

In any case there is far less tendency for Local Authority officers to carry out inspections of holdings in the western areas, whereas it is the norm in coastal areas. Issuing of notices for the control of declared plants in the former area is virtually unknown, let alone the taking of 'enter and clear' action.

The Board is taking initiatives to rectify this sort of situation; however, there are problems associated with carrying out inspections in some of the large Shire areas that exist in Queensland. Obviously, what is required is the employment of more staff, which Local Authorities are reluctant to do because of the cost. This is an issue that the Board needs to address.

Should a Local Authority refuse to accept its responsibilities in regard to the control of declared plants in its area there is power under the Act to take action against the Local Authority.

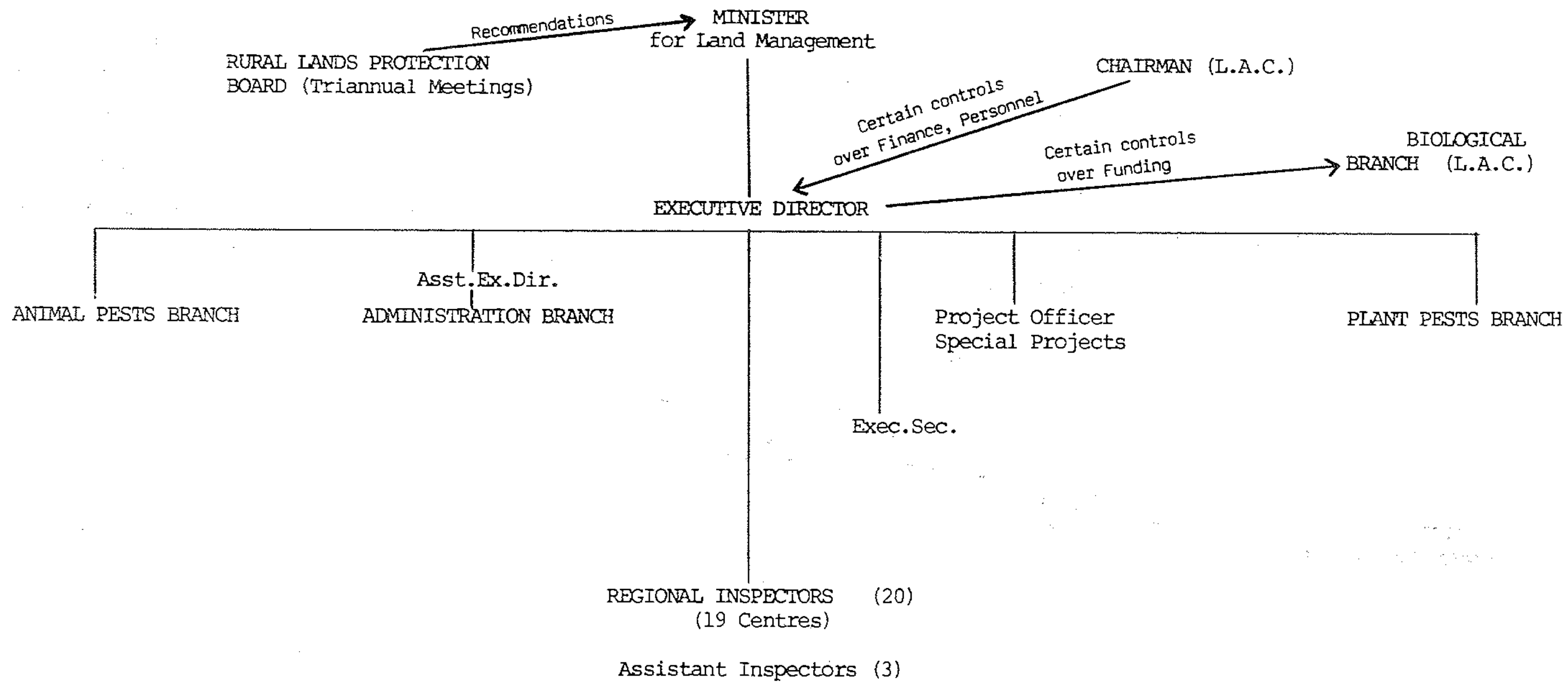
In such a case the Board can recommend to the Minister that he issue a notice on the Local Authority requiring it to carry out the necessary functions or actions. If the Local Authority does not comply with the notice then the Governor in Council may direct the Executive Director to take over the Local Authority's powers and carry out the necessary activity at the Local Authority's expense.

Strategic Planning

The Board, like all Queensland Government Departments and agencies, has recently undergone a Strategic Planning exercise. This is basically aimed at better identification of objectives, more efficient performance and improved accountability. It will be interesting to see the results of this administrative change on the operations of the Board and Local Authorities.

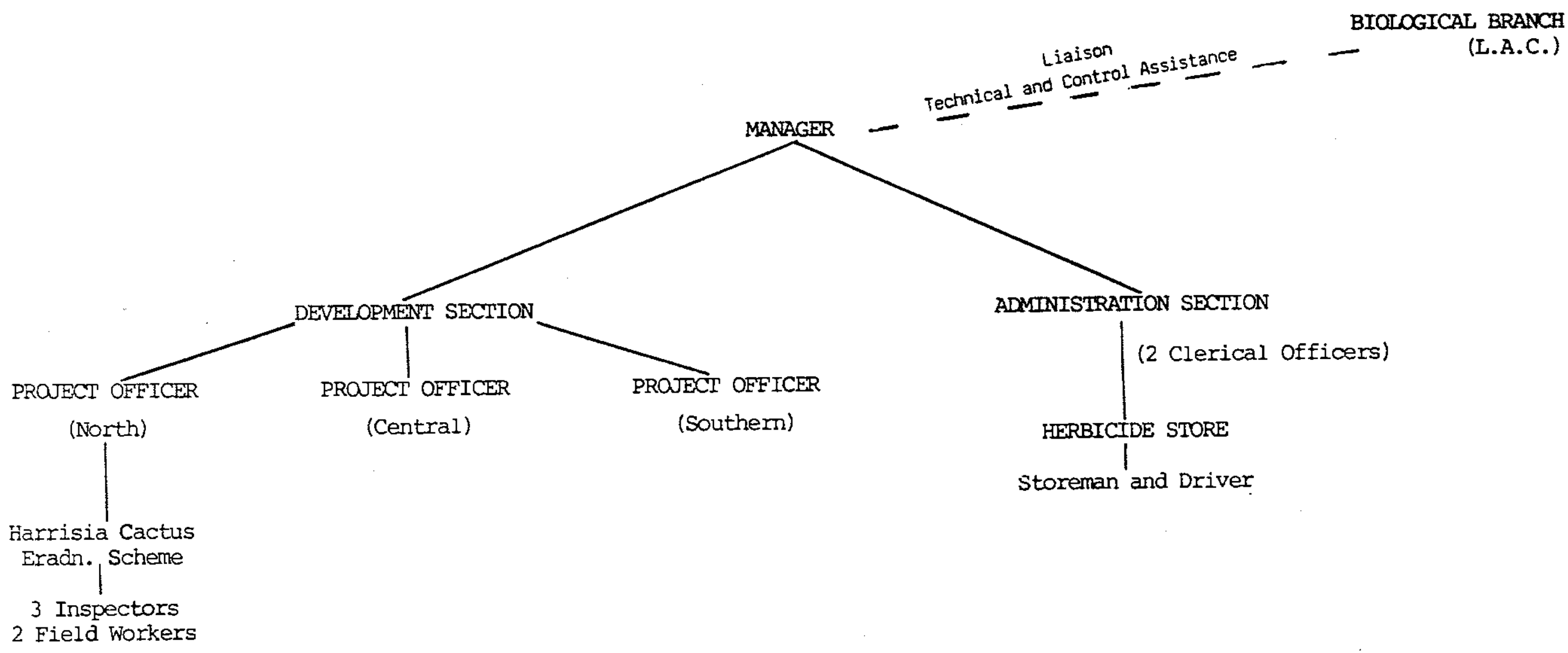
APPENDIX I.

BASIC ORGANISATION STRUCTURE - RURAL LANDS PROTECTION BOARD



APPENDIX II.

PLANT PESTS BRANCH



BITOU BUSH CONTROL AND NATIVE SPECIES SENSITIVITY TO HERBICIDES

Max McMillan,
NSW Agriculture & Fisheries,
Glen Innes, N.S.W.

The Glen Innes Weed Unit has conducted two herbicide experiments on bitou bush control and three on the sensitivity of native plant seedlings herbicides.

Bitou Control

An experiment commenced in 1985 showed that Garlon[R] (triclopyr) and Krenite[R] (fosamine) were much less effective than Roundup[R] (glyphosate) which was already registered for bitou bush control.

A parallel experiment conducted in southern NSW by John Toth gave very similar results for each of these herbicides. The effective rate for Roundup (360g/L glyphosate) was between 0.5 and 1.0ml/M^3 at both sites.

Further work by John Toth and others revealed that Brush-off[R] [metsulfuron] was also effective and appeared to reduce regeneration of bitou bush from seedlings under the sprayed bush.

An experiment comparing rates of Brush-off and Roundup in northern NSW was installed in August 1988. Preliminary results are shown in Table 1.

TABLE 1 CONTROL OF BITOU BUSH BY ROUNDUP AND BRUSHOFF, ANGOURIE 1988

Herbicide (Application method)	Rate (mL or mg/M^3)	Control Score 3MAT	(0-10)* 6MAT	Cost $/30$M^3$
Brush-off (Gas Gun)	0.0075	5.40	7.60	0.25
" "	0.0150	7.20	9.60	0.50
" "	0.0300	6.40	9.20	0.99
" "	0.0600	6.20	9.70	1.98
(High Vol)	0.0150	8.80	10.00	0.50
Roundup (Gas Gun)	0.3500	7.40	7.80	0.14
" "	0.7000	9.60	10.00	0.27
" "	1.4000	9.95	10.00	0.55
" "	2.8000	10.00	10.00	0.51

[* 0 = NO EFFECT 10 = DEAD]

From these results, Roundup appears cheaper at current prices than Brush-off at the lowest effective rates tested. (Brush-off .015g/M^3 and Roundup 0.7mL/M^3).

For high volume application at 250mL of spraymix per cubic metre, the required concentration of Brush-off would be 6g/100L and Roundup 280mL/100L.This suggests that the registered Roundup rate is unnecessarily high.

Seedlings were present in treatments, but overall there were less seedlings in Brush-off treatments.

Sensitivity of Native Species

Native species were tested as tube stock, supplied by NSW Soil Conservation Service. Seedlings were kept in shade or glasshouse after treatment with herbicide. Rates of herbicide simulated the rates tested in the bitou bush field trials. The results of all experiments are summarised in Table 2.

TABLE 2 SENSITIVITY OF NATIVE SPECIES AND BITOU SEEDLINGS TO FOUR HERBICIDES

Species	Brush-off^R	Garlon^R	Krenite^R	Roundup^R
Banksia ericifolia	MT	HS	S	S
Banksia integrifolia	T	S	T	MT
Banksia aemula (previously *serratifolia*)	MT-S	HS	T	MT-S
Coastal wattle	MT-T	HS	S	MT
She oak	S	HS	S	T
Tea-tree	S-MT	S	MT	MT
Marram grass	MT-T	*	*	MT-T
Bitou bush	HS	S	S	HS

Where: T = tolerant (score <1.5)
MT = moderately tolerant (score 1.5-2.5)
S = susceptible (score 2.5-4)
HS = highly susceptible (score >4)
"*" = not tested

Bitou was more sensitive to Roundup and Brush-off than all native species tested. This suggests that application at current rates in the field should give reasonably selective control. This has been confirmed by field experience in NSW and Queensland and by John Toth's more recent experiments.

Roundup and Brush-off showed a similar degree of selectivity in these experiments. The major differences were that *Banksia ericifolia* exhibited some tolerance to Brush-off, but not to Roundup and the She oak (*Casurina* sp) exhibited some tolerance to Roundup, but not to Brush-off. All other species exhibited at least some tolerance to both Roundup and Brush-off.

Acknowledgments: Roger Stanley and SCS for supply of tubestock and assistance
Robert Dyason, NPAO, Grafton for assistance with experiments
The NSW NPWS for provision of experimental sites

EXPERIENCES WITH BITOU BUSH IN QUEENSLAND

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INTRODUCTION

Bitou bush (*Chrysanthemoides monilifera* (L.) Norlindh subsp. *rotundata*) is a South African shrub which has become a pest of the eastern seaboard of Australia. The National Parks and Wildlife Service brought bitou bush to the attention of the Alan Fletcher Research Station in 1980. An examination of Queensland Herbarium records and sand mining leases revealed the plant was mainly confined to public lands in the Wide Bay district (200 ha) and South Stradbroke Island (500 ha). Queensland has vast areas of coastal sand dunes that could easily be invaded by bitou bush. Herbicide screening trials were set out at Rainbow beach. Of the chemicals tested, glyphosate proved to be the most effective. Having a means of control in glyphosate, and realising the infestations were small enough to be treated, the decision was made to initiate an eradication programme in February 1981.

DECLARATION

On 7 May 1981, bitou bush was gazetted as a noxious plant under the Stock Routes and Rural Lands Protection Act 1944. The provisions of this Act make it illegal to sell potted plants or use bitou bush for mining revegetation. Also the responsibility to destroy bitou bush rests with the landowner or occupier. Having the plant declared was a helpful means of dealing with reluctant landowners. With the introduction of the Rural Lands Protection Act 1985, the Queensland Government has made a firm committment to the removal of bitou bush. Under the new Act, bitou bush is listed in the eradication category 'P2' of the declared plant schedule.

WATER

To set out herbicide screening trials only small amounts of water were needed. Sufficient Brisbane tap water was trucked up to Rainbow beach for the trials. Larger volumes of water were needed for the eradication programme so Rainbow beach bore water was used as the diluent. However, the resultant herbicide performance was patchy. Apparently coastal bore water was not compatible with glyphosate. Results improved when salt sea water was used as the diluent. Salt water has been used for all glyphosate spraying, both ground and aerial work.

EQUIPMENT

In 1980 conventional spray equipment was used – a brush gun, spray hose, diaphragm pump, 400 L spray tank and four wheel drive vehicle. Some of the problems encountered with this gear in sand dune situations were difficult manouvering, bogged vehicle, damage to dune vegetation and failing to reach some areas. The next treatment was carried out using small

6 L Volpi pneumatic knapsacks. Each operator became an independant unit, able to work away from the vehicle. Lightweight equipment reduced operator fatigue. For dense infestations a sprinkler sprayer was used to distribute the glyphosate at a rate of 3.6 kg ha^{-1} using a volume of 100 L ha^{-1}. For scattered plants or under dense scrub a short Carpi lance was used. The vehicle is only used to carry a reservoir of water.

OPERATORS

The mainstay of the Queensland bitou bush control programme has been a small team of reliable spray operators. No matter how large or impressive the administration, regardless of how scientifically selective and effective the chemicals may be – the 'bottom line' is a few people who are ready, willing and able to do the actual spraying.

We have been fortunate in having the same spray team for the last eight years. Good operators are hard to find. 'Burr blindness' or failure to see the weeds can handicap a control programme. Some people do not have an accurate botanical eye and have trouble differentiating between bitou bush and bracken fern.

AERIAL SPRAYING

The spray pattern produced from a sprinkler sprayer is identical to the spray patern produced by a helicopter using the following design:

Nozzle	Raindrop size 8
Nozzle angle	45 backwards
Pump pressure	420 kpa
Speed	30 knots
Aircraft	Gas turbine Hiller
Boom length	11 m
Roundup rate	8 L ha^{-1}
Spray volume	130 L ha^{-1}
Diluent	Sea water

This spray pattern using a sprinkler sprayer has given good reliable control of bitou bush with little damage to native vegetation. Control on South Stradbroke Island began on 20 May 1986 when East Coast Helicopters was engaged to aerial spray the dense areas (53 ha) using a total of 425 litres of Glyphosate 360. Native vegetation in the aerially sprayed areas has been monitored for three years and no detrimental effects have been observed.

WEATHER

The South Stradbroke Island infestation affects 500 ha of land. Three men take four weeks to search this area and the resultant kill rate is usually 99%. Of all the factors influencing the success of the control programme – weather is the most variable. To achieve the best results, an understanding of weather is essential. Bitou bush grown under different weather conditions will respond differently to the same herbicide treatment, *e.g.* plants growing on frontal dunes exposed to prevailing wind, salt and sandblasting are much harder to kill than plants protected by a casuarina canopy.

Daily weather conditions dictate which part of the infestation will be treated on any one day; *e.g.* a strong SE wind would stop work on the eastern beach front. The wind would prevent an even spray coverage resulting in half dead plants.

The exposed beach areas are avoided during the midday heat. Also a canopy of casuarinas makes a better working environment at midday. The whole infestation is divided into small sections and each will be treated according to weather conditions.

Sections	Suitable Weather	Treatment method
1. Exposed east beach	No wind, sunshine	Chemical
2. Casuarina canopy	Slight rain, wind	Chemical
3. Scrub canopy	Rain, windy	Chemical
4. Exposed west beach	SE wind	Chemical
5. Tourist areas	Rain, wind	Hand pulling

RAINPROOFING

South Stradbroke Island has no easy access. Once men, vehicles, camping gear and equipment are moved onto the island, the job must continue smoothly. Unfavourable weather usually means a waste of time, money, labour and chemicals. Also patchy herbicide performance has a bad psychological effect on operators, lowering morale.

Like many foliar absorbed herbicides, glyphosate is vulnerable to rain. Before the chemical can be taken up, it is washed off - wasting glyphosate, labour and time. Rainproofing agents were being studied at the Tropical Weeds Research Centre, Charters Towers. The best of products tested was Bondcrete cement additive. Bondcrete produced only minor damage to *Banksia integrifolia*.

Bondcrete improved the efficiency of the 1988 eradication programme. Whenever light rain occurred during spraying, the addition of Bondcrete ensured optimum results. Spray equipment was not 'gummed up' or damaged by adding Bondcrete.

'ONE YEAR'S SEEDS - SEVEN YEARS WEEDS'

The control programme has been in progress for eight years in the Wide Bay district. There was no noticeable reduction in seedling emergence after each treatment for the first 6 years. A sudden dwindling of seedlings only occurred in the last two years. Many of the Wide Bay sites are now suitable for hand pulling.

The Wide Bay infestation affects an area of 200 ha. Treatment takes 20 man days to complete and requires 40 L glyphosate. South Stradbroke Island has been treated for the last three years. Each spraying takes 72 man days to complete, requires 250 L glyphosate and involves searching 500 ha of land.

Bitou bush is far from being eradicated in Queensland but is now considered well under control.

<u>Summary of Bitou Bush Treatments</u>

Date	Area	Method	Man Days	Chemical Used
Feb. '81	Rainbow Beach	Ground	10	15 L Roundup
June '81	Inskip Pt	Ground	20	35 L Roundup
				10 L Amitrole
Feb. '82	Rainbow Beach	Ground	8	5 L Roundup
				15 L Amitrole
Oct. '82	Rainbow Beach	Ground	10	20 L Amitrole
'83 missed - very dry				
Aug. '84	Rainbow Beach	Ground	20	20 L Roundup
				40 L Amitrole
Aug. '85	Rainbow Beach	Ground	10	50 L Roundup
May '86	Sth Stradbroke	Aerial	1	425 L Glyphosate 360
June '86	Sth Stradbroke	Ground	31	71 L Glyphosate 360
Oct. '86	Rainbow Beach	Ground	10	40 L Glyphosate 360
Mar. '87	Sth Stradbroke	Ground	72	250 L Glyphosate 360
Oct. '87	Rainbow Beach	Ground	32	80 L Glyphosate 360
Feb. '88	Sth Stradbroke	Ground	72	230 L Glyphosate 360
June '88	Rainbow Beach	Ground	20	40 L Glyphosate 360
Nov. '88	Sth Stradbroke	Ground	50	100 L Glyphosate 360
Feb. '89	Rainbow Beach	Ground	20	40 L Glyphosate 360
Mar. '89	Sth Stradbroke	Ground	19	35 L Glyphosate 360

BIOLOGICAL CONTROL OF GROUNDSEL BUSH

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Queensland 4075

INTRODUCTION

Groundsel bush *Baccharis halimifolia*, introduced during the late 1800's is a perennial weed of many situations along the mid-eastern Australian coastline. Its weediness can be attributed to a high degree of competitive ability. The plant grows rapidly, produces large amounts of wind dispersed seed, strongly compensates for any damage, and tolerates a wide range of soil types. Infestations interfere with primary production, invade and degrade native plant communities, take up useful space, and visually pollute the landscape.

A decision by the Queensland Department of Lands to investigate the possibilities of introducing biological control agents saw the first overseas exploration carried out in Florida USA in 1967. Later in 1974 an entomologist was stationed in Brazil and for several years insects were sent to Queensland. Since then more than 30 different insect species have been tested and many have been released. However only 5 species have become established and are contributing in some way to the control of the plant. Of these, 2 have become widely established, the habitat preference of another 2 restricts them to narrow ecological zones, and the remaining one, while established over a wide area, is restricted largely by climatic factors.

Trirhabda baccharidis Coleoptera: Chrysomelidae, USA

This small brown and orange beetle was the first insect to become successfully established in 1968. Both the adults and the larvae feed on the foliage, and the larvae burrow into the soil to pupate. The adults emerge in the spring and lay their eggs in crevices in the bark over a period of 1 to 2 months. The eggs lie dormant over the summer, hatching in late summer or autumn. Time of hatching varies, as it is influenced to some extent by rainfall. The metallic blue/green coloured larvae feed voraciously, and when population pressure is high, plants can be completely defoliated, with much of the softer bark at the tips of the stems being eaten away as well. This causes a spectacular "brown out", and if it precedes or coincides with bud development, severely depletes seed production, however timing is not always appropriate.
Unfortunately *Trirhabda* is restricted to Groundsel bush plants growing on poor sandy saline soils. This is because mortality of the pupal stage is high in all other soil types.Colonies once established spread relatively slowly. The nett effect of *Trirhabda* is

to interfere with seed production and to stunt the growth of plants. Results could be described as generally disappointing. New colonies can be started by releasing field collected adults or larvae, though results are better with adults.

Aristotelia ivae Lepidoptera: Gelechiidae, USA

This small brown moth was the second insect to become widely established. It has a short life cycle of about 1 month with several generations over summer. Damage is caused by the larvae which skeletonise the softer leaf tips. The caterpillars are green and about 12 mm long and feed within a silken tunnel. While the moth is now found over most of the plants range, large damaging populations are prevented from building up by climatic conditions, principally rainfall. On odd occasions when conditions suit, dense populations of larvae develop and "set back" patches of seedlings or regrowth after damage such as fire. This is most common in dry spring weather where plants are sustained by high soil moisture.

Megacyllene mellyi Coleoptera: Cerambycidae, USA

Megacyllene is the only insect from Brazil which has become established in the field. The adults are distinctively marked with 8 dark orange spots on the outer wings. The length of the life cycle is variable, slowing down over winter, but with a total of 2-3 complete generations each year depending on winter minimum temperatures. Again this insect has definite preferences for habitat type, and only survives on plants growing on poor sandy saline soils. This is because the larvae, on hatching, burrow into the woody stems and sever some of the sap conducting vessels. Where plants are growing in good soils and the sap pressure is high, it floods out, drowning then entombing the larva as it drys. On saline soils sap pressure is low and the young larvae are not killed.

Spectacular damage can result when strong colonies develop, with large plants being completely killed or being killed back to ground level. Field collection of the cryptic diurnal adults is not feasible; it is best to collect larvae and rear them through in the laboratory then release emerging adults. Large colonies are present on the low lying islands of Southern Moreton Bay, and are now making a significant contribution to the control of the plant. Further releases are being planned for suitable sites not colonised in the first release programme.

Rhopalomyia californica Diptera: Cecidomyidae, USA

In the late 60's the first attempts to rear and release this small mosquito-like fly met with failure. A second attempt in 1983 was highly succesful, and combined with an ambitious mass rearing programme saw rapid colonisation over a wide area of the plant's range. The larvae feed within the tissue of developing leaf or flower buds. The response of the plant is to form galls which then act as a metabolic sink causing general unthriftiness and reduced seed set. Heavy attack can lead to starvation and eventual death of plants.Gall flies do best in a cool moist environment when the plants are making active growth. Hot dry conditions and a lack of active shoots or buds lead to low population levels. For this reason there is often marked spatial and seasonal variation in gall fly populations, and subsequent damage to plants. In recent years the last season which was conducive to the development of large populations over a wide area was in 1985. A series of dry springs in the following years has seen numbers diminish in all but cooler shaded areas in elevated situations. A return to more favourable conditions should result in an improvement. Build up of gall fly populations can be facilitated by cutting back or burning off an area of plants in late winter or early spring to encourage the growth of lush shoots to which the flies will be attracted. Colonies can be started in new areas by redistribution of field collected cut foliage supporting mature galls.

Oidaematophorus balanotes Lepidoptera: Pterophoridae, USA

Again, early attempts to rear and establish this insect were unsuccessful. In 1985 a satisfactory rearing method was devised, and several thousand moths have now been released. Damage is caused to plants by the larvae which tunnel in the stems. There are 1-2 generations each year depending on winter minimum temperatures which affect the length of the larval stage. The plume moth is not restricted to any specific habitat type, and colonies have been easy to establish over a wide area, and are now expanding rapidly. As yet it is too early to predict what impact this insect will have on the plant population. The release programme is continuing by shifting stems containing larvae from well established sites to new areas.

FUTURE ACTIVITIES

The programme of overseas exploration for insects has now been scaled down. At the Alan Fletcher Research Station there are 4 insect species being either tested in quarantine or being reared in readiness for release, while a similar number have been located in the United States and will probably be introduced in the future. However, the number of potential insect candidates now remaining is much diminished, and a programme to look for suitable pathogens has been commenced.

CONCLUSION

Overall a permanent natural control system has not yet been achieved, and if left unchecked Groundsel bush will continue to fill most of the remaining available niche space.

BIOLOGICALCONTROLOFGROUNDSELBUSHONTHEN.S.W.NORTHCOAST

A LOCAL GOVERNMENT CASE STUDY

Ken Hayes,
Coffs Harbour City Council,
Coffs Harbour

Groundsel Bush as Noxious Weed

Groundsel Bush (*Baccharis halimifolia*) is a native of the Americas. This introduced woody weed is currently regarded as a major weed pest in Southern Queensland and Northern N.S.W., with its ability to grow in dense clusters reaching over 2 metres in 2–3 years. This shrub usurps resources that otherwise might be utilised for commercial pasture and timber species in coastal regions with an annual rainfall of over 90 cm.

Groundsel Bush grows into a small tree up to 10 metres high, and the weediness of Groundsel Bush is due to its prolific seeding and rapid growth that can take over neglected pasture, forming dense thickets within several years. Seeds will carry long distances on strong winds by parachute–like pappus. Groundsel Bush may also be a nuisance in populated areas because its pollen and other airborne parts are believed to be allergenic and a nuisance due to clogging and fouling caused by masses of airborne pappus.

Prevention of seeding is the key to control of Groundsel Bush.

Difficulties with Chemical Control

The Herbicide 24D is very effective in controlling Groundsel Bush, but there are major limitations on chemical control. In horticultural areas and National Parks, spraydrift is a serious hazard. In dense forests and inaccessible areas, especially in forestry, Crown Land and National Parks, the cost of spraying is quite substantial, and adequate funds are generally not available for control in these situations. There is also a growing resistance by the public, especially on the North Coast of N.S.W., to the use of 24D.

Biological Control

Groundsel Bush is an ideal candidate for biological control for several reasons:–

1. Because it is the only species of the genus Baccharis in Australia, and insects introduced for bio–control are unlikely to attack other plants in Australia.

2. It is a serious economic problem (the cost of control in N.S.W. and Queensland would be over $750,000).

3. It is attacked by a wide range of organisms in its native environment.

4. It is a perennial introduced species

The First Introduction of a Bio-Control Agent in N.S.W. for Groundsel Bush

In October, 1983, the Weed Demonstration Unit at Glen Innes obtained enough biological control insects of the Gall Forming Fly (Phopalomyia Californica) from the Queensland Department of Lands' Alan Fletcher Research Station to set up trial colonies at various sites along the North Coast of N.S.W. to determine the efficacy, spread and persistence of this Gall Forming Fly as a useful biological control agent for Groundsel Bush.

The method of introduction was to place young potted Groundsel Bushes heavily galled with R. Californica obtained from the Alan Fletcher Research Station in Queensland at Groundsel Bush infested sites at differing geographical locations on the N.S.W. North Coast. Coffs Harbour was one of the largest of the selected sites, with 110 potted plants being distributed at 4 different locations within the Coffs Harbour Shire.

The spread of R. Californica throughout the Coffs Shire from the release sites was quite spectacular, and by the Summer of 1985 was endemic throughout the Shire.

The effect of the Gall Fly on the seeding of Groundsel Bush in the 1985 season was very promising, with some areas of the Shire showing a 60-70% reduction in the formation of flower. This was due, however, to a near perfect set of climatic conditions both for the breeding of the Gall Fly and the Biotritus that effects the galled stems of Groundsel Bush after the Gall Fly emerges from the galls.

The results in subsequent years, however, have been far less spectacular and the 1988 season was particularly poor. This decline has most likely been due to climatic conditions, but it is also suspected that parasitism could also be occurring in the laval stage of the Gall Fly.

With the decline in the numbers of R. Californica observed in Coffs Harbour, I decided to investigate what other bio-control agents that the Alan Fletcher Research Station might have available for release on Groundsel Bush. I contacted Mr. Alan Tomley (Plant Pathologist) at the Research Station, and he told me that there were 2 more bio-control insects that were looking very promising (Megacyllene mellyi and Oidaematophorus balanotes). Both of these bio-control agents were stem-borers in their laval stage, with M. mellyi a beetle in the adult stage and o. balanotes a moth in the adult stage.

I was invited to go to Queensland in October 1987 to look at their release sites at North Stradbroke and Eaden Island areas, where we could collect larvae for rearing to adults in the laboratories at Alan Fletcher Research Station for release in the Coffs Harbour Shire.

A sum of $500 was agreed to for the Research Station to rear and supply us with enough adults to start a colony of both M. mellyi and O. balanotes in the Coffs Harbour area. I then returned to the Research Station in November 1988 and March 1989 to collect adults and larvae to bring back to establish a colony in the Coffs Shire.

These two biological control agents prefer a coastal heathland habitat and there are several areas in the Coffs Shire that have large Groundsel Bush infestations of the type that are very difficult to control by herbicide or mechanical means, which made these two biological control agents ideal for this area. It is therefore hoped that a viable colony of both species can be established in this area.

If the Coffs Harbour experiment is successful, then other areas of similar habitat along the North Coast of N.S.W. could be selected as bio–control sites, with insects being supplied from the Coffs Harbour colonies or from Queensland.

UPDATE ON CHEMICAL CONTROL OF BLACKBERRY

Max McMillan,
NSW Agriculture and Fisheries,
Glen Innes, N.S.W.

Blackberry is the major woody shrub weed in New South Wales and control programmes shrubs often include the application of herbicides. Herbicides are generally too expensive to use over large areas of dense shrubs but can be economical for small infestations or scattered shrubs. Successful control depends on applying a suitable herbicide at the correct rate and time. The method of application is also important.

Rate of Application

Herbicides must be applied at the correct rate. Many poor jobs are the result of inadequate application rates. On the other hand few people can afford to waste chemical by applying excessive rates.

Time of Application

Spray from the beginning of the flowering period, when the bushes are normally approcahing full leaf, until bushes begin to drop leaves. Spray only under good growing conditions, free from moisture stress. This requirement applies especially to the herbicides Garlon, Grazon and Tordon 50-D. Extremely poor control may result from applying these herbicides under conditions of moisture stress.

Method of Application

The most common method for applying herbicides is the high volume power sprayer fitted with a trigger operated, adjustable handgun. The Ag-murf^{R} gas gun is a low volume device which is becoming popular for treatment of small bushes. Other pieces of equipment such as knapsack sprayers, Spotgun^{R} and misters are also used.

For treatment of small blackberry bushes and sweet briar, the Ag-murf gas gun offers excellent labour efficiency, potential savings in herbicide in some situations and i useful in steep or rough terrain. It is limited to bushes less than about three metres tall and less than about six metres in diameter. The Gas Gun retails at over $500 and if other equipment is on hand, purchasing a Gas Gun may be poor economics.

High volume spraying is necessary for large bushes or dense clumps of bushes which are sprayed in bulk. This method uses more water and labour than the Gas Gun and can be wasteful when large numbers of small bushes are treated.

With both techniques, it is important to cover the whole plant with spray droplets. Herbicides applied through the Ag-murf Gas Gun should be mixed with a suitable dye (eg White Lightning^{R}) and sprayed to give fine speckling of droplets over the leaves. For high volume spraying of glyphosate and Brush-off the leaves should wet but not freely dripping.

Garlon, Grazon and Tordon 50-D should be sprayed to thoroughly wet stems and leaves. Bushes are usually dripping freely at the completion of spraying.

Ensure complete coverage by taking a systematic approach. Bushes should be treated in sections - as though spray painting - with each section being completely covered before moving on to the next section. For the Ag-murf Gas Gun, one 50ml shot, will normally treat an area of 2-4 square metres or roughly the area of one to two normal doorways. Take care to cover outlying crowns, runners and branches because they are easily overlooked.

Herbicides for Blackberry

Choice of herbicide depends on the situation and there are no hard recommendations. Cost is one important consideration and at current prices, the relative costs are shown in Table 1.

TABLE 1 COMPARATIVE COSTS OF COMMON HERBICIDE TREATMENTS FOR BLACKBERRY

		$/100LSpraymix	L/Bush*	$/Bush
Brush-off[R]	10g/100L	11.00	8	0.88
Roundup[R]	1L/100L	13.00	8	1.04
Garlon 600	170mL/100L	9.40	20	1.88
Grazon[R]	500mL/100L	15.95	20	3.19
Roundup[R] (Gas Gun)	10%	130.00	0.6	0.78
Brush-off[R] (Gas Gun)	1g/L	110.00	0.6	0.66

* 30 cu. metres

All herbicides require follow up treatment and the efficacy of a herbicide is usually assessed on the amount of regrowth occurring after the initial treatment. Table 2. gives typical patterns of regrowth after treatment in good conditions in northern NSW.

TABLE 2 TYPICAL REGROWTH PATTERNS FOR HERBICIDE TREATED BLACKBERRIES

Herbicide	Regrowth at:	12 months and	24 months after treatment
Grazon[R]		nil - slight	slight - moderate
Garlon[R]		slight - moderate	moderate - severe
Brush-off[R]		nil - slight	slight - severe
Roundup[R]		slight - moderate	moderate - severe

Grazon is the most reliable and effective herbicide. The other herbicides are less effective and give more variable results. Grazon is the best choice for cleaning up small infestations, but for larger infestations, a good program is to apply a cheaper herbicide in the first season or two of treatment and follow up in successive seasons with Grazon. After the third season, respraying should be minimal but respraying in the second season is often substantial.

If a poor result occurs with Roundup, Grazon and Garlon, this is very evident within twelve months of initial treatment and a good result normally carries through to the second season after treatment.

Brush-off is unique in that bushes which show very little regrowth after 12 months can be totally regrown after twenty four months.

The causes of excessive regrowth or poor initial results are not always clear. The main ones that have been identified for each herbicide are listed in Table 3.

TABLE 3 FACTORS ASSOCIATED WITH POOR CONTROL FROM HERBICIDES

Herbicide	Factors associated with poor results
Grazon[R]	* inadequate application rates * moisture stress
Garlon[R]	* inadequate application rates * moisture stress
Roundup[R]	* inadequate application rates * heavy defoliation * granite soils and coastal situations * retreating bushes recently treated with other herbicides
Brush-off[R]	* inadequate application rates * variable results not linked with any specific environmental factors

All herbicides tend to be less effective on coarse granite soils, but glyphosate is most affected, especially when retreating bushes severely knocked back by treatment in previous seasons. Glyphosate is leaf absorbed and bushes heavily defoliated by grazing or insect attack should not be treated.

Moisture stress is the major cause of poor results with Grazon and Garlon. Under ideal conditions, Garlon can give excellent results but under moisture stressed conditions, bushes can completely regrow after 12 months. Garlon should only be applied under ideal moisture conditions. Grazon should should only be applied at the lower concentration (700ml/100L) under ideal conditions. If there is any sign at moisture stress, the higher concentration (1l/100L) should be used.

Glyphosate and Brush-off are less affected by moisture stress and both have given excellent results under severly stressed conditions. Application is not rccommended under these conditions but moisture stress is clearly less critical with these herbicides than with Grazon and Garlon.

Other factors to consider in choosing a herbicide are water quality (glyphosate needs clear water) and damage to grasses. All the herbicides kill clovers, but glyphosate kills the perennial grasses. This is useful if pasture establishment is planned but may be undesirable in other situations.

Glyphosate has given very effective results through the Agmurf Gas Gun whereas the other herbicides, especially Brush-off, have been less effective when applied through the Gas Gun than high volume.

UPDATE ON CHEMICAL CONTROL OF LANTANA

Max McMillan,
NSW Agriculture & Fisheries,
Glen Innes, N.S.W.

Lantana is the most widespread and economically damaging woody weed of coastal NSW. It is a diverse species with a range of "ecotypes". The most commonly recognized types are red lantana and common pink. Common pink occurs along the entire coastal belt of New South Wales, whereas red lantana occurs mainly around Kempsey, Coffs Harbour/Grafton and in the Kurrajong area near Sydney.

There are three common varieties of red lantana, all of which are toxic to livestock and from time to time cause serious stock losses. Red lantana is noxious in those shires where it commonly occurs. Pink lantana is also noxious in several coastal shires.

The method of lantana control should be chosen to suit the situation. Large arable areas should first be controlled mechanically and sown to a competitive pasture. Herbicides can then be used to treat lantana regrowth.

Large non-arable areas may be uneconomical to treat, since herbicide cost alone is about $120 per hectare. This cost is totally wasted unless pasture is established and seedling lantana regrowth is controlled.

Where only small areas or scattered bushes occur, herbicide treatment is the simplest and often the mose economical option. Roadsides, stock reserves, fencelines etc are obvious situations for application of herbicides.

Chemical Control

Red lantana is reputed to be more difficult to control with herbicide than common pink. In northern NSW, Weed Unit experiments do not support this belief.

Herbicides have been tested in seven experiments over the last six years in northern NSW by the Glen Innes Weed Unit. Two of these experiments were conducted on common pink variety and five on red lantana. In the south of the state, John Toth, Weed Research Agronomist has conducted five experiments on common pink lantana.

Glyphosate has proven to be the cheapest and most effective herbicide in experiments on all types of lantana in both northern and southern NSW. The major problem with glyphosate is the complete removal of ground cover which opens the way for lantana seedlings and other weeds.

Herbicides such as DP60 and 2,4-D are less effective, usually requiring one or two resprays to kill the original bushes. Grazon^{R} and Tordon^{R} 50-D are effective but more costly than glyphosate. The advantage of herbicides such as DP60 and Tordon 50-D is that they do not kill the grass cover. Grasses grow strongly under the chemically treated lantana and prevent or reduce the establishment of seedling lantana and broadleaf weeds.

Whichever herbicide is used initially, respraying will usually be necessary either to kill seedlings and broadleaf weeds or to control regrowth. Three possible programmes are suggested in table 1 for an imaginary paddock of scattered lantana. This 10ha paddock contains 100 bushes, each of 30 cubic metres volume and each occupying 30 square metres of ground.

Programme 1 begins with glyphosate and includes the sowing of pasture seed and respraying with 2,4-D to control seedlings and broadleaf weeds. Respray volume is assumed to be 50% of the original spray volume.

Programme 2 begins with Tordon 50-D and assumess 10% of original spray volume on respray 12 months later. No pasture seed is sown.

Programme 3 begins with DP60. Respray volume in the first year is 50% and second year 10% of original spray volume. No pasture seed is sown.

TABLE 1 COST COMPARISON OF THREE POSSIBLE PROGRAMMES FOR LANTANA CONTROL

	PROGRAMME 1		PROGRAMME 2		PROGRAMME3	
Herbicide	glyphosate ($2ml/M^3$)		Tordon 50-D ($5ml/M^3$)		DP60 ($2.5ml/M^3$)	
Mixing rate	1:100		1:100		1:200	
Spray Volume	Litres	$	Litres	$	Litres	$
Year 1	600	78	1500	270	1500	50
Year 2	300	6	150	27	750	25
Year 3	-	-	-	-	150	5
Sub total	900	84	1650	297	2400	80
Labour	Hours	$	Hours	$	Hours	$
Year 1	4.0	40	4.5	45	4.5	45
Year 2	3.0	30	4.0	20	3.0	30
Year 3	-	-	-	-	2.0	20
	7.0	70	8.5	65	9.5	95
Pasture Seed	1kg	18	-	-	-	-
Labour (sow pasture)	2 hrs	20	-	-	-	-
		38	-	-	-	-
TOTAL PROGRAMME COST	192		362		175	

Assumptions:
* 100 bushes each $30M^3$ in volume
* glyphosate applied at 200ml spraymix per M^3 bush.
* Tordon 50-D and DP60 at 500ml spraymix per M^3 bush.
* Labour $10/hour.
* Spraytime 2 minutes per bush; 1/2 hour setting up, mixing, washing out, 1/2 hour tank refill.
* 50% respray: about 1.5 minutes per bush, 1/2 hour mixing etc.
* 10% respray: about 1 minute per bush, 1/2 hour mixing etc.
* 1000 Litre spraytank.

Table 1 is a best guess for programme costs because at present we do not have sufficient information on respraying volumes. It may be that the initial dose rate can be lowered in some instances, provided that respraying occurs within 12 months.

The efficacy of the herbicides on the first spray has now been fairly well studied and a summary of the attributes of each herbicide follows. Comparative application costs are given in table 2.

Glyphosate

Glyphosate is effective and reliable at rates which are cheaper than other herbicides. Effective rates are about .5 grams active per cubic metre for red lantana and .5 to .75 grams active for common pink. A rate of .5 grams/m^3 equates to a spray volume of 4 litres of 1% Roundup^R on a bush 6 metres in diameter and 2 metres high.

Small heavily grazed bushes of common pink can be difficult to kill with glyphosate because it is absorbed only through leaves.

Queensland research has shown that late summer to autumn is the optimum time to treat with glyphosate.

DP60 (Dichlorprop)

DP60 is a useful herbicide because it is safe on grasses and reasonably cheap. The currently registered mixing rate is 0.5% (1 in 200). Weed Unit results suggest that a mixing rate of 1% would be more appropriate. An application rate of 5ml of DP60 per cubic metre of lantana is necessary for reliable results.

At the 0.5% mixing rate, DP60 is cheaper to apply than glyphosate but most bushes will regrow and require respraying. DP60 is sometimes considered too selective because it does not control a range of other broadleaf weeds that commonly occur in coastal situations.

Tordon 50-D

This herbicide gives reliable control of lantana and also controls a wide range of other broadleaf weeds which commonly occur in the same situation as lantana. It is safe on established grasses and also provide some residual control of germinating broadleaf weeds.

At effective rates, Tordon 50-D is about three times more costly to apply than glyphosate but selectivity and versatility makes it a useful alternative for small infestations.

Buckshot^R

A reliable and effective rate has not been determined for Buckshot, which has given erratic results over all rates tested. Weed Unit results indicate heavy respray requirements for Buckshot treated bushes. Buckshot is good general purpose broadleaf weed killer and is safe on grasses. Buckshot is not registered for lantana control but is covered by a Pesticide Order in NSW.

2,4-D

This herbicide has not been adequately tested in the Weed Unit programme. Results indicate similar efficacy and cost of DP60 on pink lantana but inferior (very poor) control of red lantana.

UNREGISTERED HERBICIDES

Grazon DS

Grazon is only registered for mist blower application. Information from weed unit trials is very limited, but suggests that applied at sufficiently high rates Grazon gives effective control. When applied by high volume techniques Grazon is probably not as cheap or effective as Tordon 50-D.

Brush-off

Brush-off has given variable but sometimes excellent results and respraying has been effective in controlling the limited regrowth which does occur. A suggested rate is 50mg per cubic metre, and a mixing rate of 20 g/100L. The standard 10g/100L may be adequate given that respraying will be required.

Registration of Brush-off would be useful because lantana often occurs in the same areas as bracken fern, for which Brush-off is the preferred herbicide. It also occurs with blackberry and a range of other broadleaf species for which Brush-off is registered or potentially useful.

Chopper

John Toth's research with Chopper indicates that it may have a place in lantana control in certain situations - notably total vegetation control situations.

TABLE 2 COMPARATIVE COST OF LANTANA CONTROL HERBICIDES

Herbicide	Cost/L or g ($)	Effective Rate (Ml or mg product per cu. metre)	Cost/M^3 (cents)	Registered Mixing Rate
glyphosate	13.00	2	2.60	1.0%
DP60	6.50	5	3.25	0.5%
Brush-off[R]	1.15	50 mg	5.75	-
Tordon[R] 50-D	18.00	5	9.00	1.0%
Grazon[R] DS	40.00	2.5 ?	10.00	0.35-0.5%
Buckshot[R]	8.25	8 ?	6.60 ?	0.5% *
2,4-D	5.50	?	?	0.4%
Chopper[R]	78.40	0.6	4.70	-

* Pesticide Order only

MR. DICK SMITH

NSW MANAGER NUFARM CHEMICALS PTY. LTD.

SYDNEY

AVCA

THE FARM-CHEMICAL INDUSTRY ACCREDITATION PROGRAM

WHAT IS AVCA?

The Mission of the Agricultural and Veterinary Chemicals Association of Australia Ltd is to:

- Promote and advance the regulatory, commercial legislation, educational, self-regulation and public image interests of the agricultural and veterinary chemicals industry in a responsible way.

- Be the major point of reference by politicians, the public service, the media, trade union and community interest groups for consultation on matters pertaining to the agricultural and veterinary chemicals industry.

AVCA STANDING COMMITTEES

- Public Affairs Committee
- Commercial Legislation Committee
- Clearance & Registration Committee
- Animal Health Committee
- AVCA Resistance Action Committees - Insecticides
  - Fungicides
  - Herbicides
- Chemical Industry Health and Safety Advisory Sub-committee

AVCA WORKING PARTIES

- Focus Groups
- Research and Development
- Membership

AVCA INDUSTRY TASK FORCES

- Industry Accreditation and Training
- Biotechnology and Regulation
- Animal Growth Promotants
- Chemicals for Pest Control
- Transport, Handling and Storage of Dangerous Goods
- Emergencies
- AVCA Codes of Operational Practice
- Industry Statistics and Economic Data Base
- Public Release Summary
- Reseller/Distributor representation
- Proprietary Rights to Data
- Labelling

AVCA STATE DIVISIONS

To further the interests of the Industry by identifying and establishing liaison with

- State Legislators
- Administrators
- Media
- Farmer Organisations
- State Based Employees of AVCA Members

Critical to success is the establishing of continuous lines of communication which will assure ready access to these groups for AVCA and vice versa.

To maintain a continuous watching brief in all areas of activity and responsibility. When necessary, consult with the AVCA Secretariat and advise of developments/events at state level, including particularly significant media items.

To undertake the planning and organisation of the annual AVCA Convention in the state selected.

To encourage contact between AVCA members employees.

To maintain cohesiveness of purpose and a sense of belonging to AVCA while presenting a common platform to the various publics with which our industry interacts.

AVCA OBJECTIVES FOR 1989

1. Overview the introduction of the Agricultural and Veterinary Chemicals Act.

2. Provide input to and monitor closely the Senate Inquiry into the industry.

3. Implement the National Farm Chemical Industry Accreditation Program.

4. Develop a statistics and economic data base for the industry.

5. Improve the effectiveness of the State Divisions.

6. Prepare an appropriate long term strategy for AVCA.

7. Represent the interests of the farm chemical industry within the Chemical Confederation of Australia.

8. Develop recommendations for regulation of products/technologies arising from biotechnology.

HISTORY

* Hurried along by the organochlorine problem;
* Aim was to have a single, national training course;
* AVCA has had in planning for 2 1/2 years;
* Was proposed as a self-regulation initiative rather than more government regulation.

CALL FOR SUBMISSION

- Selected colleges from each State were asked to submit a course proposal;
- The South Australian TAFE proposal was accepted (not the cheapest);
- The proposal is for two levels; one a basic introductory course with emphasis upon safety, correct label interpretation and the implications of recommendations and, two, a specialist course with regional emphasis once all of the initial training is completed.

FARM CHEMICAL INDUSTRY COURSE

FARM CHEMICAL INDUSTRY NATIONAL TRAINING PROGRAM

STUDENT MANUAL

An AVCA/South Australian TAFE initiative

TRAINING PROGRAM

* The course is available nationally;
* 3000 students are expected to complete the course in 1989 but there is pressure for a higher throughput;
* Students receive a certificate of completion;
* AVCA estimates 10 000 individuals within the industry will require training;
* A fee will apply to this course which may vary but is expected to be in the vicinity of $300 - 375.

PERSONNEL ACCREDITATION

* Requirements are for successful completion and passing of the course;
* One year's appropriate experience;
* An undertaking for the student to remain contemporary via an annual renewal of accreditation;
* AVCA will provide information updates;
* Re-examination at set intervals may be required.

MODEL

* BASIS, the scheme in the U.K.;
* Registration under BASIS a legal requirement;
* It involves anyone who sells, advises or recommends agricultural chemicals in the U.K.;
* All users are required to be registered;
* Premises need to be registered as well.

WHAT IS INVOLVED

* The course allows for the average student to complete the training in 100 hours of study time;
* It includes 64 hours of class contact time;
* Additional work is assignments and preparation;
* Part I includes sections on the farm chemical industry, pesticides safety and application with a two hour exam;
* Part II includes an introduction to plant protection and introduction to animal health followed by a two- hour examination;
* Pass mark for Part I is 80% and for Part II is 70%;
* Alternatives are correspondence a fast-track system for students with more than 10 years' experience and modular courses have been introduced.

QUALITY CONTROL OF TRAINING

* South Australian TAFE will maintain the standards for the course;
* Lecturers will be reviewed by panels established for that purpose;
* The exam is not difficult but the high pass mark will require a thorough understanding of the course;
* Train the trainer courses have been established;
* A standard lecturer's kit with slides and advice on running has been established;
* A full time project manager has been appointed;
* The course will remain under continual review.

WHO DOES IT AFFECT

The accreditation scheme will have an impact on most, if not all, industry employees. However, the requirement to undertake the training course will be directed at : -

* any industry member who sells, advises, recommends, applies or handles farm chemical products. This group will include industry field staff and extension personnel, company sales representatives and sales and advisory staff employed by resellers and distributors.

* The industry will also encourage consultants, applicators and government officers to undertake training and accreditation if they advise on or recommend industry products.

TEETH FOR THE SCHEME

* AVCA has applied for a Trade Practices Commission authorization for a proposal to refuse to supply product for premises and staff who are not accredited;
* The introduction time for the first stage is 1992;
* Full compliance is set down for 1994;
* AVCA will seek government endorsement of the industry combined accreditation program;
* Staff and premises will both have to satisfy the accreditation standards;
* The process will be overseen by a committee of management;
* Technical committees will advise the board of management;
* Some 2 600 - 3 000 premises will require accreditation;
* The program is consistent with the industry product stewardship programs which are common within AVCA member companies.

PREMISES ACCREDITATION

* AVCA has developed a 'Standard for the Storage, Transport and Handling of Farm Chemicals';
* This establishes the minimum legal and industry requirements for a premises;
* The document is available for purchase from AVCA;
* Initial accreditation will involve a self-assessment process;
* The Standard will include a check-list for premises;
* Subsequent accreditation will require regular inspections to ensure compliance.

THE SENATE ENQUIRY

- Will focus political and public attention on the Australian farm chemical industry.

- AVCA strongly opposed the proposal for the enquiry. Unnecessary and posed a threat to our valuable export markets.

- Importance of managing industry's approach cannot be overstated.

- Imperative that we retain the freedom to operate in a legislative and social environment which protects Australia's status as a world leader in Agriculture.

- The Senate Committee and the Australian Public must be convinced that we are a responsible industry.

- We must sell a positive message, enhance our industry's image, and improve the perception of our products.

- We will be under unprecedented scrutiny.

- Anti chemical lobby will have the opportunity to make allegations under Parliamentary privilege.

- A major commitment is needed from AVCA member companies to meet this challenge.

Parliament of the
Commonwealth of Australia
SENATE SELECT COMMITTEE ON

Agricultural and Veterinary Chemicals

IN AUSTRALIA

On 1 November 1988, the Senate established a Select Committee to inquire into and report upon the following matters:

(a) *The adequacy of arrangements under the legislation relating to agricultural and veterinary chemicals for administration and coordination systems for agricultural and veterinary chemicals;*

(b) *the efficacy of chemical, non-chemical and integrated management systems; and*

(c) *the economic, social and environmental Impact on Australia of agricultural and veterinary chemicals and their alternatives.*

The Committee may also consider and recommend amendments to the Agricultural and Veterinary Chemicals legislation introduced into Parliament during the 1988 Budget sittings.

The Committee invites any interested persons or organisations wishing to express views on matters relating to this reference to lodge a written submission with:

The Secretary
Senate Select Committee on Agricultural
and Veterinary Chemicals in Australia
Parliament House
CANBERRA ACT 2600

as soon as possible, but by Friday, 31 March 1989. The Committee will consider all submissions and may invite individuals and organisations to give supporting evidence at public hearings. Further information and notes to assist in the preparation of submissions are available from the Secretary to the Committee on (062) 77 3575.

WHO 106 IS ON THE SENATE COMMITTEE?

The Committee which will undertake the Inquiry is comprised of six Senators and is chaired by Senator Mal Colston (Labor, Queensland).

Other committee members are:

Senator Rosemary Crowley
(Labor, South Australia);
Senator John Morris
(Labor, New South Wales);
Senator John Panizza
(Liberal, Western Australia);
Senator David Brownhill
(National, New South Wales); and
Senator John Coulter
(Democrat, South Australia).

Under the terms of reference for the Inquiry, this Committee must report its findings back to the Senate before the last sitting day of 1989.

WHAT IS AVCA DOING?

- An aggressive and positive lead.

- The focal point of AVCA activities.

- Have set up an industry task force.

- AVCA submission to the enquiry
  - Compilation of economic data to support our claims.
  - Costs to agriculture should products be removed.
  - Benefits to both farmers AND the economy in general.

- Industry position papers have been prepared to support our argument on controversial issues when raised.

- AVCA will be represented every day of the Inquiry's public hearings.

- AVCA to lobby committee members, politicians and public servants of relative departments.

- AVCA has lobbied other organisations which have an involvement (eg farmer associations)

- Public relations strategy has been developed.

- Inquiry Watch newsletter to inform AVCA member staff.

WHAT WE CAN DO

- Be informed.

- Stimulate discussion/debate.

- Staff training.

- Promote safety procedures.

- Help create a responsible image.

- Support your company! and AVCA's efforts to ensure a successful result.

THE VINE WEEDS OF COASTAL RAINFOREST

A.G. Floyd
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Coffs Harbour, N.S.W.

Introduction

Many vines are not declared noxious weeds because they are not a problem to agriculture production, the traditional prime use of land. However, there are many areas today where natural vegetation requires protection from rampant vines whether it be extensive national parks, state forests, smaller remnants private land, roadsides or creekside strips of aesthetic, recreational and/or scientific value. All areas have a land manager who is responsible for its protection.

Because rainforests have historically been reduced to scattered fragments with extensive perimeters and edge effects; and by definition contain many native vines, they are particularly susceptible to introduced more invasive vine species which can quickly upset the delicate balance in this, the most complex of ecosystems. Of the 19 species of problem weeds recorded for the Big Scrub, nearly 70% are vines and scramblers (Dunphy, 1988b).

This paper concentrates on the eight major exotic viney weeds of rainforest in N.S.W. discussing their history of introduction, ecology, damage and control.

Major Vine Weeds of Coastal Rainforest

The following eight major vine weeds have been identified in the coastal rainforests of N.S.W.

1. Macfadyena unguis-cati Cat's claw vine
2. Anredera cordifolia Jalap, Madeira or Potato vine
3. Cardiospermum grandiflorum Balloon vine or Heart seed
4. Ipomoea cairica Purple morning glory
5. Ipomoea indica Blue morning glory
6. Protasparagus africanus Red climbing asparagus
7. Protasparagus plumosus Black climbing asparagus
8. Protasparagus densiflorus c.v. Sprengeri Broad asparagus fern

1. Macfadyena unguis-cati Cat's claw vine

A garden escape on the north coast of N.S.W. and Southern Queensland with showy large yellow flowers and vigorous growth, originating from the West Indies and South America. Bad infestations also occur on the rich alluvial flood plains at Wingham Brush and Bellingen.

Capable of growing in restricted light (unlike Anredera), the stems wander across the forest floor producing tubers about every 50 cm which in turn produce new plants so as to carpet the forest floor. If on a flood plain, another crop of tubers are produced in the latest deposit of silt to produce layers of tubers as at Wingham Brush (Stockard et al., 1985). Upon reaching a tree it can climb vertically initially by the claw-like 3-hooked tendrils between each pair of leaflets and then later by adventitious roots from the stem. Upon reaching the light, growth is accelerated; and in addition the tubers are activated which in turn send stems up the host tree until its trunk may be completely obscured. The vine eventually smothers the canopy of the tree as well as actively competing with its roots until it dies producing a pole of vines which eventually topples to the ground.

It can also propagate from seed which is produced in large quantities but is fortunately of short viability.

Control

1. All vines around each tree are cut at about 1.5 m above ground and pulled clear of the trunk.
2. A second cut 30 cm below the first is made and if over 1 cm diameter the basal end is painted with 100% Roundup immediately. Stems under 1 cm diameter are stripped on one side for 20 cm with knife to increase the surface area and then painted.
3. Because of the strip cleared of vines around the trunk, any regrowth can be readily spotted; and when 1 - 2 m long it is pulled off, coiled and sprayed on the ground with 1:5 Roundup.

2. *Anredera cordifolia* Jalap, Madeira or Potato vine.

Originally introduced from tropical America because of its perfumed long white tassels of flowers and its ability to quickly cover its support with dense lush foliage. It is now a widespread garden escape in N.S.W. and Southern Queensland coastal areas. Many lowland subtropical rainforest remnants on rich alluvial floodplains are badly infested where this most destructive, prolific and persistent vine reduces the host trees to vine-shrouded pole-like structures. Because of its thick fleshy leaves and bunches of tubers it is the heaviest of the problem vines and can smash the branches of trees by its sheer weight. Typical examples are Wingham Brush and Bellinger Island, whilst in the dry rainforest of Rotary Park, Lismore it is regarded as the worst weed (King, 1988).

Unlike the cat's claw vine it does not set seed in Australia nor does it grow under shady conditions. However, it does produce aerial tubers in great profusion particularly before dying after having been cut, when the cluster may be up to 30 cm diameter. These lie dormant on shady forest floor; but may grow at the rate of 1 metre per month once light is able to penetrate, such as when the vine is killed. It twines up into the canopy smothering the crown in the same way as the cat's claw vine. These two vines work together in that the cat's claw vine initiates the attack causing the death of the tree and a small opening to form which is then enlarged by the jalap vine which is so rampant as to overrun the cat's claw vine. Regeneration is solely from the tubers which may be as numerous as 1500 per square metre; and as with the cat's claw vine may be buried beneath successive layers of silt. Painting of cut stems is ineffective because of the viscous exudate (Stockard et al., 1985).

Control

1. Vines are cut from around the tree at about 1.5 m above ground and pulled clear of the trunk (as for cat's claw vine).

2. At Wingham Brush where the Jalap vine is very robust, all stems over 5 cm diameter are scraped with a knife for about 20 cm all round and immediately painted with undiluted Roundup. This ensures that sufficient herbicide is absorbed, despite the viscous exudate (Stockard et al., 1985).

For smaller stems at Wingham Brush and for all stems in Rotary Park, Weedicide is not applied at this stage due to the exudate. Instead the stems are cut up and laid on the ground where the resultant mulch will suppress and often kill the dormant tubers (King, 1988).

3. When the regrowth from cut stems and tuberlings is .5 – 1.5 m long it should be bundled clear of non- target species and sprayed with 1:50 Roundup. In addition, sprouting tubers may be either picked up and bagged or sprayed with 1:5 Roundup when growing vigorously in spring to autumn according to their density and ease of detection. A wiper applicator using 1:2 Roundup could give more control of application with less damage to favoured species.

Because the bunches of tubers may remain on the dead vines for up to 2 years before falling at Wingham Brush, it will be necessary to continue this spraying or collection of tubers over that period (Stockard et al., 1985). However because of the drier site at Rotary Park, the surface and size of tubers on the vines is greatly reduced and there are no layers of buried dormant tubers. Hence there is a more rapid drop in sprouting (King, 1988).

3. Cardiospermum grandiflorum Balloon vine or Heart seed

This species and/or the less common C. halicacabum was probably first introduced to Australia from tropical Asia, Africa and America by the Colonial Secretary Alexander Macleay to the Elizabeth Bay house garden in Sydney in the 1830's to 1840's. It can be a problem as an edge curtain on trees along many streams on the north coast. It is the major weed in the rainforest regeneration project in the recreation area on Fawcett's Creek, Kyogle; and is destroying much vegetation along the upper Richmond River at Wiangarie, Rukenvale and Moore Park. At Rotary Park it is not a major problem, but is prolific as an edge curtain in one area (King, 1988). Other streamside infestations are at Bellingen and Wingham.

It has attractive balloon-like fruit reminiscent of that of the cape gooseberry and contains a central heart shaped papery partition with one globular black seed attached. These are able to spiral to the ground or to float upon the surface of the stream. This is a vine of the forest edge and cannot tolerate low light conditions. It tends to invade the side branches rather than the tops of the trees and does not produce the heavy mass of material as do the cat's claw and jalap vines. Also it does not produce either ground or aerial tubers; and although it may produce many seedlings they are easily pulled out as the root system is not robust.

Control

1. Cut and pull down as much as possible. Cut up and spread on the ground as mulch.

2. Spray regrowth with 1:75 Roundup when vigorous, taking care that it is clear of non-target species. The more growth the better (King 1988; Stockard et al., 1985).

3. Pull seedlings by hand.

4. Ipomoea cairica Purple morning glory

Native to tropical Asia and Africa but now widespread in coastal and estuarine habitats from coastal N.S.W. to southern Queensland and on Lord Howe Island. Although classed as one of the serious weeds at Rotary Park reducing host trees to pole-like structures, it is less abundant than I. indica (King, 1988). However on the coast at Brunswick Heads Nature Reserve it is the more important species. It is a weak climber, but under suitable conditions it can smother trees. It is able to establish itself in relatively undisturbed rainforest and in the ecotone (Dunphy, 1988b).

Control

1. Cut close to the ground and pull down as much as possible. Cut up and spread on the ground as mulch. Cut, scrape and point all major visible roots with 1:1 Roundup (Brown, pers. comm.)

2. Spray regrowth when vigorous with 1:50 Roundup. However, only a very small percentage of vines will reshoot from the basal portion and should be spot sprayed as required (Brown, pers. comm)

5. Ipomoea indica Blue morning glory

This native of the tropics and also sub-tropical America was probably introduced into Australia in the 1830's to 1840's to Elizabeth Bay House garden in Sydney by the Colonial Secretary, Alexander Macleay. It is now widespread throughout coastal N.S.W. and southern coastal Queensland.

One of the serious weeds at Rotary Park reducing host trees to pole-like structures (King, 1988). It is also the major problem vine at Maclean.

Control

1. Cut close to the ground and pull down as much as possible. Cut up and spread on the ground as mulch. Cut scrape and paint all major visible roots with 1:1 Roundup (Brown, pers. comm.)

2. Spray regrowth when vigorous with 1:50 Roundup. However only a very small percentage of vines will reshoot from the basal portion, so that follow-up is often minimal (Brown, pers. comm.)

6. Protasparagus africanus Red climbing asparagus

Introduced as a garden ornamental from Cape Province, South Africa. It has only recently become a pest in south-east Queensland as from the early 1970's in the remnant dry rainforest patches and particularly at Kingaroy. In N.S.W. it is common in the Big Scrub at Wilson Park, Currie and Rotary Parks and is also occasionally found at Boatharbour, Eltham, Johnstons Scrub and Coolgardie (Dunphy, pers. comm.). A single plant has recently been found at Brunswick Heads Nature Reserve (Brown, pers. comm.). This species is the most robust and aggressive in the genus, climbing rapidly into the canopy, enveloping the crowns and smothering them to create canopy gaps as in the manner of Anredera. However it is not as heavy and does not smash the crowns under its weight; but could cause long-term ecological and genetic consequences (Conran and Forster, 1986).

It originates from a large sub-surface corm up to 25 x 15 cm diameter from which arise up to ten thick woody stems up to 2 cm diameter with spiny scale leaves and fine feathery foliage. The orange-red berries are in the axils of the branches.

Control

Control is simple, although initially painting of the cut stems with weedicide was found to be ineffective. The recommended treatment is to cut the stems as high as can be reached from the ground and then again just above the corm. Then several gouges are made in the corm with a knife or machete to which 50% Roundup is applied by brush (King, 1988).

7. Protasparagus plumosus Black climbing asparagus

Originally from Natal and Durban, South Africa; and then introduced to Australia as a garden ornamental under the name Asparagus setaceus. It is now naturalised in Queensland, N.S.W. and South Australia and is a serious weed on Lord Howe Island (Clifford and Conran, 1987). It is regarded as the worst weed in the Big Scrub rainforest remnants being in 78% of the 32 sites (Dunphy, 1988b) It is fairly common in the littoral rainforest at Broken Head (Brown, pers. comm) and also at Iluka Nature Reserve. It is a less vigorous climber than P. africanus (King, 1988), and although it may occasionally reach the canopy, it is very prolific in the lower 5 m where it smothers the vegetation and prevents regeneration.

It has small corms from which a multitude of smooth wiry stems up to 8 mm diameter emerge. The leaves are fine, needle-like and in bundles, whilst the fruit are black and in clusters at the ends of the branchlets. In the more sandy soils it may produce underground stems rooting at each node. It tolerates low light conditions and can establish in virtually undisturbed rainforest.

Control

1. Difficult and costly. The small corms should be dug out with a knife. Small seedlings should be sprayed with 1:50 Roundup (King, 1988).

2. The stems may be cut and painted with 1:1 roundup, which is effective, but very labour intensive. Alternatively they may be simply cut intow places and allowed to sprout (King, 1988).

3. The resultant regrowth and seedlings should be sprayed and resprayed with 1:50 Roundup as for P. africanus. However, the new shoots may be over 40 cm long before leaves are produced and hence are difficult to spray (King, 1988; Dunphy, pers. comm.)

8. Protasparagus densiflorus c.v. Sprengeri Broad asparagus fern

This species is a native of south-east Cape Province and Natal, South Africa but is now naturalised in N.S.W. and Queensland. It is a pest in littoral rainforest on sand near the sea, such as at Broken Head, Park Beach and Sawtell Recreation Reserves near Coffs Harbour and on the Sydney Harbour foreshores as well as Lord Howe Island. It may have sprawling branches up to 2 m long which carpet the forest floor smothering small shrubs and suppressing regeneration (Dunphy 1988a).

It prefers sandy soils near the sea and where the canopy is somewhat open; but it can also tolerate low light conditions. It has root tubers aud flattened leaf-like branchlets.

Control

Eradication is difficult, as with P. plumosus, where repeated follow-up is necessary.

1. Cut out the entire plant with a knife. Spray seedlings with 1:40 Roundup (Brown, pers. comm.).

2. Spray leafy regrowth and seelings with 1:40 Roundup with particular attention to runners (Brown, pers. comm.).

Suggested Legislative Changes to Facilitate Control of Vine Weeds in Rainforest

Because all the major vine weeds were introduced for their horticultural worht, plants of some are still readily available from nurseries and plant sale outlets. It is intolerable that scarce human and financial resources are being expended on controlling a species such as asparagus fern which can be bought for $2.50 at the supermarket nearby.

Legislation is required to ban the sale of such plants which would come under the category of "Community Noxious Weeds". The N.S.W. Noxious Plants Advisory Committee lists species which adversely affect the community (rather than merely farmers) and for which there are effective economical control measures available. But there is equally a clear need to prevent by legislation the sale and cultivation of those major vine weeds where there is at present no control available at reasonable cost.

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THE CONSERVATION AND MANAGEMENT OF URBAN BUSHLAND AS CARRIED OUT BY THE NATIONAL TRUST OF AUSTRALIA (NSW)

JUDITH RAWLING

ABSTRACT

Though better known for its role in the conservation of our cultural heritage, the National Trust in NSW has been involved with issues concerning the conservation and management of urban bushland almost since its inception over 40 years ago. From work on some of its own properties, the Trust began in the 1970's to undertake work on a contract basis for a variety of land management authorities, using the Bradley Method of Bush Regeneration. In more recent years, the growth of this work, (now covering some 36 urban parks and reserves), the variety of needs and challenges this represents, and the growth of scientific information about the causes of the degradation of bushland, have resulted in a move from bush regeneration per se to bushland management.

The Trust's current policies are set out in its 1988 Policy Paper - **Urban Bushland.** In developing this policy, the Trust has identified the limitations of the Bradley method, with its emphasis on low-technology, hand methods to ensure minimal soil disturbance, the idea of working from the least weed-infested areas, and allowing the rate of native plant regeneration to determine the rate of weed removal. The Policy now emphasises the need to use a variety of methods, chosen with scientific advice to suit the needs of the particular area. The aim is to ensure that effective action is taken to mitigate the adverse effects of urbanisation and to maximise the protection of the entire spectrum of heritage conservation values associated with urban bushland.

This approach requires a greater degree of planning, management and supervision, extensive negotiation and liaison with managing authorities, training and skills in the use of power tools, and funding at a level which can provide for all of these as well as the payment of teams in the field.

THE CONSERVATION AND MANAGEMENT OF URBAN BUSHLAND AS CARRIED OUT BY THE NATIONAL TRUST OF AUSTRALIA (NSW)

JUDITH RAWLING
BUSH MANAGEMENT OFFICER
NATIONAL TRUST OF AUSTRALIA (NSW)

INTRODUCTION AND HISTORICAL CONTEXT

The National Trust is associated in most minds with the struggle to preserve Australia's cultural heritage. As the largest voluntary conservation organization in the country, the NSW Trust has led the fight to save many of Australia's oldest and most significant buildings. Less well known is the Trust's commitment to the conservation and preservation of the natural environment.

Almost since its inception in 1945 the Trust has been involved with issues concerning the conservation and management of urban bushland, and in the early 1970s the problems of these natural areas were examined by the Trust as it sought to promote the regeneration of native plants in bushland on some of its own properties, especially the Ludovic Blackwood Sanctuary at Beecroft in the northern suburbs of Sydney.

The Trust had become increasingly concerned that there were no eucalypt saplings to replace mature trees as they died. It became clear that the Trust must manage the vegetation in a manner which encouraged the regeneration of native plant species and inhibited exotic plant growth if the plant community on this site was to be conserved for future generations.

A new method of regenerating bushland devised by the Bradley sisters of Mosman satisfied the Trust's requirements and was adopted for use at the Blackwood Sanctuary. In 1975 the Trust employed Joan Bradley and her small team of assistants to begin work using a method of weed removal which ultimately became known as the Bradley Method of Bush Regeneration.

The work carried out by the Trust has since spread well beyond the boundaries of its own properties. As a trained workforce was built up through regular bush regeneration schools and workshops the Trust expanded its activities, undertaking contracts for various land management authorities, chiefly local government, but also private industry, the Federal Government and authorities such as the New South Wales Historic Houses Trust. Approximately 85 persons are currently employed on a part-time basis to carry out bush regeneration work in some 36 urban parks and reserves in the Sydney Metropolitan Area, while Trust professional staff travel widely throughout the State as speakers, educators and consultants in bushland management.

These latter activities reflect a move in emphasis from bush regeneration per se to bushland management. Recently the Trust has undertaken an extensive review of the principles and techniques used in planning and undertaking a bush management program for a managing authority. The results of this review and the Trust's current attitudes to problems and issues in urban bushland management are contained in the new Trust publication **A Policy Paper - Urban Bushland**, and are the central theme of today's discussion.

REVIEW OF THE BRADLEY METHOD OF BUSH REGENERATION

The Bradley Method provides a different approach to the treatment of weed invasion of native vegetation. Rather than seeking to control selected weed species, the regeneration of existing native plant species is encouraged by the removal, in stages, of all of the competing weed species. Weed removal is undertaken only when native plants can be expected to colonize the treated areas, so that badly degraded areas with few remaining native plant species are not considered suitable for treatment using the Bradley Method.

The aim of the Bradley Method is to restore and maintain an ecosystem in which natural regeneration can occur. The Method is based on three principles:

<u>Working from the least weed-infested areas to the most densely infested</u>. In the least weed infested areas there are abundant native plants and seeds to colonize sites from which weeds have been removed. In dense weed infestations the number of weed seeds and other propagules are likely to outnumber those of native plants. This results in weed growth rather than native vegetation regeneration. Even in dense weed infestations, significant improvement can be achieved by freeing individual native plants from weed competition. This technique, known as "spot weeding", may involve removing only

one large weed beside the native plant or a number of small competing plants.

Minimal disturbance. This includes replacing top soil so that the stored seed is not buried too deeply. The natural mulch is replaced to assist in soil moisture retention, to maintain an even soil temperature and to discourage further weed growth.

Allowing native plant regeneration to determine the rate of weed removal. Weed infestations are treated progressively at a rate determined by the ability of the adjoining native plants to fill the gap created by each weed's removal. Native plants which regenerate must be allowed to form a dense and healthy group before adjoining weeds are removed. These native plants can then successfully colonize the newly weeded area.

It should be stressed that hand-weeding is not, in itself, the Bradley Method. Various techniques can be used under the Bradley Method. Although hand-weeding is the most commonly used approach at the present time, herbicide and even mechanized equipment can be used provided that the principles of the Bradley Method are observed.

Whilst the three "principles" of the Bradley Method have worked well in many areas, especially bushland with relatively little weed disturbance, they are not necessarily the most appropriate for every area.

For instance, whilst disturbance results in the germination of weed species, it can also promote the germination of native plants. Provided that the management input is there to remove the unwanted plants, disturbance (such as fire or topsoil disturbance) can be a useful management tool.

Natural communities comprise a number of co-existing species which utilise a common resource base. Disturbance (whether "natural" cyclic disturbances such as fire, flood or animal impact, or man-made - mechanical clearing or the input of urban stormwater drainage), directly affects the resource base of the community, by providing new resources or by removing or depleting pre-existing ones. Such resource changes are readily utilized by new species in the community, whether native or exotic, so that a series of successional changes is set in motion.

It is important to remember that natural communities are adapted to a natural disturbance "regime", and that such disturbance is necessary for the long term maintenance of a diversity community of native species. Of course disturbance may also promote weed invasion, particularly if there is a ready source of weed propagules, so that the land manager must endeavor to strike a fine balance to allow the natural disturbances that promote native species, while minimizing the unnatural disturbances that lead to weed invasion.

There is substantial scientific evidence to show that maximum species diversity is present when moderate disturbance is created (Fox 1988). Thus it is possible that, by minimizing disturbance or even eliminating it completely from the system, species diversity will decline and the community will ultimately become simplified and potentially more vulnerable to environmental stresses.

Working in the good areas first is not always the best approach to adopt. If good areas are continually infested with seed from bad areas, it could well be best to eliminate the main source of seed before treating the better areas, provided the long term maintenance of the treated bad areas is possible.

Most urban bushland reserves have some chronically degraded areas, where the native plant component is largely or totally absent. These sites are most frequently those bordering housing, below drainage outlets, along creeklines, perimeters and pathways.

These sites, termed as "Red Areas" by the Trust (and coded as such on its vegetation survey maps), have long been considered as "lost causes" and not suitable for regeneration using the Bradley Method. Although it has always been Trust policy to recommend sympathetic landscaping of such areas by the management authority in conjunction with the regeneration work. in practice this has rarely happened.

Further, it has been the general belief amongst regenerators that such sites could not deteriorate further and that no harm would be done to the adjacent bushland by leaving these sites untreated. In many cases such sites have been left as "barriers" to random access of natural areas. Such a practice ignores the dynamic nature of the situation they represent. They are major sources of seed and the foci of expansive invasion of surrounding natural areas.

Extensive and prolonged weed infestations may alter the soil chemistry and soil structure, perhaps irrevocably, and by their very presence may alter the physical environment so substantially that the area may become unsuitable for future native plant regeneration. (Lamb 1985).

There is also considerable evidence to suggest that weed infestations move outwards on a front, fueling their own advance by dropping nutrient-rich litter and, in effect, preparing the soil for future weed establishment (Crombie 1985). Thus the seemingly static nature of the weed infestation is an illusion created largely by the high concentration of exotics in a small area, which contrasts strongly with low density in areas of better bushland.

The inability of the Bradley Method to cope with these badly degraded areas has meant they they were never dealt with, and this has resulted in an ongoing serious source of weed infestation, an extraordinary high level of maintenance in newly cleared sites, and a belief amongst managing authorities and the public that the Trust, and other proponents of the Bradley Method, never achieved any progress in areas where the need was seen to be greatest.
Politically this is self-defeating!

Again, adhering strictly the the "principle" of allowing native plant regeneration to determine the rate of weed removal has resulted in some areas of weed infestation never being treated.

Because natural regeneration is highly dependent on climatic factors, progress has been extremely slow on most sites, with minimal expansion of regeneration activities into new areas. In 1986, eleven years after the adoption of the Bradley Method, the Trust had still not completed the primary weeding in any of the reserves in which it worked, and during that period of time no badly degraded area was ever tackled.

Proceeding only at the rate of native plant regeneration ignores the steady and insidious deterioration of the surrounding vegetation, which eventually leads to a decline in species richness and invariably to the degradation of the entire natural area.

In one Sydney harbourside reserve where a regeneration team had worked for over nine years (and, in strict accordance with Bradley "principles", only in the better bushland), a substantial proportion of the native plant understorey has been totally lost.

As well, the canopy trees throughout the reserve, described in the Trust's 1979 Bushland Survey as "a healthy and vigorous stand of Eucalyptus botyroides" had become so weakened by a massive invasion of lantana and exotic vines, that they readily succumbed to borers, fungal attack on their roots and insect attack in the crown. Many of these trees have since died.

REVIEW OF THE BRADLEY RULES AND TECHNIQUES

Coupled with its review of the Bradley "principles" the Trust has been reviewing the appropriateness of a total adherence to the rules and techniques advocated by the Bradley sisters. In **Bush Regeneration** (1979) Joan Bradley stated that "we regard all local natives as good". This belief has led those who have followed the Bradley's teachings to adopt a policy of **never** removing a local native plant.

A weed has been variously described as a plant growing in the wrong place, a useless or troublesome plant, or a plant that grows profusely to the detriment of other plants.

While it is generally acknowledged that exotic species, that is those plants that have been imported into Australia from overseas, are unwelcome weed species in our bushland, it is rather more difficult to determine if an Australian native plant, and especially one that is indigenous to a locality, is a plant that is growing "out of place" or one that is likely to "cause harm to other native plants".

A few native plants, for example, Sweet Pittosporum (Pittosporum undulatum), a species with a limited distribution in the Sydney region, have dramatically increased in numbers and in distribution in recent years. This may be due to soil nutrient build-up or lack of fire, but whatever the causes this species is behaving like a weed in the Sydney area and in other parts of coastal New South Wales and Central Victoria (Gleadow 1981).

An occasional plant of of coastal rainforest sites and damp gullies, Sweet Pittosporum has invaded much of Sydney's dry sclerophyll vegetation, including heathland, woodland and even wetland margins. This species forms an almost continuous sub-canopy in all sites where Bradley Method techniques have been applied for some years, and because of the dense shade of its heavy canopy, or possibly because of specific alleopathic interactions, most native plant regeneration is suppressed. In such sites native ground cover is almost absent, and with the exception of a few small ferns and herbs, the understorey vegetation has been eliminated.

It is important to realize, however, that Privet and Camphor Laurel seedlings readily establish under a Pittosporum canopy and it can be expected that once the Pittosporum degenerates after a relatively short life-span of 25-30 years, these weed species will once again dominate the community unless continual maintenance weeding is undertaken.

The management problems of one Pittosporum-dominated site, (Blackwood Sanctuary), have recently been reviewed by Fox and Benson (1988) and included in a recent paper delivered to a Victorian Symposium on **Weeds on Public Lands - An Action Plan for Today**.

In her paper,"The Ecological Status of Alien Plant Species" Fox reviews a number of the management options available for the bushland at Blackwood and clearly outlines the ecological consequences of adopting each option. Her paper is highly recommended for its practical application of ecological principles to urban bushland management.

Again, Joan Bradley advised "where possible mulch also with the weeds themselves" and that "mulch is our best friend". Weeds are an unnatural element in a native plant community. To re-cycle these artificial elements may not be in the best interests of the maintenance of the natural communities on the site. Where practicable, and especially where the weeds are fleshy and likely to have high nutrient levels, the Trust advocates their removal or burning from the site, and disagrees with the statement that "burning weeds, or carting them out of the bush, is worse than unnecessary."

The use of mulch in bushland will of course suppress weed germination. However, it will also suppress native plant regeneration, particularly those plants which require bare soil and sunlight to germinate and establish. Eucalypts, for example, will not germinate in the absence of a suitably open site (such as that found after a bushfire) nor will they germinate under a thick layer of mulch. Similarly such conditions are unsuitable for the establishment of the majority of the fire-dependent species typical of the Hawkesbury sandstone plant communities.

The preoccupation with maintaining a closed canopy in all regeneration sites ignores the basic requirements for seed germination and the establishment of seedlings in different plant communities. The retention of an "unnatural canopy" (often of weed trees) may result in the change of one native plant community to another which may not be deemed desirable in the management objectives for a particular site.

The liberal use of mulch in all regeneration sites, and the retention of a closed canopy, have promoted the conditions suitable for the establishment of wet sclerophyll and gully species. Possibly as a result of the application these techniques, few of the regeneration sites located on Hawkesbury sandstone and treated in accordance with Bradley "principles", have responded with the anticipated dry sclerophylll plant regeneration. These sites are wholly or partially being increasingly dominated by soft-leafed, moisture tolerant species.

In the majority of urban reserves where regeneration programs are underway wetter elements form the bulk of regenerating species. Blueberry Ash (Elaeocarpus reticulatus), Bleeding Heart Tree (Omalanthus populifolius), Cheese Tree (Glochidion ferdinandi), Sweet Pittosporum, Basket Grass (Oplismenus imbecilus) and the native Wandering Jew (Commelina cyanea) have established whether the original plant community was forest, woodland, heathland or wetland.

These gradual changes in Sydney's bushland may represent a naturally occurring "shift" away from the sclerophyllous Hawkesbury sandstone-based vegetation to a wetter plant community, or they may in fact be due to a number of external factors - changes in drainage patterns or a shift in fire regimes. However, the possibility that certain regeneration techniques can play a role in this shift cannot be discounted.

The economics of applying the Bradley Method must also be questioned. The traditional approach of using only small hand tools has resulted in the adoption of work practices which are unacceptable on a cost/benefit basis. An approach confining weed-removal to small hand tools is not acceptable when a team is contracted on a professional paid basis to undertake a bush management program for a management authority.

Associated with the use of small hand tools has been a pre-occupation with ground dwelling plants (often annuals) at the expense of removing canopy weeds, and woody weeds which threaten the remnant native plant canopy. As the canopy plants usually determine the nature of the total plant community priority should always be given to removing canopy weeds and the creation of a healthy and stable canopy of indigenous species.

The Bradley Method has traditionally been totally involved in treating the **symptoms** (ie: weed invasion) of a malaise in small remnants of urban bushland, rather than coming to grips with the **causes** of those symptoms. This attitude has been aided and abetted, perhaps unknowingly, by the adage of "working in the good areas first". The Trust regards the identification of the **causes** of degradation leading to weed infestation as one of its more important and immediate tasks when contracted to work in an area. Often the cure for the problem (bad drainage, weed dumping, changes in fire regime) is beyond the power of the Trust to implement, and in these cases, the Trust will make appropriate recommendations to the managing authority.

NEW INITIATIVES

The goal of the new initiatives being implemented by the Trust is to ensure that effective action is taken to mitigate the adverse effects of urbanization and to maximize the protection of the entire spectrum of heritage conservation values associated with urban bushland.

In the first instance, this involves the determination of long-term aims and objectives for each area of urban bushland. In determining these aims, it is essential that the whole area of each reserve or site is considered.

Ideally, management plans should be prepared by the managing authority under the guidelines set by **State Environmental Planning Policy No 19 - Urban Bushland**. The Trust assists with the preparation of such Plans and, if requested, designs a program of works to implement the aims of the Plan on a contractual basis for the managing authority.

As part of its total management program for urban bushland the Trust formed, in 1986, a Bushland Management Advisory Committee. Committee members are drawn from a variety of fields, including agronomy, entomology, ecology, botany, zoology and landscape architecture. The Committee advises Trust professional staff on aspects of the Trust's bush management work, assists with the formulation of policy, and gives advise and practical assistance on site monitoring and survey techniques.

Issues considered by the Committee to date have included the preparation of management objectives for individual reserves, the use of fire as a management tool, techniques for treatment of "Red Areas", plant propagation and the importance of retaining genetic integrity in areas where supplementary planting is necessary, and the "Pittosporum" problem and associated changes in vegetation structure in urban areas.

IMPLICATIONS FOR MANAGEMENT AND PLANNING

The implementation of these new approaches has demanded a change in the way the Trust approaches its own planning and management of activities. In a situation where the Bradley Method is strictly applied, a team in the field can in effect be left to work at its own pace in a prescribed area, with no objectively established goals to be achieved within the life of a contract. No purchase of equipment beyond simple hand tools is required, and there is no provision for herbicides or other materials.

Under the present policies, these additional demands on finance exist, as does the need to set particular goals, to integrate the work of the teams with staff hired to carry out heavier clearing and other work, and with employees of the local council or other relevant authority. All of this requires more detailed planning and reporting, and the availability of funds to cover this activity.

Whatever the managing authority, negotiations for the contract must include provision for these essential planning and co-ordinating activities. They are "overheads" in one sense, but in fact form an essential part of the service provided. The Trust is most experienced at working with local government, but there are many other land owners/managers who can and do seek assistance with bushland management. There can be very different problems and needs outside the metropolitan area. In any situation, however, it is important to note that bushland **management**, properly carried out, is an activity which does require attention to a variety of matters outside the actual processes of weed removal and bush regeneration per se.

SUMMARY

It is frequently heard amongst proponents of the Bradley Method, and claimed by Joan Bradley herself, that the strict application of the "principles" are the only **proven** method of bush regeneration and further, that the Method is successful "in every sort of plant community, wet or dry, rich soil or poor, rainforest, tall timber or heath" (Bradley 1988).

The Trust disagrees with these assertions and firmly believes that any approach to the management of urban bushland must be a pragmatic one. Each site must evaluated separately, and a problem-solving approach adopted by the managing authority. Each site has a unique set of problems and no one set of rules or techniques will solve all these problems. In fact, the Trust firmly believes that a strict adherence to any "method" ultimately stifles initiative and restricts the application of scientific and practical advances made in the field.

The Trust believes that the criteria for a successful approach to the development of skills in native plant regeneration include:

* keen powers of observation;
* knowledge of, or the ability to develop, skills in plant identification;
* an understanding of how plant communities are structured;
* an understanding of the adverse pressures being exerted on remnant bushland, and of the means available to reverse those pressures;
* the vision to consider any site on a "whole catchment" basis rather than concentrating on any "good" areas;
* an ability to make specific judgements based on the above, rather than attempting to apply, mechanically and slavishly, any preconceived inflexible principles.

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THE ECOLOGY OF INTRODUCED WOODY WEEDS IN NORTHERN QUEENSLAND

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Abstract: *The distributions of eight declared woody weeds (*Acacia nilotica, Cassia obtusifolia, Cryptostegia grandiflora, Gmelina asiatica, Mimosa invisa, Prosopis spp., Rubus alceifolius, and Ziziphus mauritiana) *in northern Queensland are described in relation to growth characteristics, dispersal mechanisms, and seed longevity. Some non-declared woody weeds* (Calotropis procera, Lantana camara, Ligustrum *spp.*, Parkinsonia aculeata) *are also compared. Most of the species have a defence against grazing, and can regenerate from the root crown after disturbance. Mammals and/or birds play a large role in seed dispersal. Most of the species have long-lived, hard seeds.*

INTRODUCTION:

This paper presents a brief sketch of the distribution, ecology and pest status of the major introduced woody plants growing in northern Queensland. Plant descriptions can be found in Kleimschmidt and Johnson (1977) and/or Auld and Medd (1987). Current research into the chemical and biological control of these weeds is covered in a separate paper at this conference (Wilson, 1989). Some comments are made on chemical control methods.

Most of the species are declared under the Rural Lands Protection Act (1985), and were declared "noxious" under previous legislation (Table 1). For details of the declaration categories, see Pestfact (1987). African boxthorn (*Lycium ferocissimum*) was discovered near Hughenden in 1936, but is not considered in this paper. Giant sensitive tree (*Mimosa pigra*) is declared in Queensland, although its distrubution is hopefully limited to the Northern Territory.

Badhara Bush (*Gmelina asiatica*: Verbenaceae)

Badhara bush is a much-branched, semi-deciduous shrub to 3 metres tall, or a tree to 8 m. Root suckers are common. Branchlets are rigid, hairy when young, and carry spines. Bark is yellow to brownish-white. Leaves are thin, opposite, mostly 2-3 X 2 cm, oval to triangular, and glabrous when mature; young leaves may be 3-5 lobed. The large, bright yellow flowers are borne at the end of branchlets. Fruits are yellow when ripe, oval to pear-shaped, 1.8-2.8 cm long, and 1-2 seeded.

The species occurs at 3 sites near Rockhampton. It occurs on old mining leases, on gravelly hillsides and along watercourses; it may originally have been planted for its medicinal value. Badhara bush does not appear to be spreading rapidly, but control with herbicides is proving extremely difficult.

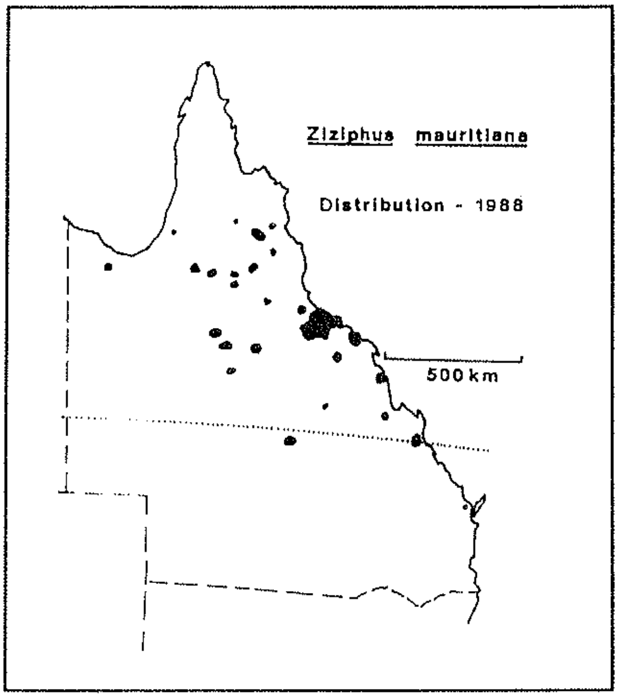

Figure 1

Chinee Apple (*Ziziphus mauritiana*: Rhamnaceae)

Chinee apple (or Indian jujube) is a large shrub, or small spreading tree up to 8 metres tall. Chinee apple was probably introduced as a source of fresh fruit for gold miners, and it is now well established around the old mining towns, wherever native timber was removed. By 1922, it was abundant around Townsville, where it can grow as a mid-storey in *Eucalyptus* spp. woodlands. Selected strains with desirable(?) fruit have been planted further afield (Fig. 1). The occurrence of seedlings along cattle tracks is evidence for dispersal by cattle, but detailed data is lacking.

It grows on a wide variety of soils ranging from gravelly mullock heaps to cracking clays, but is most 'weedy' on duplex soils (clay subsoil with a sandy topsoil) and alluvial soils. Biological control of this species has not been proposed, since *Ziziphus* spp. (jujube, Chinese date, etc.) are fruit trees, albeit of minor importance.

Giant Bramble (*Rubus alceifolius*: Rosaceae)

Giant bramble (Kalkman, 1984) was first recorded at Mount Bellenden Ker, in 1922. The species now occurs in the wet tropics from about Tully to Cairns, mainly in the lowlands, foothills and the eastern edge of the Atherton Tablelands. It forms dense, thorny thickets along roadsides, rainforest margins and creek banks, but is not considered a problem in cultivation or established sown pasture.

Giant Sensitive Plant (*Mimosa invisa*: Mimosaceae)

G.S.P. is a serious weed of pastures and cultivation (especially sugar cane), in the wet tropical lowlands around Innisfail, Tully, Ingham and Mackay. Seedlings only a few weeks old can produce viable seeds (Holm *et al.*, 1977). A stringent spraying program, managed by the Rural Lands Protection Board, is underway to contain regeneration at known infestation sites, and to contain the spread of the weed.

Mesquite (*Prosopis* spp.: Mimosaceae)

The small tree *Prosopis pallida* (synonym: *P. limensis*) is main species of mesquite growing in northern Queensland. It was widely planted as a shade tree around homesteads on the Mitchell grass downs. It is spreading in many localities, with the worst infestations being around Karumba, Cloncurry, McKinlay, and Hughenden.

Hybrid *P. pallida* X *P. glandulosa* X *P.* sp. (Panetta and Carstairs, in press) were recently found near Julia Creek and McKinlay. A small patch of true *P. juliflora* was recently found near Townsville. The mesquites are a major woody weed in the rangelands of southwestern U.S.A. (DeLoach, 1985). Cattle and horses relish the sweet pods, thus contributing to seed dispersal (Brown and Archer, 1987).

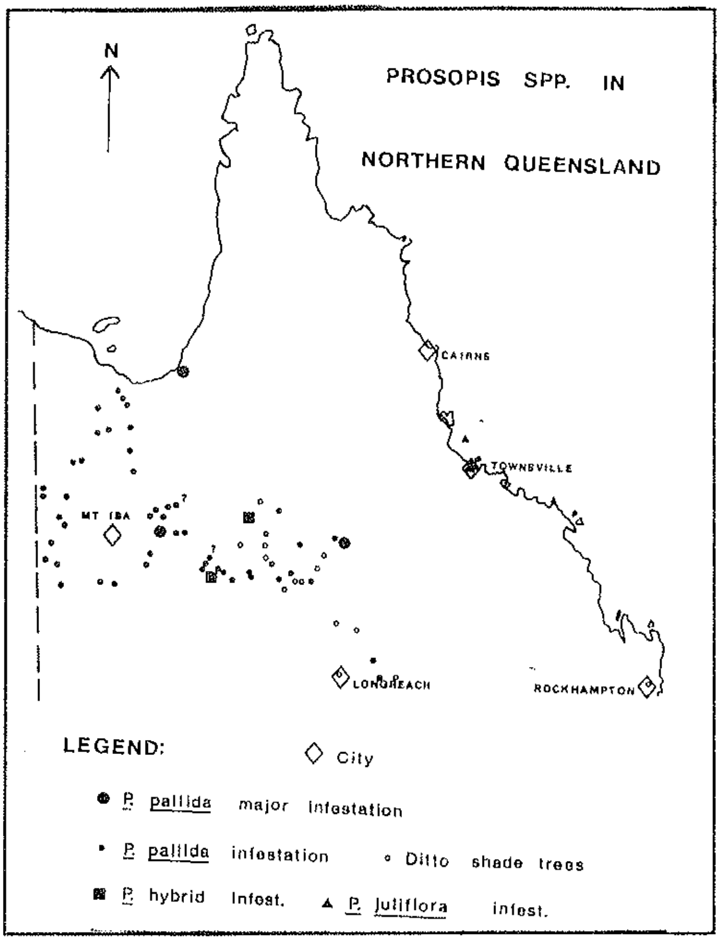

Figure 2

Prickly Acacia (*Acacia nilotica*: Mimosaceae)

Prickly acacia was first introduced to Queensland as a shade, fodder and ornamental plant in the 1890's. Seeds were carried around in saddlebags, and broadcast by hand. Well over 500,000 ha of heavy cracking clay soils and 1,200 km of artesian bore drains are now infested with prickly acacia (Fig. 3; Carter *et al., in press*). Heavy coastal clays and basalt soils are also colonized.

One large tree growing on an artesian bore drain, which provides a reliable water supply, can produce around 70 kg of pods plus seeds (> 200 000 seeds) per year (Bolton *et al.*, 1987). Passage of the seed through the gut of cattle "softens" the seeds, enabling ready germination when water is available (Harvey, 1981). Stock thus spread seeds from bore drain infestations to open grassland, where mass establishments of seedlings occur in seasons of above average rainfall. The browsing of sheep, cattle, and goats is insufficient to prevent many of these seedlings from surviving to maturity. Fences are a major barrier to the spread of the weed from infested paddocks to 'clean' country. Prickly acacia is a useful plant at low densities, when control is feasible. There is presently no simple way of keeping the species at low densities.

Rubber Vine (*Cryptostegia grandiflora*: Asclepiadaceae)

Rubber vine is a rampant woody vine, which grows as a shrub in the open. Late last century, rubber vine became popular with miners and early settlers as a hardy ornamental. The species spread along watercourses and was abundant in several localities by 1917 (Fig. 4). When Allied rubber supplies were captured in World War II, rubber vine was investigated as an alternative source of rubber. Although quality was high, yield was low. By 1973, infestations covered 49,000 ha (10,000 km) of rivers and streams, and 73,000 ha of river frontage, flood plains, and "harder" country (Fig. 4). The light seeds are dispersed by wind and floods; cockatoos were recently observed carrying ripe pods for consumption of (most) seeds in a nearby tree (Bolton and Vitelli, pers. obs.). Sites with a humid microclimate and soil moisture status (such as streams, under leaf litter and under shrubs) are more favorable for germination and establishment (Dale, 1978).

The major problem for the cattle industry is the difficulty of mustering cattle out of the impenetrable thickets. Conservation managers are concerned that rubber vine chokes out native vegetation. Kakadu National Park and the Kimberleys could be next.

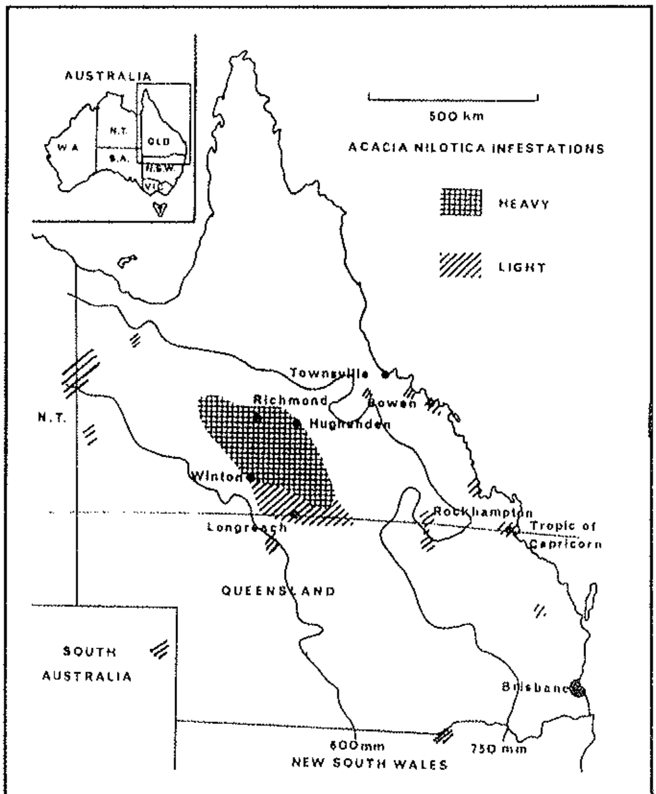

Figure 3 Modified from map of Willson (1985).

Sicklepod (*Cassia obtusifolia*: Caesalpiniaceae)

Sicklepod grows in the wet tropical lowlands between Mackay and Innisfail, wherever the annual rainfall exceeds 1650 mm (James and Fosset, 1982/3). Infestations now extend to the top of Cape York Peninsula (James, pers. comm., 1989). Sicklepod infests sugarcane fields, creek flats and hilly grazing land. Dense, vigorous, mono-specific stands smother out all but the most vigorous pastures. Control of sicklepod is by repeated slashing, improved pasture establishment, and/or overall spraying with herbicides in the early stages of growth.

SOME NON-DECLARED WOODY WEEDS:

Calotrope (*Calotropis procera*: Asclepiadaceae)

Calotrope or rubber bush is found throughout northern Australia. In Queensland, it is found along most river systems, and adjacent 'dry' country, in the Gulf region, and western Cape York Peninsula. Calotrope contains a bitter cardiac poison (Everist, 1981), but hungry cattle eat the plant without any apparent ill effect. Few herbicides provide effective control.

Lantana (*Lantana camara*: Verbenaceae)

This is a well known weed in eastern Australia (Smith and Smith, 1982; Swarbrick, 1986). In northern Queensland, it is a particular problem in dairy pastures in the wet tropics. Several biotypes are remarkably drought-tolerant. Herbicidal control is complicated by the many biotypes.

Parkinsonia (*Parkinsonia aculeata*: Cesalpiniaceae)

Parkinsonia (Miller and Pickering, 1980; Woods, 1985) was introduced around the turn of the century, as an ornamental and shade tree. In Queensland dense infestations occur in the Isaacs River and central highlands districts. In many localities throughout western Queensland there are small infestions along creek lines, artesian bore drains, floodplains, and black soil plains. It is probably the most widespread of the introduced woody weeds in Queensland, occurring in more districts than rubber vine, lantana or prickly acacia.

Privet (*Ligustrum* spp.: Oleaceae)

Ligustrum sinense and (to a lesser extent) *L. lucidum* are weeds of ex-dairy farms and bushland on Atherton Tablelands. Control with herbicides is proving difficult.

Other Species

In the wet tropics, molucca bramble (*Rubus moluccanus*), wild tobacco tree (*Solanum mauritianum*), guava (*Pisidium* sp.), custard apples (*Annona* spp.), camphor laurels (*Cinnamomum camphora*), and coffee (*Coffea arabica*) are weedy to varying extents. In drier climates, yellow oleander (*Thevetia peruviana*) is a garden escape; leucana (*Leucaena leucocephala*) is a weed of bushland, and urban waterways.

DISCUSSION:

All of the species are perennial, except sicklepod, which is annual or biennial; giant sensitive plant is sometimes biennial. All have chemical or physical defences against large grazing animals. Vegetative propagation of new plants, by root suckering, layering, etc. is rare compared with many native woody weeds. However, regrowth from the root crown is common to the whole group. It occurs when above-ground parts are damaged by drought, fire, frost, slashing or sub-lethal herbicide doses. Most have strong root growth in the seedling stage, enabling survival of such disturbances at an early age (e.g. mesquite: Haas *et al.*, 1973). All have effective long-distance dispersal, so that colonization begins from scattered small populations (Auld, 1987), similar to fire spots ahead of the main bushfire front.

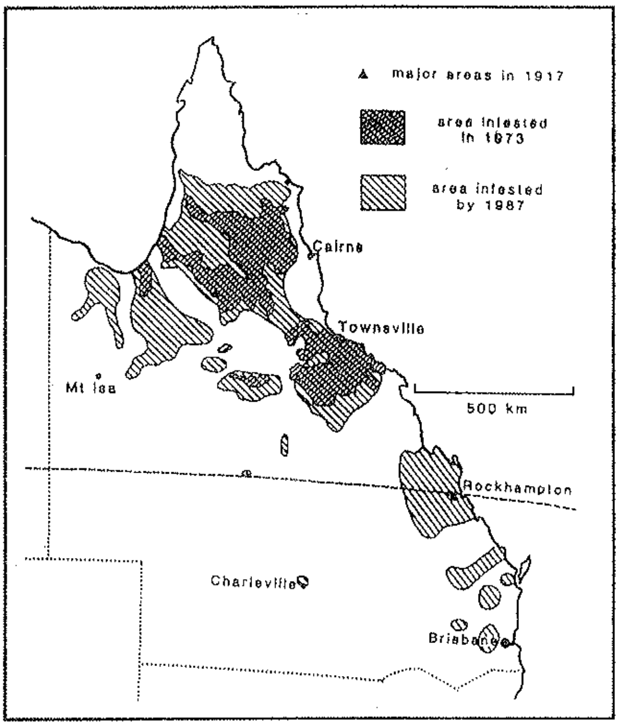

Figure 4 Rubber Vine (*Cryptostegia grandiflora*) distribution.

Many of the species produce "hard" seeds (Table 1), which remain viable in the soil for many years. A proportion of these seeds establish annually in wet climates, or after suitable rain in dry climates. Fires, or mechanical soil disturbance (e.g. bulldozing) may break seed dormancy and synchronize germination. Impenetrable thickets or tangled masses of vegetation are formed; these reduce pasture productivity, and impede access for mustering, and provide hiding places for stock.

The success of the above weeds seems to confirm at least three of Groves' (1987) characteristics of successful weeds, namely high seed production, effiecient dispersal characteristics and seed dormancy. Detailed climate matching was beyond the scope of this paper. Low (or absent) populations of natural enemies, and unpalatability of vegetative parts to stock seem to be important factors in the success of woody weeds. Although mammals, including domestic stock, and birds are prominent in seed dispersal (Brown and Archer, 1987; Murray, 1986; van der Pijl, 1972), burrs do not feature highly in the above woody weeds. Burrs are a common characteristic of understorey plants in northern Queensland, however.

Overall, high-volume spraying with herbicides is usually unsuccessful on adult plants, especially on species with bipinnate (feathery) leaves. Uptake of the herbicide is minimal due to the fine leaflets falling off. Aerial spraying is practised routinely on only giant sensitive plant and rubber vine. Basal bark spraying with herbicide in diesel is reliable, but expensive. In general, root-uptake herbicides are unsuitable due to their high cost, low selectivity, and unreliability in dry climates. Low volume methods (splatter gun, sprinkler sprayer, etc) show promise on regrowth.

Woody weeds usually become a permanent feature of rangelands, where the cost of control exceeds (by many times) the productive capacity of the land. Vegetation structure is modified, making the land less suitable for productive or conservation uses; truly 'land degradation'. Perennial pasture species are often eliminated; bare ground becomes common. Soil erosion thus proceeds, with only the grossest forms being prevented by the woody invaders (Condon, 1983).

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Table 1: Some data on introduced woody weeds in northern Queensland. (All species are also dispersed by gravity, and by overland drainage in floods. All species are dispersed by 'man', in soil or on vehicles, etc., to some extent.)

SPECIES	ORIGIN	DECLARED (NOXIOUS)	DEFENCE	SEED DISPERSAL	HARD SEEDS?
Acacia nilotica	Africa S. Asia	1957	spines	in animals	Yes
Calotropis procera	Asia, Africa	–	mildly toxic	wind, water	No
Cassia obtusifolia	tropical America	1981	toxic	man, in animals	Yes
Cryptostegia grandiflora	Madagas- -car	1955	toxic	wind, water, birds	No
Gmelina asiatica	India	1973	spines	birds	Yes?
Lantana camara	tropical America	–	prickles, some toxic	birds, man	?
Ligustrum spp.	E. Asia	–	unpalat- -able?	birds	*
Mimosa invisa	tropical America	1952	prickles	on animals, man, water	Yes
Parkinsonia aculeata	tropical America	–	spines	animals?, water	Yes
Prosopis spp.	N. and S. America	1954	spines, unpalatable leaves	in animals	Yes
Rubus alceifolius	S.E. Asia	1955 & 1968	thorns	birds	Yes?
Thevetia peruviana	tropical America	–	highly toxic	?	Yes?
Ziziphus mauritiana	E. Africa & S. Asia	1959	thorns	in animals?, birds?	Yes

* = dormancy (Burrows and Kohen, 1983)

RECENT ADVANCES IN BIOLOGICAL CONTROL OF PATERSON'S CURSE (IN NSW)

by Leon W. Smith,
Principal Agronomist (Weeds),
NSW Agriculture and Fisheries
SYDNEY.

On the 29th July 1988 the first release of the Echium moth (*Dialectica scalariella*) was made on Paterson's curse (*Echium plantagineum*) in NSW at Young by NSW Agriculture and Fisheries since the injunction preventing CSIRO from releasing the insects was set in place.

From that time to end of December 1988, 8,000 plants containing 200,000 Dialectica larvae were released on 96 sites in NSW. The sites ranged from Kyogle in the North to Albury in the South and Carrathool in the West. As of March 1989 establishment of the moths was excellent at most sites. Spread of up to 5-15 kilometres from the release sites has occurrred in some areas.

The season although not a big "Paterson's curse year", has been excellent due to the summer rainfall in most areas which has allowed for the survival and re-establishment of the weed. Survival of the moths has been excellent on Viper's Bugloss (*Echium vulgare*) due to its more prolonged growth into the summer period.

At this time no major damage has been reported although Hugh Milvain, Yanco has reported large numbers of larvae active on young plants and District Agronomist, Cooma reports finding moths active 15km from a release site at Cooma on Viper's Bugloss.

The breeding and release program is continuing this year with actual moths being released instead of larvae in potted plants. This will be far more convenient than handling potted material.

Just how much damage the Echium moth will cause to Paterson's curse plants will not be apparent for some time. However CSIRO has imported two additional strains of Dialectica moths one from Portugal and another one from France and it is expected these will be better adapted to the different climatic zones experienced in Australia.

Over the next 3 to 5 years CSIRO intend to import the following agents to help control Paterson's curse.

2 weevils - *Ceutorhynichus* spp.

2 *Ethmia* moth species.

2 flea beetles - *Longitarsus* spp.

2 Echium bugs - *Dictyla* spp.

a stem borer- *Phytoecia coerulescens.*

All these insects except the two Ethmia species are approved for introduction into Australia for quarantine testing.

It is expected that the Echium weevils will be released for field testing in the Spring of 1989 as well as one of the flea beetles and the Ethmia insects. It is intended that the Echium bugs will be available in 1990 and the other insects in later years. However breeding and availability of these additional insects may be delayed depending on circumstances and at this time no guarantee can be given when they will be available for general distribution.

A diagram of the feeding niches of the natural enemies proposed as biological agents for Paterson's curse is shown in the diagram. The agents will be discussed in relation to their potential effects on the plant.

The author acknowledges the assistance of Mr. J.J. Dellow, Special Agronomist (Weeds), NSW Agriculture and Fisheries, Orange, and Dr. E. Delfosse, CSIRO, Canberra in the preparation of this paper.

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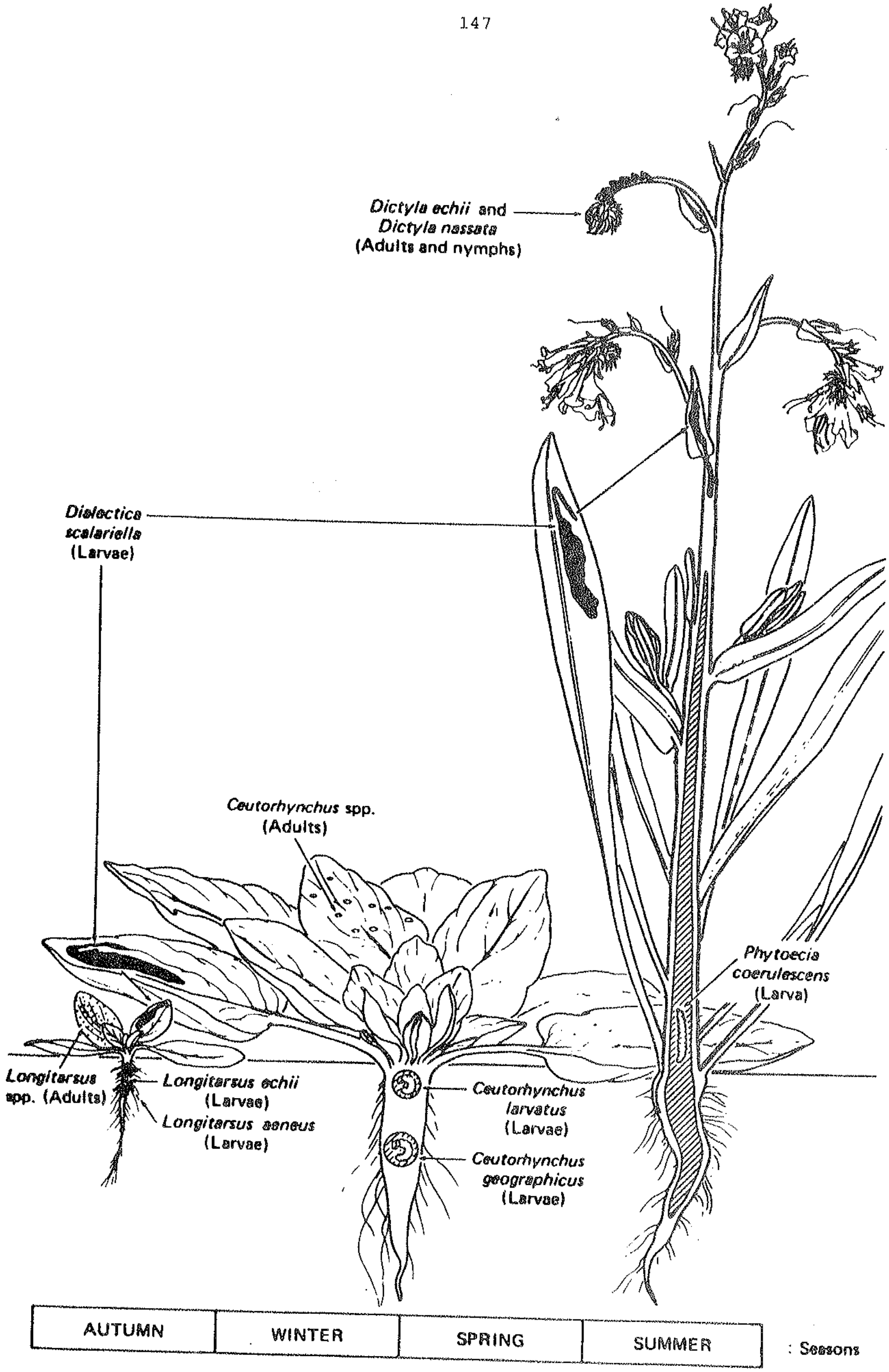

Figure 4 Phenologies and feeding niches of the eight species of natural enemies of *Echium plantagineum* L. that are proposed as biological control agents for the weed. (Modified from Wapshere 1985.)

THE OCCUPATIONAL HEALTH & SAFETY ACT – REQUIREMENTS FOR SPRAY OPERATORS AND THEIR EMPLOYERS, WITH BRIEF NOTE ON STANDARDS FOR STORAGE OF PESTICIDES

Richard Bolton
Division of Occupational Health
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The Occupational Health & Safety Act came into being on the 4th May 1983. Both it, and the growing number of regulations under its umbrella are having a profound effect on the responsibilities of employers, occupiers of premises, manufacturers and suppliers of plant and substances and persons engaged in certain contract work.

The act is unique because it applies to all situations where persons perform work either as employees or as self employed persons. Thus, making it the most comprehensive safety legislation in New South Wales to date.

When the Occupational Health and Safety Act was gazzetted it reinforced and extended some 26 pieces of safety legislation which in their majority still exist today. For completeness the relevant legislation associated with pesticides are as follows;

- (i) Worker's Compensation Act. No. 70 (1987) N.S.W.
- (ii) Clean Air Act. No. 16 (1961) N.S.W.
- (iii) Dangerous Goods Act. No. 68 (1975) N.S.W.
- (iv) Factories, Shops and Industries Act. No. 43 (1962) N.S.W.
- (v) Industrial Arbitration Act. No. 2 (1940) N.S.W.
- (vi) Local Government Act. No. 41 (1919) N.S.W.
- (vii) Pesticides & Allied Chemicals Act. No. 57 (1978) N.S.W.
- (viii) Poisons Act. No. 31 (1966) N.S.W.
- (ix) Public Health Act. No. 30 (1902) N.S.W.

With the advent of the Occupational Health & Safety Act, the use of pesticides in a safe manner is more clearly controlled. The Act has overcome the inadequacies of the pre-existing safety legislation identified by the Robens Comittee into Occupational Health and Safety in the United Kingdom.(5)

> "Present regulatory provisions follow a style and pattern developed in an earlier and different social technological context. Their piecemeal development has lead to a hap hazard mass of law which is intricate in detail, unprogressive, often difficult to comprehend and difficult to amend and keep up to date. It pays insufficient regards to human and organisational factors in accident prevention, does not cover all work people, and does not deal comprehensively and effectively with some sources of serious hazard."

The importance of the Act

The importance of this act is clear when we examine the groups who commercially use the bulk of pesticide in New South Wales. These include:

Rural Workers

There are over twenty five thousand rural workers in N.S.W., who constitute the largest single group of users of pesticides in N.S.W. (Bureau of statistics). Almost all commercial crops in N.S.W., are heavily and repeatedly sprayed with chemical pesticides. Unfortunately, rural workers are the hardest group to educate in the safe us of pesticide, because of their life styles and in many cases their isolation from relevant teaching facilities. Occupational exposure to pesticides is openingly accepted within the farming community. However, this "acceptability" is unacceptable, when their level of exposure to pesticides is the highest in New South Wales.(7)

Licenced Pest Controllers

Sinc the 1st May 1988, the Occupational Health and Safety Act has required that all pest control companies and their operators must be licenced in N.S.W. As a result pest control operators are required to achieve a niminated level of training and theoretical knowledge prior to their licences being issued. Currently, there are 1270 licenced pest control operators and 636 registered pest control companies in N.S.W.

Government Authorities

These include;

(i) County Councils & Local Government Councils (n=178)
(ii) Electrical Commission
(iii) State Rail Authority
(iv) Road and Traffic Authority; and,
(v) The Department of Agriculture & Fisheries

The continued use of pesticides is essential if man wishes to prevent unacceptable food loss, property loss and prevent insect-borne diseases. So as not to counteract the benefits of pesticides, it is essential that they be handled safely. However, the commonest cause of occupational poisoning in N.S.W. is due to the mishandling of pesticides.(7) This is not only tru in N.S.W. but also throughout Australia and the world. In 1985 for example, the American state of California reported that occupational disease rates resulting from pesticide exposure was higher compared to the total workplace disease rates.(6) Although numerous epidemiological studies and case reports have been published, we still do not know the full effect of occupational exposure to pesticides.(1-2)

The objectives of the Act (S5)

The Act has four main objectives;

(a) to secure the health, safety and welfare of persons at work;
(b) to protect persons at a place of work (other than person at work) against risk to health or safety arising out of the activities of persons at work;
(c) to promote an occupational environment for persons at work which is adapted to their physiological and physchological needs; and,

(d) to provide the means whereby the associated occupational health and safety legislation may be progressively replaced by comprehensive provisions made by the Act itself.

These objectives give effect to the broad philosophical approach of the Act. However, the philosophical basis of the Act is not consistent with the reality of the "Aussie Battler" on the land who is more concerned with economic survival than the condition or safety of his work environment. For larger commercial and government uses of pesticides on the other hand the Act has had two main areas of influence.

The responsibilities of the employer to his employees.

In regards to his employee, the employer is to;

(i) Ensure health, safety and welfare at work of all his employees. (S15 (1)) The employer's obligation to ensure a safe work place would appear to be an absolute one, excluding any consideration as to whether something is "reasonable" or "practical".

(ii) Provide and maintain safe and healthy systems and equipment. (S15 (2) (A)) The employer is required to provide necessary spraying equipment and ensure that this equipment is kept safe and properly maintained. In addition to this, he is responsible to provide necessary protective equipment. Essentially, for a pesticide user, a boiler suit buttoned at the wrist and throat, elbow length gloves, washable hat, impervious footwear and an approved agricultural type respirator; and,

(iii) Provide information, instruction, training and supervision. (S15 (2) (c)) These are to be provided to such an extent as will ensure the health and safety of employees at work. Although there are many limitations, the employer is obligated to provide training to his employees through attendance at courses offered at technical colleges, or through an organised "in-house" training course.

The employer or the self employed pest controller also have to ensure the health and safety of persons other than employees at places or work. (S16) Therefore if a local council decides to spray excessive growth over footpaths in its municipality, then the council is responsible for the health and safety of those using the footpaths.

The responsibilities of the employee to the employer

The second area of responsibility falls on the employee. Once the employer has fulfilled his/her obligations then the employee is to;

(a) Take reasonable care to ensure the health and safety of others. (S19 (a)) This means for example that a greens keeper, employed at a local playing field, is required to fence off an area which he has sprayed. He should not allow children to play on the area until such time as the pesticide has been hosed into the soil and the area has properly dried.

(b) Co-Operate with the employer regarding health and safety. (S19 (b)) The employee must carry out health and safety instructions or follow guidelines given to him by the employer. If he fails to do so, and an accident occurs, he may be responsible; and,

(c) The employee shall not interfere with or miss-use equipment provided in the interest of health, safety and welfare. (S20)

The formation of an Occupational Health & Safety Committee.

Depending on the size of the organisation the employer and the employees may be responsible for the establishing and maintenance of an Occupational Health and Safety Committee. (Division 2) A committee is to be formed when there are more than 20 persons employed at the place of work and the majority request the establishment of a committee, or if the Occupational Health, Safety and Rehabilitation Council direct the establishment of such a committee. (S23 (1))

The employer and employees are then obligated to report any health and safety issue to the committee for them to investigate. During such an investigation, the employer must make available necessary information, allow the comittee to carry out monitoring and support committee recommendations designed to improve the health and safety of persons at work. In addition to this, the employer is responsible for the equiping and training of the committee members to assist them in the performance of their duties.

Storage of pesticides.

The Occupational Health and Safety Act and it s regulations do not specifically outline guidelines for the storage of pesticides. However, if an employer or a self-employed person is going to ensure the health, safety and welfare of their employees or persons not in their employ, then they are obligated to provide a suitable storage system, such as that prescribed by the Hazardous Pesticide Regulations 1978. (S123M)

The Hazardous Pesticide Regulations require that a hazardous pesticide be stored on or above a surface which is;

(i) impervious to the pesticides, (not carpet, sheets, blankets or foam).

(ii) bunded so as to be capable of retaining not less than 25 percent of the hazardous pesticides stored there on.

(iii) so situated as to provide access for decontamination and washings; and,

(iv) so drained as to enable the hazardous pesticide and any washings to be readily drained into a sump or pit which will hold the drainings or washings for subsequent disposal. An adequate supply of water shall be provided for washing down spillages.

Hazardous pesticides transported by vehicle must be kept under lock and key to prevent unauthorised access. Utilities and open table top vehicles must be fitted with a lockable cabinet or box secured to the vehicle for transportation of hazardous pesticides. Hazardous pesticides should not be transported in the bulk tank.

Hazardous pesticides to be diluted in the bulk tank should be mixed at the site of application.

Conclusion.

The Occupational Health and Safety Aet has revolutionised N.S.W. legislation controlling the health, safety and wlefare at work. When looking at the size and importance of the pesticide industry is has clearly improved the handling of pesticides by outlining the responsibilities of the employer and the employee towards themselves and the public. Relative to the pre-existing health and safety legislation, the Occupational Health and Safety Act is in its infancy. There is further scope for the integration of the Act with other related Acts and particnlarly so in relation to the safe handling of pesticides.

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COLOUR AND INFRA RED AERIAL PHOTOGRAPHY AS AN AID IN WEED SENSING, MAPPING AND ADMINISTRATION

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Agriculture & Noxious Plants Controller,
Snowy River Shire Council.
Berridale, N.S.W.

Introduction

Aerial photography can be a useful tool for weed control for Local Government bodies. Its degree of usefulness can take numerous forms both at a field and administrative level.

Whilst cost may appear to be a stumbling block for a single purpose use, if utilised by all council departments their value increases markedly.

There are 4 main aerial photographic films:

1. Black and White
2. Kodak Infra Red – See later comments
3. Kodak 2445 – Probably a true colour of the earth's surface, as you see it from an aircraft but usually gives an overall bluish flat finish to the prints
4. Kodak 2448 – Provides a slightly enhanced colour, i.e. it is more definitive between the different colour tones particularly when processed using a hand rewind system and not putting through an automatic processor. It is generally, however, the weather conditions and the control over development that provided the best negatives and hence the best photographs.

The choice to use infra red over colour photography can be a matter for considerable discussion. However, practicalities must eventually determine the choice. In order to appreciate the difference between the two methods we must first discuss the advantages or otherwise of the two alternatives.

Infra Red

Infra red photography measures the infra red light that is reflected from the photographed surface. Healthy green plant leaves come out bright red. Anything that changes the leaves from being healthy and green affects the infra red reflection and colour rendition. How much use this can be for weed sensing is very much in its infancy, however its use is relatively well established in the U.S.A. and Canada for determining crop abnormalities. For example in corn, the time of natural death at different maturities and premature dying of similar maturities can be detected by taking infra red pictures at regular intervals. It is also possible to detect plant or leaf abnormalities and determine the extent of the problem.

In 1987 the Snowy River Shire Council had an experimental exercise carried out with infra red and colour photography to determine a method of identifying serrated tussock infestations in rough terrain. The time chosen was at the end of winter when the tussock was displaying a typical gold/green colour. Identification on the infra red was good and slightly better than colour. However, both necessitated ground inspections to accurately locate the serrated tussock on the photo prints.
Probably, the main disadvantage with infra red is its lack of usefulness to other departments of the Council, for such things as locating illegal dwellings for the Health and Building Department, or locating road problems in the Engineering section. If shared use of the prints is required colour photographs are preferred and can be better utilised. However, infra red is available in the 9" negative size through the organisation this Council used to take photographic runs in 1988. With the clarity experienced in the colour prints, it could well be the only method for sensing weeds in some situations.

There is very little cost difference between using infra red and colour photography.

Colour

Colour photographs can identify weed infestations quite well if the timing is right to display their most colourful period of growth. Whilst colour didn't show as dramatically as infra red it was quite satisfactory. However, other advantages were available that caused us to carry out our survey by this means, these were:

(a) Availability at the critical time of the year of a considerably better camera with a 9" negative size and a sophisticated tracking system (it was not known at this stage that infra red was available with the larger camera).

(b) The usefulness of colour over infra red for other departments within Council.

(c) Availability of enlargement prints for colour to 1/2 or 1 metre square.

Use of Air Photos - To influence Councillors into accepting the costs of aerial photographs, the following points can be utilised.

(a) To identify a weed or numerous weed problems in an area at a point in time (which can in later years be used as a comparison).

(b) To identify for legal purposes the accurate plotting of an area of infestation and/or detail any areas treated.

(c) Assist and influence landholders in co-operating in joint group control efforts.

(d) Assist in planning control programmes with co-operators.

(e) To assist in influencing Councillors, the importance and location of weed problems in a given area.

(f) Use by the Health and Building Departments for illegal dwelling locations, developmental planning, damage through deafforestation and/or land misuse, and comparison at a later date for land degradation.

(g) Use by Engineers Department for road realignment, comparison over a period of years for wear and tear on engineering structures and areas, determining water catchment values, etc.

As a further argument for the funding by Council of aerial photographs the following can apply:

(i) A legal fund can be set aside with revenue for breaches of the Noxious Plants Section of the Local Government Act (under Section 640 of the Act, Council can receive the full fine).

(ii) Application through Government Grants for photos of Vacant Crown Lands.

(iii) Specific engineering requirements, e.g. bridge locations, major earthworks, flood damage etc.

Method

The firm utilised by Snowy River Shire Council was B.H.P. Engineering who were contracted to do a photographic survey during the feasability study stage of the very Fast Train Project. Whilst in the area they offered their services to Council. This firm had a sophisticated Wild RC 10 6" camera and drift site tracking system and produced a 9" negative size. The clarity of the enlargement photographs from this size negative can supply dramatic detail at ground level.

The preparation necessary for the photographic run of the areas selected to be photographed are as follows:-

(a) A 1:50,000 Topographic map

(b) Recommendation of altitude to fly at:-

A photographic coverage of 5 square km (2 1/2 x 2 1/2 km) requires the aircraft to fly at approx. 6,000 feet above the surface to be photographed. Shots at 2 km intervals along a north south or east west line then allows a 20 - 25% overlap approximately. This overlap is insufficient for stereoscopic use but quite adequate for other requirements.

Whilst a greater altitude will give a larger coverage and appear to be more economical it may not provide the clarity at ground level of the blown up prints.

(c) Desirable that someone conversant with the area to be photographed, accompanies the pilot and surveyor to assist the location of the aircraft on target, which results in less time wasted.

(d) The topographic map must be clearly marked with the desired runs with a numbering or alphabet system operating, and possibly a spare copy made to ensure that an accurate record of the runs is kept.

(e) The end point in view is the acquisition of 1/2 metre or 1 metre square blow ups of the negative in colour.

(f) Photographic enlargements may be produced of the whole 9" x 9" negative to a pre determined size i.e. 1m x 1m or to an approximate scale,

e.g. 6000 feet flying height = 1:12000 photoscale
6 times enlargement given a photograph at approx.
1:2000 with size of 1.38m square.

(g) Selected areas of the 9" x 9" negatives can be masked out and enlarged up to about 10 times and can provide good detail at a practical size and with little film graininess.

(i) Additionally, if the original photography is flown with 60% forward overlaps, every second 9" x 9" prints could be produced to carry out the above weed identification. Should precise measurements be required then the 60% stereo coverage could be used to photogrammatically measure to +/- 0.25m.

Interpretation and Use of Photographs

The main purpose of the photographs for our Council was the location and mapping of heavy infestations of serrated tussock.

To identify the infestations it is necessary to take the 9" negative colour prints into the field with a clear plastic overlay and map the heavy infestations. After carrying out this exercise on several photographs we then found it possible with the 1 metre blowups and a magnifying glass to map them direct without the necessity of the field exercise. Wether this will work for all weeds is undetermined.

Use for Legal Purposes

To have the facility to almost accurately determine the size and area of an infestation of declared noxious plants and provide this as evidence in court can greatly enhance a Council's funds spent on control efforts, under Section 474 of the Local Government Act. A simple method of determining the areas involved is as follows:

(a) Using the 1/2 or 1 metre enlargement, accurately assess the scale ratio. This is done by measuring on the ground several points 1/2 to 1 km in length, i.e. a fence line or road, track etc., then measure the same points on the enlarged photographs. A simple calculation will give the ratio required.

(b) By placing 1 mm square graph paper (transparent) over an enlargement photo, plastic covered, with the weed infestation marked in black, it is possible to trace the area involved and calculate the amount of square mm on the graph paper. This figure is then multiplied by the ratio factor and squared and broken down into hectares. The same exercise can be carried out also with a planimeter, however it takes a little expertise in reading the results.

(c) If it is felt that infra red photography may provide a better image – it is a relatively inexpensive exercise to use a good 35 mm camera and some infra red film and charter a local aero club plane for an hour and trial the specific problem areas with film. However, the area covered by this means is small and for broad area use is probably not adequate to enable fine details and measurement, but it can offer a valued assessment whether it will best suit the job and involves little expense.

Summary

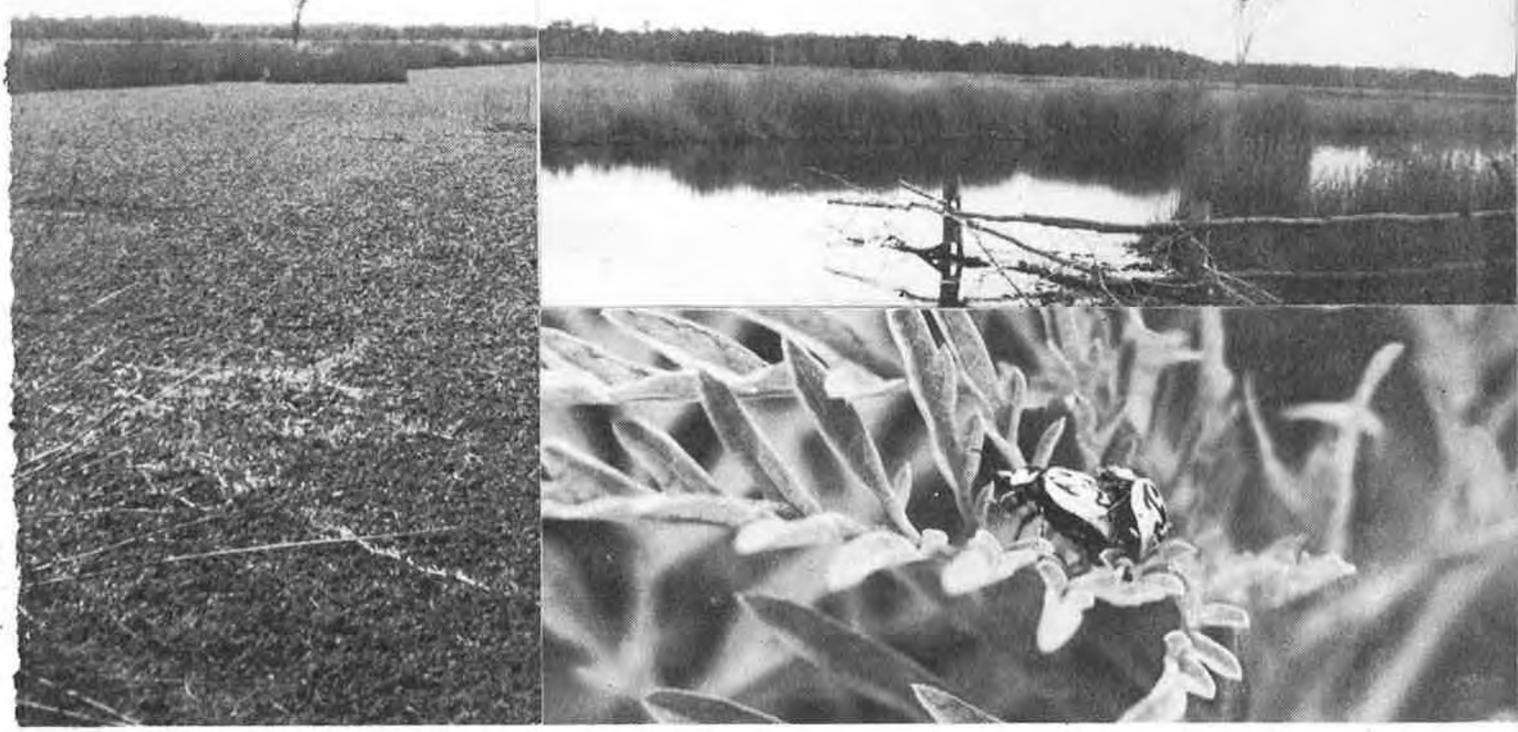
Aerial photography will undoubtedly become more popular in the future either in infra red, colour or black and white for many reasons. Its use for weed detection from a Local Government level is a completely new tool and much is to be learnt. Therefore any work individual councils may undertake in this area should be well documented to enable us all to use it as a learning experience for the future.

PROCEEDINGS OF THE

5th Biennial Noxious Plants Conference 1989

"Noxious Plant Control: Responsibility, Safety and Benefits"

VOLUME 2



NSW Agriculture & Fisheries

COVER ILLUSTRATION

Before and after effects of *cyrtobagous salviniae* on salvinia.

Zygogramma bicolorata on ragweed.

(Photographs by Robert Dyason - Grafton)

Cover Design by John Hoye, NSW Agriculture & Fisheries, Goulburn

ERRATA

VOLUME I –	"Developments with Dodder Control".
PAGE II –	"This control programme aims to:"
2nd Point	*Eucalypts have been parasitised Spraying programs, delete spraying programs and insert by Golden Dodder.
3rd Point	*Co-ordinate landholder and government by Golden Dodder, delete Golden Dodder and insert spraying programs.

PROCEEDINGS

OF THE

5TH BIENNIAL NOXIOUS PLANTS CONFERENCE

"NOXIOUS PLANT CONTROL –

RESPONSIBILITY, SAFETY AND BENEFITS"

VOLUME II

NORTHER RIVERS COLLEGE OF ADVANCED EDUCATION

LISMORE

17th – 21st JULY, 1989

ROBERT DYASON,
Conference Convenor,
NSW Agriculture & Fisheries,
GRAFTON

PETER GORHAM,
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CONFERENCE PROGRAMME

DAY 1 - MONDAY, 17th JULY, 1989

	Topic	Speaker	Session Chairman	
8.30	Late registrations		Brian Scarsbrick	
9.15	Welcoming address	Cr. Malcolm Olive, Chairman, Far North Coast County Council		
9.30	Opening address	Hon. Richard Bull, M.L.C.		
10.00	Morning tea			
10.30	Mycoherbicides	Madeleine Say	Ian Kelly	
11.15	Ragweed, Parthenium and Noogoora burr control post Epiblema	Rachel McFadyen		
11.45	Legal Session	Alan Russell		
12.30	Luncheon			
1.30	The Wiregrass Action Group	Lester McCormick	John Howarth	concurrent workshop sessions
2.00	Developments with Dodder control	Neil Nelson		
2.30	Scrub encroachment in the Western Division	Peter Gray		
3.00	Afternoon tea			
3.30	Pasture manipulation for weed control, especially Parramatta grass	John Betts	Graham Matthews	concurrent workshop sessions
4.00	Use of grazing stock for weed control	Guy Robinson		
4.30	Prickly Pear into the 1990's	Les Tanner & John Hosking		
7.00	Workshop for elected members			

DAY 2 - TUESDAY, 18th JULY, 1989

8.30	Formulation work at the Alan Fletcher Research Station	George Diatloff	Derek Brown	
9.00	Adjuvant Technology	Bill Blowes		
9.30	Ecology of invasions	Richard Groves		
10.00	Morning tea			
10.30	Effect of environmental factors on herbicide efficacy	Leon Smith	Max McMillan	
11.10	Control and identification of drug plants	John Dolan		
11.40	The Tropical Weeds Research Centre. The Queensland Weed Society	Trevor Armstrong		
12.05	Noxious plant control administration in Queensland	Jeff Cummings		
12.30	Luncheon			
1.30	***Bitou bush control update*** 1. Chemical control	Max McMillan	Peter Gray	concurrent workshop sessions
	2. Chemical control	John Toth		
	3. Chemical control in Qld - a case study	Tom Anderson		
	4. Biological control	Roger Stanley		
3.00	Afternoon tea			
3.30	Biological control of groundsel bush	Alan Tomley & Ken Hayes	Peter Gorham	concurrent workshop sessions
4.15	Progress in chemical control of Alligator Weed	John Sale & Ken Bunn		
7.00	Noxious Plants Officers' Association General Meeting			

DAY 3 - WEDNESDAY, 19th JULY, 1989

	Topic	Speaker	Session Chairman	
8.30	Blackberry & Lantana chemical control update	Max McMillan	Mike Steinhaeuser	
9.15	Bus Tour	Max McMillan, Don Armstrong, Robert Dyason		
9.15	Lantana trial			
10.30	Morning tea			
10.30	Application demonstrations			
12.30	Luncheon			
1.30	Bus trip to Byron Bay - Salvinia/groundsel bush biological control	Robert Dyason Robert Waller		

DAY 4 - THURSDAY, 20th JULY, 1989

	Topic	Speaker	Session Chairman	
8.30	The Big Scrub Environment Centre's approach to Noxious Weed control	Anne Close	Leon Smith	
9.00	New Zealand Trip Report	Jim Cherry		
9.30	Permits for Pesticide Use	Col Byrnes		
10.00	Morning tea			
10.30	AVCA Accreditation for pesticide resellers & users	Dick Smith	Warwick Rofe	
10.50	New herbicides and new uses for old herbicides 1. Monsanto 2. Dow 3. Du Pont 4. Elanco 5. Macspred	 Steve Jones Kerry Webb Bernie Horsfield Don Heussler Stan McFadzeen		
12.30	Luncheon			
1.30	Weed control on protected lands	Bob Attwood	Ron Baker	concurrent workshop session
2.00	The vine weeds of Rainforests	Alex Floyd		
2.30	Weed control in Bushland	Judith Rawling		
3.00	Afternoon tea			
3.30	Chemical control of Sifton bush	John Toth	Les Tanner	concurrent workshop sessions
4.00	Silverleaf nightshade - chemical/biological control	Peter Gorham		
4.30	Distribution and control of woody weeds in North Queensland	Matt Bolton		
7.00	Conference Dinner ***After Dinner Speaker: The Rt. Hon. J.D. Anthony***			

DAY 5 - FRIDAY, 21st JULY, 1989

	Topic	*Speaker*	*Session Chairman*
8.30	Recent Advances in Biological Control Biological Control of Paterson's Curse	Leon Smith	Bob Trounce
9.00	Controlling weeds in adversity: A council's experience with injunctions and the Land and Environment Court	Chris O'Keeffe	
9.30	Disposal of unwanted pesticides - what happens after the recall?	Bruce Dowling	
10.00	Morning tea		
10.30	Occupational Health & Safety Act	Richard Bolton	Hugh Milvain
11.10	Infra-red Photography for weed sensing	Bob Leech	
11.40	Conference evaluation		
12.30	Conference close		
12.30	Luncheon		

OPENING ADDRESS

5TH BIENNIAL NOXIOUS PLANTS CONFERENCE

The Hon. Richard Bull,
MLC.

It was with a great deal of pleasure that I accepted the Minister for Agriculture and Rural Affairs, Mr. Ian Armstrong's invitation to open this conference.

Mr. Armstrong sends his apology because he was called to attend meetings in Perth and Darwin this week.

Firstly, I would like to extend a warm welcome to everyone attending the 5th Biennial Noxious Plants Conference.

In particular, I would like to welcome our visitors from interstate.

I believe we have visitors from South Australia and Queensland present.

Noxious plants affect us all in many ways.

However, it is of great interest that weeds cost NSW about $500 – 600 million each year and of this cost noxious weeds contribute about half.

Examples are, blackberry $20 – 25 million, serrated tussock $18 – 20 million, St John's Wort $7 – 9 million, thistles $20 – 25 million.
There are 28 weeds declared noxious on a Statewide basis and another 55 in certain areas or shires so you can see that the figure of approximately $300 million for noxious plants is a fairly conservative estimate of the costs or economic impact of these plants.

Over the past several years, there has been a considerable increase in noxious weeds in the State, i.e. parthenium weed, Paramatta grass and Johnson grass to name a few.

There are several reasons for this:

i) Good seasons – we have seen considerable increase in rainfall in many areas and this has caused increased weed growth – some suggest it is the start of the greenhouse effect, only time will tell if this is true.

ii) Weeds have spread more widely – caused by human activities such as movement of grain, animals, machinery and road transports – an example is the spread of parthenium weed in feed grain and in agricultural seeds.

iii) From 1981/82 to 1987/88 the State Government contribution to noxious plant control remained static at $2.5 million and council works programs stagnated or declined due to lack of funds.

Mr. Armstrong has recently stated "It is vital that noxious weeds be kept under control now or we will face much larger problems and greater costs later on".
He also said "In line with pre-election commitments the State Government immediately increased its funding for noxious weed control by 1 million dollars to $3.5 million and will increase funding to $5 million as promised over the next few years".

This injection of funding for noxious plant control will undoubtedly help local government councils with their programmes of control and help overcome the increase seen in noxious plants in recent years.

However, local government and others working with noxious plants need to be ever vigilant for the occurrence of new weeds or old weeds in new areas.

The recent problems with parthenium weed illustrates this point very well.

The chance discovery of a parthenium weed plant on the Quirindi/Gunnedah Road, and the subsequent publicity and awareness through television and local press, resulted in a farmer alerting authorities to 400 hectares of badly infested newly sown pastures.

There were about 500 plants.

Another farmer reported a paddock infested by a harvester (over 200 plants) and there have been numerous other roadside and small infestations from as far a field as Jerilderie, Hillston, Nyngan, Coonabarabran, Mullaley and Quirindi.

It is obvious that we must carry out more awareness and publicity campaigns about noxious plants, aimed at the landholder as well as the general public.

I believe another Noxious Plant Awareness week is planned for next year, but please don't wait until then to carry out awareness campaigns about noxious plants.

They must be done now by individual councils and everyone concerned with noxious plants.

Mr. Armstrong also recently said "I am determined to get tough on weeds".

In this he means noxious weeds as well as other weeds.

People who do not comply with legislation should be duely prosecuted.

Many councils already do a good job in this area, but I believe that more councils should be getting tough on people who harbour noxious weeds and they should prosecute people if they do not attempt to eradicate the weeds.

The Minister for Local Government, Mr. David Hay and Mr. Armstrong have recently reached a historic agreement which I'm sure will assist you all with your noxious plant control programmes.

In future the Minister for Agriculture and Rural Affairs will be solely responsible for the legislation concerning noxious plants.

A separate Noxious Weeds Act will be in place to administer noxious plants control and local government will be the body responsible at the local level. There will be a streamlining of administration and action on various matters will occur quicker than in the past. For example, approval to distribute grant funds, declaration of noxious plants and changes to legislation.

Mr. Armstrong believes that weeds officers should have the same right of entry to private land as noxious animal inspectors.

He has indicated this to the working party who is handling the preparation of the new legislation and I'm sure they will take note of this.

Another matter of concern is noxious plant control on Crown land.

The Minister is seeking to have State Government authorities accept their responsibilities for eradicating weeds on Crown Land the same as private landholders.

He has already written to all Ministers concerned with this matter and has already received a positive response from most of them.

I understand that the matter of noxious plant control on Crown Lands will be an important consideration in the new legislation.

The community is becoming more concerned about pesticide use and pressures are being placed on Governments to reduce the use of pesticides with alternative controls whenever possible.

Unfortunately, the use of alternative methods such as biological control is not possible with all weeds.

However, I would urge you all to be particularly careful when using chemicals which have residual properties and not do anything which might in any way cause environmental damage.

There are people waiting for mistakes to happen, who will publicise them widely.

Officers from NSW AGriculture and Fisheries are there to help you and offer advice on all matters relating to safe pesticide use.

Please use these services when needed.

Today we need to look ahead to the future so our farming systems are profitable as well as sustainable.

This means developing farming systems for weed control which integrate all the tools or strategies we have available to us.

This same principle should apply to councils programmes:

- strategic use of the hoe
- cultivation where applicable
- grazing management to maintain pastures
  so gaps don't occur for weeds to develop,

including good soil management.
- biological control.
- use of competitive pasture species such as phalaris and other perennial grasses and legumes.
- strategic use of chemical controls
- replacement of noxious plants with suitable plants (farm or national parks)

With the good season for competitive growth and with most landholders having funds available, I believe we should press very hard to try and get landholders to reduce their noxious plant problems now.

With the extra Government grant funds available, councils should be able to operate more effectively.

The Government is operating under considerable financial restraint and we expect funds to be spent wisely and efficiently.

Accountability is of major importance if further funding is to be obtained.

Councils have now been given the chance to prove they are the responsible body to administer noxious plant control.

The Minister expects you all to carry out this responsibility to the fullest extent.

The NSW Department of Agriculture should be commended for organising this Conference and I know a lot of work has gone into its planning and organisation.

Special mention should be made of Mr. Robert Dyason, Chairman of the Organising Committee, who has contributed so much of his time to organising this Conference.

These conferences have built up an excellent reputation over the years and this is demonstrated by the way they continue to be so well supported by local government and other organisations.

The conference, in a timely move, addressses environmental concerns.

The treatment of this subject ranges from a paper dealing with environmental effects on herbicide efficacy, to a discussion of the Byrill Creek court case.

In a notable departure from previous conferences, the opinions of the conservationist movement have been actively sought.

In a paper which is intended to stimulate thought and discussion amongst the weed control community, Anne Close of the locally based Big Scrub Environmental Centre will speak on her organisation's attitude towards noxious weed and roadside vegetation control.

Despite a plurality of approach, I suspect that we all have much more in common with conservation organisations that is at present conceded.

It is significant that of 39 conference papers, one third mention biological control or manipulation of the weed by non-chemical means in order to gain control.

These are indeed stirring times for noxious weed control in NSW and I believe it behoves us all to do our best to meet the challenges of the future.

The conference with its challenging programme, innovative field day and scope for fellowship with a range of people should assist you in this area.

May it be profitable and rewarding to all participants.

Mr. Chairman, Ladies and Gentleman, I now have much pleasure in officially opening the 5th Biennial Noxious Plants Conference.

CONTENTS

VOLUME II

FORWARD

Lismore and the Northern Rivers Campus of the University of New England proved to be an excellent venue for the Fifth Biennial Noxious Plants Conference. Mr. Robert Dyason and his Organising Committee should be congratulated for their efforts in making this Conference one of the most interesting and enjoyable conferences I have ever attended.

The conference theme "Noxious Plant Control: Responsibility, Safety and Benefits" was ably covered by the programme of topics and the high quality of speakers. The Hon. Richard Bull, MLC, who opened the conference on behalf of the Minister for Agriculture and Rural Affairs, set the scene by emphasising the need to make people aware of the importance of weeds and how much they cost us. He also emphasised the need for those responsible for enforcing control of noxious weeds to be concerned about the environment and accountable for their actions.

With the close proximity to Queensland it allowed speakers from that State to present a wide range of topics of common concern including biological control of numerous species, formulation of herbicides, and chemical control of Bitou bush. It was pleasing to have so many high calibre speakers from Queensland present throughout the conference for discussion outside the formal sessions.

The new lecture facilities and amenities of the Northern Rivers campus set the scene for expanded conference activities. For the first time workshops were held concurrently with the main conference proceedings. At these workshops practical subjects such as "writing for the media" and "TV presentations" were demonstrated.

Today communication with diverse groups of people is important and it is essential that noxious plants officers know now to express themselves and justify their actions, especially when treating noxious plants with herbicides. The conference was made well aware of one group's attitude to noxious plant control and I believe this demonstrates how important it is that we learn to communicate effectively and also establish lines of communication so we can tap a wider range of information sources when outrageous claims are made.

Another new innovation was the workshop for elected members and this created lively discussion as well as an opportunity for ideas to be brought forward for the new legislation being prepared. Also the session by Alan Russell allowed for a reasoned debate on the new legislation.

There were many highlights to the conference including the excellence of the conference dinner, the eminence and quality of the after dinner speaker The Right Hon. Doug Anthony, the field day activities and the fellowship between delegates.

Congratulations to the winners of the Innovative Ideas Competition, the Grass Weeds Identification competition and the Noxious Plants Officers trip to New Zealand. Special thanks to Du Pont and Nufarm for sponsoring these events as well as Monsanto, Combined Chemicals and Dow who also sponsored the conference.

Again I must emphasise that it is important to put to good use the knowledge and experience you gained from the conference. Our main job is to control weeds or make sure they are controlled and if benefits can not be shown from holding these conferences we may be forced to abandon them.

Let's all make a special effort for Weeds Awareness Week to be held 15–19th October 1990 and I look forward to seeing you all again in 1991 at the Sixth Biennial Noxious Plant Conference.

LEON W. SMITH
Principal Agronomist (Weeds)

THE WIREGRASS ACTION GROUP

Review of a major advisory campaign.

L.H. McCormick (A), G.M. Lodge (B) and C.P. Dadd (C)

(A) District Agronomist, Manilla.

(B) Research Scientist, Agricultural Research Centre, Tamworth.

(C) Livestock Officer (Sheep & Wool), Gunnedah.

A major problem on the Slopes and Tablelands of northern N.S.W. is wiregrass (*Aristida ramosa)*. Wiregrass is a perennial summer growing frost susceptible grass of low nutritional value and its sharp seed contaminates sheep meat and wool products. The associated low stocking rates and the discounts applied to sheep products represent significant costs to the grazing industry.

A grazing management strategy to increase the abundance of more beneficial grass species at the expense of wiregrass had been in existence for at least 15 years with practically nil adoption.

Why had there been no adoption, certainly this information was presented to the grazing industry 11 years ago but created little interest?

A multidisciplinary group, known as the Wiregrass Action Group was formed to review the wiregrass problem and to see if a need existed for the control strategy. A logo and letterhead were developed so producers could identify the group.

A survey in 1986 of four shires on the slopes was used to determine if a market existed for this technology. **74% of respondents** had wiregrass and **83%** of these considered wiregrass a problem. **61%** of respondents with wiregrass had actually tried to control it but very often with only fair to poor results. Average stocking rates on this country were 1.2 – 1.8 DSE/ha although the average annual rainfall ranges from 630 – 1200mm.

The survey results indicated there was a real need for wiregrass control and that graziers were interested in being involved in a control program. Although the survey showed graziers were aware of the problems of wiregrass it also showed they were unaware of what it was costing them, which may account for the inital low rate of adoption.

The Wiregrass Action Group mounted a two stage campaign to address the wiregrass problem.

Stage 1) AWARENESS – to create interest in the grazing community and get landholders thinking about wiregrass control. The target area for this campaign is the northern Slopes and Upper Hunter.

STAGE2) ADOPTION - to increase the knowledge on control methods and adoption onto properties.

1) AWARENESS CAMPAIGN

The awareness campaign highlighted the five main problem areas associated with wiregrass; low nutrition, illthrift and contamination of wool, skins and carcases, as well as the cost of these problems to the producer. This information was presented at many field days, conferences, meetings and wool stores prior to sales. These problems were also highlighted at grass recognition and pasture management schools. The press and radio also played an important role.

Four other techniques were used to deliver the awareness message:

* Demonstration Site: A site was selected at "Wairuna" Barraba, to demonstrate the strategy of wiregrass control. This site played a big role as a field day venue and acted as a model for local graziers.

  The most important speaker we found at these field days was the landowner Mr Mark Thompson, who well understood the problem of wiregrass and what it meant to him to be able to control it.

* Information package: The package consisted of an information sheet "Getting Started In Wiregrass Control" on letterhead, wiregrass control stickers, a slide/tape series,video and four display boards. The package has had extensive use at meetings and field days and has been of greatest benefit to extension officers not totally familiar with the program.

  Wireman a computer program complimented the information package and showed the expected change of income using wiregrass control. Wireman takes into consideration interest rate, extra stock purchases, subdivision and the cost of supplying water.

* 4,500 newsletters are distributed by the group each quarter. The newsletters contained timely information on the control strategy, trial results, economic information and even fencing tips.

* Roadside signs have been a recent undertaking. These signs highlight paddocks along the major roadways that wiregrass has been controlled in. These signs have been very effective in reinforcing the wiregrass control strategy.

EVALUATION AT STAGE 1

To guage the effectiveness of the awareness campaign a small survey was conducted at AgQuip Gunnedah 1986 twelve months into the campaign (Table 1).

Table 1 **Survey of Persons Viewing the Wiregrass Stand – AgQuip Gunnedah 1986**

64% had a wiregrass problem.

55% of those who had a problem had heard of the Wiregrass Action Group.

77% of those with a wiregrass problem but had not heard of the Wiregrass Action Group were outside the target area.

22% of those without a problem had heard of the Wiregrass Action Group.

This survey indicated the awareness campaign had so far been effective and it also highlighted the extent of the wiregrass problem in other areas.

Interest in the campaign was also indicated by the attendance at field days and meetings.

2) ADOPTION PHASE

This phase of the program aims at increasing the producers knowledge and skills on implementing the strategy and increasing the numbers of users.

* Early Adopters: Properties of early adopters offer an opportunity to develop interactive local groups to promote this strategy. Results to date on this type of approach have been very effective.

* Commercialising Control Strategy: Acceptance by private industry is seen as a method of further highlighting the benefits of this program and we are at present seeking companies who will use information in their advertising literature.

* Case studies of individual properties are being used to promote not only the successes of the wiregrass control strategy but also to show how flexible the system is. The case studies so far have described the use of goats, cattle and supplements in combination with wethers and purchase of sheep over the summer period to increase the grazing pressure.

* Advertorials offer an opportunity to involve other sections of the industry, already a double page feature has been in the North West Magazine (circulation 43,000) which included case studies and methods of wiregrass control.

EVALUATION AT STAGE 2

A survey of graziers, with sheep, undertaken in July 1988 was used to evaluate graziers attitudes and adoption of the grazing management strategy, **56% of respondents** with wiregrass had undertaken a grazing strategy and Table 2 outlines what strategy they had undertaken.

Table 2 **Grazing Strategies Undertaken to Control Wiregrass**

42% used the heavy summer grazing, winter/spring rest as recommended.

15% used a spring burn and heavy summer grazing.

5% had subdivided larger paddocks to increase grazing pressure.

4% purchased Merino wethers to control wiregrass.

35% used other strategies.

The survey showed that graziers understood the need to use heavy summer grazing to control wiregrass but did not fully understand the importance of using a winter rest to increase beneficial species and provide a competitive pasture to prevent the reinfestation of wiregrass.

The Wiregrass Action Group will now be reviewing the problems associated with the adoption of the winter rest as outlined by graziers in the last survey.

CONCLUSIONS

The incorporation of a multidisciplinary group paid dividends in terms of a large knowledge base, formulation of plans and the early production of the information sheet 'Getting Started In Wiregrass Control'. Members of the group are also still contributing their expertise in newsletter articles and at meetings.

This group needed an identity and needed to be readily identified as the authority on wiregrass control and native pasture management, this was achieved not only through the name and logo but by having our own letterhead, and stickers. Running native pasture management schools also identified us as authorities on native pastures.

Through the media and newsletters, tremendous attention was drawn to the awareness campaign and this gave the group the audience it needed.

Native pasture management is being received with greater interest these days, landholders are becoming increasingly aware of the value of natives but the real test for this program will be adoption.

The adoption of the strategy has been the hardest part of the program to assess, not only because of the logistics but also because of the length of time adoption takes place over. Survey results to date have been encouraging,adoption is on the increase.

If this strategy is seen by the grazing industry and extension workers as an integral part of pasture improvement then the wiregrass control strategy will have a greater chance of adoption. The grazing industry has indicated they need wiregrass control, the costs of wiregrass are too high.

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WOODY WEED ENCROACHMENT
A MAJOR PROBLEM IN THE WESTERN DIVISION

P. J. GRAY
Noxious Plants Advisory Officer
NSW Agriculture & Fisheries
Dubbo

INTRODUCTION

Vast areas of the rangelands in the Western Division of NSW are being affected by the encroachment of inedible native woody shrubs. The encroachment is continuing and unless a practical solution to the problem is found graziers will be faced with an increasing problem of declining returns and increasing costs.

The invasion of these woody weeds is not an easy problem to contend with, especially given that removal is a costly and time consuming process and the properties are large with relatively low land values. Scrub invasion is considered a to be a major problem by more that 50% of property owners in the Division with an excess of 60% of the area being susceptible.

From the point of view of people involved in noxious plant or general weed control in the central and eastern parts of NSW the actual problems may be different, however, many of the basic concepts are similar.

In both cases the principle of understanding the environment and the natural forces involved together with the changes due to man applies. As with other weed control, vegetation management is the key to success.

BACKGROUND

To most people in NSW, the Western Division is the "Outback" and they have little knowledge or understanding of the area. There are some marked differences between this part of the state and the Central and Eastern Divisions with which most people are much more familiar.

The Western Division comprises 40% of the land area of NSW being that part of the state west of an indirect line between Balranald in the south and Walgett in the north.

The boundary was established by Government authority in 1884, being arbitrarily determined to approximate the then current land use. Shire and Regional boundaries do not always co-incide. The concept recognised the need at that time for special tenure arrangements to meet the requirements of the area.

Apart from mining, the pastoral industry is the main source of income with some dryland cropping now being carried out in the eastern extremities and and irrigated cropping along the major rivers such as the Darling.

The holdings are relatively large, varying from an average of 4000 hectares running 3000 sheep in the east to 40,000 hectares running 5000 sheep on the west. Over three quarters of the properties have no full-time employees, so available labour in proportion to area is very low.

The climate is semi-arid with unreliable rainfall, varying from an annual average of 450mm in the far north-east, 250mm in the far south-west to 150mm in the far north-west, with droughts being a prominent feature.

An important aspect of the rainfall is its irregular nature which can be expressed as a figure of 40% in the far north-west and 30% along the eastern fringes. By way of comparison the figure for the western slopes wheat belt is 25%.

A feature of the climate is that of hot summers and mild winters coupled with a low relative humidity and high evaporation rates which approach 3000mm per year. (Hassall and Associates, 1982)

Apart from grey cracking clays along major drainage basins which are not subjected to scrub encroachment problems, the soils of the Division are principally mildly acidic hard setting massive red earths, often gravelly, and red sandy aelolian soils without a strong dune development. These soils are invariably of low fertility with a particularly low phosphorus status and with most of the nutrients being in the surface few centimetres where they are susceptible to loss by erosion. (Harrington et al, 1984)

Many of the soils are susceptible to wind and water erosion and scalding when the vegetation cover is removed. In addition stock walking compacts the top soil, reducing permiability.

The low soil fertility and extreme climatic conditions reduce the possibility of introducing desirable plant species from other regions.

PRODUCTION CONSTRAINTS

An Economic Study by Hassell and Associates for the Western Lands Commission in 1982 identified scrub invasion as one of the four principal production constraints of the region. It was listed as a problem by 72% of all properties and emphasised by landholders in the already scrub-invaded areas. The report recommended that the problem warranted a special research effort to find effective and economic control measures.

The study found that properties with the greatest density of shrubs had a 20% lower income and a 40% higher debt than counterparts in drier but less shrubbed environments.

The economics of scrub control in the Western Division are exacerbated by the extensive size of holdings, the relatively low value of the land and the lack of farm labour with 75% of all properties not employing any full time staff. In the period 1962-75 there was a reduction of 70% in the number of full time station hands in the Division.

Property incomes are reduced by scrub invasion because:

1. Carrying capacity is reduced. It has been estimated that the available forage can be reduced to as much as 15% of that of open country.

2. Lower reproductive performances.

3. Increased losses due to fly strike because of the difficulties of mustering stock.

4. Increased costs of operations such as mustering.

5. Lamb losses due to predation by feral pigs which are harboured by the shrubs.

6. The effects of drought can be much greater.

SCRUB INVASION

The problem of scrub invasion is most severe in the eastern and north-eastern parts of the Division with the greatest reductions in carrying capacity occurring in the Cobar-Byrock area. Scrub invasion in this district was first commented on in the 1880's. In the centre of this district (Coolabah) the dual effects of scrub invasion and erosion have reduced the carrying capacity by 26%. (Joint Select Committee, 1983)

The major problem species are many and varied, belonging to various plant families and this demonstrates how plant species are adapted to their natural environment.

The major problem species are:

Family Sapindaceae:	Broadleaf Hopbush	(*Dodoneae viscosa* var *arborescens*)
	Narrowleaf Hopbush	(*Dodoneae attentuate*)
Family Myoporaceae:	Turpentine	(*Eremophila sturtii*)
	Budda	(*Ermophila mitchellii*)
Family Mimoseae:	Mulga	(*Acacia aneura*)
Family Caesalpincaceae:	Punty Bush	(*Cassia eremophila* var *eremophila*)
Family Cypressaceae:	White Cypress Pine	(*Callitris columellaris*)

Broadleaf Hopbush – *Dodoneae viscosa* var *arborescens*

This is a 2–3 metre shrub with inconspicuous flowers occurring in late winter–spring and the fruit a red or purplish capsule featuring 3 or 4 vertical wings. The leaves are 3–8 cm long and 5–14 mm broad.

Its habitat is loamy red earths in mallee and white cypress communities, shallow stony soils on hillslopes and ridges in mugga ironbark and curraway communities.

It sometimes covers extensive areas, usually occupying the open sites between tree canopies in dense to open woodlands. There may be dense stands in areas where trees have been partially cleared. It may readily invade disturbed areas such as roadsides.

It is sparingly grazed by stock during droughts and is not highly regarded as a source of fodder but can be browsed by goats.

Narrowleaf Hopbush – *Dodoneae attentuata*

A slightly spreading, many stemmed sticky shrub, usually 1–2 m high but occasionally to 5 m, flowering mainly in spring–summer. The fruit is a redish or purplish capsule with 3, rarely 4, vertical wings to 10 mm long and 14 mm wide. The leaves are 2–8 cm long and 1–4 mm broad.

It's habitat is mainly deep sandy soils in a wide variety of vegetation types and particularly in disturbed areas.

The shrub is more extensive in the northern part of the Division, with dense stands often occurring in areas around watering points and shearing sheds which are periodically subjected to severe grazing and trampling. Historical reports suggest that it has increased in density and spread in the north of the Division since European settlement.

It is only browsed by sheep as a last resort but can be browsed by goats.

Turpentine – *Eremophila sturtii*

A sticky, hairless 1–4 m shrub with lilac or pale–mauve flowers occurring mainly in spring but which may be present at any time during the year. The fruit is a slightly pointed oval drupe, 4mm long, almost dry and densely clothed in long soft hairs.

Its habitat is mainly sandy and loamy red earths in mallee, mulga and bimble box communities as well as solonised brown soils in belah–rosewood woodlands.

The shrub occurs over much of the Division with the exception of the south–east section and the alluvial soils of the major floodplains. Infestations range from widely scattered plants to dense infestations covering large areas.

In addition to seedlings, propagation occurs from root suckers which form readily from disturbed roots and it is this feature which, coupled with the mature plants ability to recover after fire, makes the plant difficult to control. It is extremely drought resistant.

The plants are unpalatable to stock.

Budda – *Eremophila mitchellii*

A 3 m shrub or a shapely 9 m tree with white or pale–cream flowers which mainly occur in the spring with a secondary flowering in the autumn.

Its habitat is mainly bimble box, white cypress pine, wilga, gidgee and leopardwood communities on sandy loam and clay loam red earths, red brown earths and duplex soils.

Budda occurs mainly in the north–east of the division and is particularly prevalent in the Cobar district.

As with turpentine it is very difficult to control and is generally considered unpalatable to stock.

Mulga – *Acacia aneura*

A tall shrub/tree to 8 m with bright yellow flowers which occur at any time of the year subject to suitable rain.

Its habitat is mainly sand plains, dunefields and rolling pediplain country on red earths as well as the slopes and tops of hills with stony and skeletal soils.

It is widespread througout the region with the exception of the Riverine Plain in the south and the flood plains of the northeast, being dominant in the north and northwest.

Mulga mostly forms a rather open woodland with an irregular pattern of clumps. In the Cobar district particularly, however, dense regeneration has taken place forming almost impenetrable scrub and in this situation it has created problems similar to other woody shrubs.

Mulga is a useful source of fodder, being regarded as one of the best western fodder trees, and it has been extensively lopped for this purpose in times of stock fodder shortages. It is also a valuable source of timber and it is a point of discussion as to whether it is a problem weed or not. While it forms a useful fodder resource in times of drought, in those areas where it is dense it reduces the amount of herbage available during normal seasons and thus contributes to a reduction in carrying capacity

Punty bush – *Cassia eremophila* var *eremophila*

A 1–3 m shrub with bright yellow flowers occurring mainly in late winter–spring. It is a relatively short lived species, however this is compensated by its prolific seeding.

Its habitat is mainly red loam and sandy soils in mulga, bimble box, white cypress pine and red box communities throughout the region.

While over much of its range in the southern part of the region punty bush usually occurs as scattered plants or small colonies it has, since European settlement, increased markedly in the northern part where it has invaded extensive areas of open woodland and grassland. In particular once cleared paddocks close to homesteads which were ploughed to provide feed for station horses have become dense stands of punty bush.

It is rarely browsed by any form of livestock.

White Cypress Pine – *Callitris columellaris*

A straight single trunked 20 m tree with flowers occuring in spring–early summer.

Its main habitat is coarse, textured red brown earths in almost pure stands or in association with numerous other tree and shrub species.

It is widely distributed throughout the region decreasing in the southern riverine areas. It occurs as isolated trees or in extensive forests and in the Cobar district the dense thickets of young trees have become a problem. The timber has been extensively used for buildings and fence posts, however, it is unlikely that in dense stands the young trees will develop to a commercial size.

The trees are only occasionally browsed particularly by goats.

(Cunningham et al, 1981)

CONTROL METHODS

Woody weed management is a major priority for many graziers in the Western Division.

To date research has generally found that mechanical clearing has to be repeated to be effective and the costs are often far in excess of the value of the land. Clearing causes soil disturbance which can enhance the ability of shrubs to establish from seeds and is not effective against root sprouters such as turpentine unless followed by deep ploughing. The problem of post-clearing management is compounded by the lack of suitable pasture species to plant back into the disturbed situation such as is done in central Queensland after brigalow clearing.

Herbicides can be used for thinning large trees or particular areas of importance, however, the cost of treating extensive shrub infestations is not generally economically feasible. As with the case of mechanical clearing new seedlings will soon emerge requiring further treatments.

Goats have shown the potential to reduce the scrub encroachment of some species. They are regarded as a tool for defoliating shrubs and have the added benefit of generating income. Recent studies have concentrated on narrow leaf hopbush (*Dodoneae attenuata*) a woody weed known to be eaten by goats and investigations are continuing on a long-term basis.

Research by CSIRO, NSW Agriculture & Fisheries, and the Soil Conservation Service has demonstrated that management burning can effectively manage shrubs. With fire, graziers can reduce the number of shrubs in a paddock and reverse encroachment.

THE ROLE OF MANAGEMENT BURNING

Reports from early European explorers and settlers indicate that much of western NSW looked like open park land with tall trees, few shrubs and well grassed plains. This is not now the situation in many areas of the Division. Vast areas of the Division now bear dense infestations of shrubs.

Before European settlement fire was very common in the rangelands. Aboriginal people frequently used fire to manage their land and their food supplies and, in addition, wildfires caused by lightning were common.

Livestock grazing has altered the natural balance between species, removed plants so increasing erosion and compacted the top soil so reducing permeability. As a result of grazing the amount of available fuel for wildfires has been reduced.

Under the natural balance occuring pre-settlement the larger size and longevity of trees/shrubs dominated grasses which, however, provided fuel for fires which reduced the density of trees and shrubs.

As a result of grazing the amount of available fuel for wildfires has been reduced thus reducing the impact of fires which on term has contributed to the vegetation balance being altered towards shrub dominance in many areas.

Not only has grazing reduced the potential intensity and extent of fires, but graziers also actively reduce the extent of fires when they occur. Thus the reintroduction of fire for scrub management can assist in restoring land to a more desirable "open" condition.

Research has shown that the deliberate and planned use of fire, i.e. a management burn by landholders can be a very useful tool to combat scrub encroachment in the Western Division.

A management burn is a fire that is planned, controlled, and carried out to manage woody weeds. It is carried out for a specific purpose in a specific area which differs from a wildfire which is a fire without a management objective, is usually out of control and can cause great damage to the environment, property and livestock.

A management burn is the most economic and ecologically sound method of broadacre shrub management, particularly for those areas dominated by the shrub species most easily killed by fire. The direct costs for management burning are far less those for alternative techniques such as chemical treatment or mechanical clearing.

Research by CSIRO and the Soil Conservation service has shown the effect of fire depends on the species, age and height of the plant. The following is a list of common shrubs and their susceptibility of fire:

Table 1.1 Common shrubs and their susceptibility to fire.

Highly susceptible > 90% killed	Susceptible 30–90% killed	Resistant
Mulga (*Acacia aneura*)	Hopbush (*Dodonaea viscosa*) (*Dodonaea attenuata*) Punty bush (*Cassia eremophila*) Silver cassia (*Cassia artemisioides*) Turkey bush (*Eremophila gilesii*)	Turpentine (*Eremophila sturtii*) Budda (*Eremophila mitchellii*) Fushsia bush (*Eremophila duttonii*) Emu bush (*Eremophila longifolia*)

Although some species are tolerant of fire as adults, their seedlings are highly susceptible during their first year. There are also benefits in reduced mustering costs from burning resistant species. If the paddock has been burnt previously then a percentage of the resprouts will also be killed.

Studies by the CSIRO Rangelands Research Centre have shown autumn burns may increase the death of resprouting shrubs from an average of 20% to about 50%. Although autumn burns are most likely to kill resprouting shrubs, late summer "hotter" burns can also be as effective, as the proportion of the area burnt out is usually greater. However, it is more difficult to obtain fire permits during hot summer months.

The response of pastures to rain is also more uncertain in summer than it is in autumn, and so autumn burning reduces the period the soil surface remains bare thus reducing the risk of erosion. (Harland et al, 1989)

Although spring burns are not as effective, any chance to burn in spring should be taken because opportunities to burn are rare due to the lack of fuel, (unless the fuel load is exceptional whereby one can risk wating until late summer or autumn).

Large-scale demonstration burns have not shown any general increase in the germination of shrub seeds after fires. Some incidents of increased germination may occur, however, these can usually be attributed to "hot spots" or because of wildfires of higher intensity.

The future germination and survival of shrub seedlings in a burnt paddock depends on the seasonal conditions and, most importantly, grazing management. Stock pressures must be controlled to encourage the growth of regenerating perennial grasses and the germination and establishment of grass seedlings. These perennial grasses can be very effective in out-competing shrub seedling for scarce soil moisture reserves and this can lead to the death of most shrub seedlings during their first summer.

WOODY WEEDS TASK FORCE

Following representation from the NSW Farmers Association identifying woody weed encroachment as the major problem facing landholders in western NSW, a Woody Weeds Task Force was established in August 1988.

The task force consists of representatives from the government agencies; NSW Agriculture & Fisheries, Soil Conservation Service of NSW, Western Lands Commission and CSIRO, and representatives from the NSW Farmers' Association and Pastoralists Association of the West Darling.

The major objectives of the task force are to:

i. develop practical strategies which will encourage the effective implementation of woody weed management programs.
ii. raise the level of community awareness of the costs and effects of the woody weed problem.
iii. examine current technology and identify aspects of the woody weed problem that require further investigation and research.

The shrub encroachment problem in western NSW was identified in the 1901 Royal Commission into Crown tenants and in several reports since, yet adoption of control techniques to manage woody weeds has been slow. Members of the task force are enthusiastic to ensure that this extension initiative maintains its momentum to halt woody weed encroachment into productive land.

A task force working group has been formed in Cobar which will co-ordinate the release of advisory material to the rural community. This group would welcome suggestions for action and can be contacted through the chairman, Warwick Date at NSW Agriculture & Fisheries, Cobar.

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ADJUVANT TECHNOLOGY

W.M. BLOWES – Monsanto Australia Limited

When the active ingredient of a herbicide is placed on the surface of a plant it may only exhibit a fraction of its potential herbicidal activity. This potential can be optimised however, by judicious use of adjuvants. Adjuvants can facilitate the dispersion of the active ingredient in a carrier such as water, distribute this evenly over the surface of the plant, and aid in pentration of the outer lipid layers of the foliage.

For the purposes of this discussion I would like to restrict my comments to adjuvants that affect herbicidal activity on the plant and I have tried to intermix the theory of adjuvant technology with examples using Roundup (R) and adjuvants commonly used in Australia.

Adjuvants can be classified as:

- spray modifiers
- activators

SPRAY MODIFIERS: these adjuvants are further classified as:

Spreaders: Compounds added to the spray solution as a tank mix that cause droplets to spread on foliage eg. Pulse.

Spreader Stickers: have the same function as spreaders but an additional agent is added to aid retention of the active ingredient on foliage during wet conditions.

Stickers: may be single additives that cause active ingredients to adhere better to plant surfaces and make water soluble products rainfast eg. Bondcrete.

Spray Thickeners: usually hydrophilic polymeres that increase the size of spray droplets when added to the spray mixture in a tank mix eg. Nalcotrol. The resultant gel is said to have a reduced tendency to drift but small droplets are not eliminated so spray drift is still possible and the use of these compounds does not substitute for sound application technique.

Foaming Agents: larger particle size sprays are generated using air to create a foam 'droplet'. These adjuvants are used to reduce drift and appear to do so under good conditions in New Zealand. Under hot and/or dry conditions however, there may be greater evaporation of these droplets due to their greater surface area and this may actually contribute to more drift.

ACTIVATOR ADJUVANTS – increase herbicidal activity.

Surfactants: These adjuvants facilitate wetting, spreading, dispersing, solubilizing and emulsifizing to bring about enhanced herbicidal action. Surfactants can influence herbicidal activity:

- within the spray solution
- on the cuticle surface
- within the cuticle layers

- within or on cells underlying the cuticle
- within plant tissues remote from the treated area.

Surfactants can facilitate herbicidal effectiveness in many ways eg.

- lowering surface tension
- improving coverage
- removing air films between spray drops and leaf surfaces
- inducing stomatal entry
- facilitating cell wall penetration
- increasing permeability
- acting as humectants.

Compounds that act as surfactants (or surface active agents) tend to concentrate on the surface of the liquid in which it is dissolved. Molecules that perform in this manner are generally comprised of two segments:

- Lipophilic segment which is non polar and water insoluble
- Hydrophilic segment which is polar and fairly soluble in water

The relative amounts of each of these segments determine the physical properties of the surfactant. Surfactants are characterised by an empirical numbering system that describes the relative amounts of these segments in a surfactant. This is known as the Hydrophilic - Lipophilic Balance (H.L.B.).

Surfactants are classified by the polar portion of the molecule and there are four types:

Anionic surfactants: when the surfactant ionizes in water the active portion of the molecule (the one containing hydrophilic and lipophilic segments) is an anion or negatively charged.

Cationic surfactants: the active portion is positively charged.

Non ionic surfactants: there are no ionizable polar end groups but the molecule is comprised of hydrophilic and lipophilic segments.

Ampholytic surfactants: both positive and negative centres are found on these molecules.

Wetters: surfactants with the ability to reduce the contact angle and surface tension of sprqay droplets and by improving wetting may increase the degree of stomatal or cuticular penetration.

Penetrants: these are added to increase the rate of penetration through the lipid layer by increasing hydration and solubilisation of the cuticle.

Oils: Phytobland oils - are highly refined paraffinic oils that are usually sold with 1 or 2% surfactant. These sometimes provide increased herbicidal activity eg. selective grass herbicides.

Oil surfactant concentrates - contain up to 20% surfactant and phytobland oils. These also can increase herbicidal activity.

Detergents: 10 – 70% surfactants which also contain soap and other additives like optical brighteners. These can reduce herbicidal activity and their use should be discouraged.

Undoubtedly, adjuvants can enhance herbicidal activity but as yet no single property or combination of properties has been identified that will permit prediction of surfactant effectiveness. New adjuvants must consequently be evaluated separately to determine the spectrum of their effectiveness.

ECOLOGICAL CONTROL OF TERRESTRIAL WEEDS

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Methods of controlling terrestrial weeds have evolved as land use systems changed and diversified over time. But the aim of control has always remained the same – namely, to limit the number of plant propagules in the long term to a level tolerable to human activities. Rarely has eradication been a management aim and then only in somewhat specialised cases. In this contribution I shall review some of the ways by which populations of weeds have been deliberately limited. I define ecological control of a weed as the planned use of one or several methods of control when integrated with an understanding of the dynamics of the ecosystem in which the plant occurs. Control methods used in agricultural ecosystems usually simplify the system. Ecological control methods in more natural systems, on the other hand, aim to maintain or even enhance biological diversity in the longer term.

In this contribution I shall discuss the different methods of control in terms of their relative importance in reducing plant populations of St John's Wort *(Hypericum perforatum)* in temperate grasslands. From this example I shall present some general principles for more effective control of weeds, especially in natural Australian ecosystems.

CONTROL OF ST JOHN'S WORT

Legislative methods

One method of controlling weeds is to prevent their entry to a country or region. Such a method is a policy of exclusion enacted by parliamentary legislation (Navaratnam & Catley 1986). the method is presumably effective in limiting the number of invasive plants entering Australia, although I have been unable to obtain figures on the numbers and identities of weedy species which reach an entry point but are then detected and thereby excluded. This method does not usually keep out 'new' species of known taxonomic identity unless they are especially troublesome in another country. St John's wort is known to have been introduced deliberately to Asutralia in the 1880's (Parsons 1973), although A.M. Gill (personal communication) showed that multiple introductions of the plant were highly probable; certainly it was cultivated in Melbourne in 1858 and in Adelaide in 1859. As a federal system of quarantine was not initiated until the first decade of the twentieth century, exclusion of St John's wort never was a practical proposition. But it may be wise to prevent entry of other species of the genus *Hypericum* into Australia in future, as several already in Australia are known to be weedy, e.g. tutsan *(H. androsaemum)* and St Peter's wort *(H. tetrapterum)* in Victoria (Parsons 1973).

Al allied method of legislative control for weeds is to declare them 'noxious' once they have entered a country. Whilst in theory this method gives management authorities the legal power to control growth and reproduction of such plants, in practice it seems neither to reduce the rate of spread of a weed nor to lead to more effective control in most cases

(Moore 1971; Amor & Twentyman 1974). A.M. Gill (personal communication) showed how ineffective this control method has been for St John's wort over the timespan of its invasion of southeastern Australia.

Physical Control Methods

To be effective in the long term, control programs for St John's wort need to reduce seed production to close to zero; in the short term, reduction in growth of St John's wort and thereby reductions in replenishment of root reserves are essential for control. Most physical control methods seemingly have no effect on populations of St John's wort. Cultivation of invaded land is not effective on its own, even in arable areas (Davey 1917). Burning increases, rather than decreases, the density of the plant (Dodd 1920; Moore and Cashmore 1942), although it may temporarily reduce growth and destroy some seeds (Campbell and Delfosse 1984). These methods have no effect on limiting the numbers of seeds produced or on reducing reserves in the root system.

Chemical control Methods.

Application of herbicides to stands of St John's wort may reduce growth and seeding of the plant, depending on time of application and level of active ingredient (a.i.) in the herbicide mixture. the present recommendation, based on results from pasture research, is to use either 2,4-D ester applied at the rate of 3.36 kg a.i./ha at early flowering (late spring) or glyphosate (1.68 a.i./ha) applied in summer or early autumn before annual pasture species germinate (Campbell & Delfosse 1984). This recommendation may affect associated plants to varying extents and may not be appropriate to situations where values other than agronomic ones are important, as in nature reserves. The effectiveness of these recommendations is based on reductions in percentage ground cover of St John's wort after 2 years (Campbell *et al* 1979); I can find no results for concomitant reductions in the level of seeding of St John's wort in response to herbicide application or any results for a period longer than 2 years.

Control by competing plants

The growth of St John's wort may be controlled in pasture by competition from other plants, especially from a mixture of subterranean clover and perennial grasses (Moore & Cashmore 1942). Four and a half years after sowing various pasture species into land heavily infested with St John's wort, Moore & Cashmore (1942) showed that the number of St John's wort plants was reduced by 96% on plots containing the winter-growing subterranean clover and by 64% of the level of an unsown 'control' on plots containing the summer-growing white clover. A perennial grass such as phalaris was more effective in reducing yield of St John's wort than was annual ryegrass over 4 years of measurements at a site near Tumbarumba in southern New South Wales. Moore & Cashmore attributed control by this means to shading of the procumbent shoots of St John's wort by the dense canopy of subterranean clover produced in winter. More probably, as Clark (1953) has suggested, the mature plants of St John's Wort are being controlled by perennial grasses in summer when competition for moisture is severe, and seedlings of St John's wort are being shaded in winter by a dense canopy of subterranean clover leaves.

A more extreme form of competition imposed on St John's wort plants is to radically change land use of the invaded area from either grassland or woodland to a plantation of *Pinus radiata* which, when canopy closure is reached in 10–12 years, completely shades St John's wort. As a plantation of *Pinus radiata* lasts about 40 years, it has been an effective long-term control method in southern New South Wales and north-eastern Victoria.

The use of indigenous species to control St John's wort populations has not been evaluated experimentally, although in southern Australia the indigenous perennial kangaroo grass *(Themeda australis)* is able to suppress growth of St John's wort (Davey 1919).

Biological Control

Attempts to control St John's wort by the introduction of insects from Europe where the plant originates date back to 1919 when a search began in England for potential biological control agents. Ten insect species were subsequently introduced to Australia from England and southern France. Six are known to have been released in Australia between 1930 and 1940 (Campbell & Delfosse 1984). Of these insects, only the chrysomelid *Chrysolina quadrigemina* from southern France survived in sufficient numbers to cause significant damage to St John's wort in grasslands. The adult chrysomelid exerts its controlling effect by completely defoliating the plant in spring, whilst in late autumn and winter its larvae feed on the young buds and leaves. Various of the other insects introduced attack different parts of the plant but in Australia they have relatively minor effects on plant density at other than a local level. The same insect has been the most successful biological agent for St John's wort subsequently in the western USA (Huffaker 1967; Dahlsten 1986), Canada (Harris *et al* 1969), Chile (Villanueva & Faure 1959) and South Africa (Stirton 1983). So successful was the biological control programme for St John's wort in California that the weed has been removed from that state's list of primary noxious plants.

In regions other than California the success rate of entomological control has not been as satisfactory, however (Huffaker 1967). Whereas the level of control in California was at least 99%, in southeastern Australia the level of mortality of St John's wort was much less (about 54% averaged over 16 sites). Huffaker (1967) attributed this significant difference to the differing incidence of summer rainfall between the two regions. Summer rainfall in southeastern Australia promotes regrowth of the defoliated plants and enables them to survive. Huffaker observed a greater level of mortality of St John's wort plants in South and Western Australia because these regions are much more summer-dry than are northeastern Victoria and southern New South Wales. In these latter regions the plant continues to be a weed of both grazed pastures and of natural areas.

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In summary, St John's wort increased initially in grasslands from the sites to which it was introduced deliberately because it was able to invade ground made bare as a result of overgrazing by domestic stock. The perenniality, profuse seeding and deep root system of St John's wort enabled it to compete successfully with annual grasses and forbs and to become dominant within about 20 to 30 years from its time of naturalisation. Because seeds of St John's wort has the capacity to germinate and reinvade an area should there be significant reductions in vegetative cover at any time over a long period. Clark (1953) commented appropriately concerning St John's wort in pine plantations that "*Hypericum* is generally the last plant to be excluded by the pines and the first to reappear". In the temperate-climate regions which St John's wort has invaded, I conclude that control will always be more effective if it arises from the long-term interaction between the effects of one or several natural enemies and of competing perennial plants as modified by appropriate grazing regimes and by the incidence of summer rainfall.

Conclusions

Some attributes of St John's wort seem to be associated with the weedy nature of the plant. They include:

1. St John's wort and its congeners were all introduced deliberately and usually because of their perceived value to horticulture or for their medicinal values. The only instance I know for the accidental introduction of St John's wort is its introduction from Australia to South Africa as a contaminant in seed from Australia in 1942 (Stirton 1983). The 200 or more species of *Hypericum* generally are distributed world-wide in temperate and subtropical regions. Several species with large, bright yellow flowers are valued as garden plants.

2. Because weeds such as St John's wort have been introduced many times, some genetic variation occurs which may be expressed both morphologically and physiologically. Certainly, St John's wort in southern Australia has been shown to vary morphologically (Campbell 1987), although the genetic nature of this variation is not yet clear for Australian material. Robson (1968) has described several hybrids of different ploidy levels in European material.

3. St John's wort is an early colonizer of disturbed sites in its countries of origin.

4. Seedlings of St John's wort have a high growth rate which can be reduced substantially by shading (Moore *et al* 1989).

5. Plants produce large numbers of seeds early in their life cycles and a proportion of seed is usually dormant. St John's wort produces an average of about 30,000 seeds (Salisbury 1942, Tisdale *et al.* 1959, Parsons 1973) which are small and sticky and readily dispersed.

6. As well as reproducing sexually St John's wort reproduces vegetatively, both from crowns and rhizomes (Campbell & Delfosse 1984), once plants are established.

7. The leaves of St John's wort can be toxic to domestic herbivores because of the alkaloid hypericin contained in them.

St John's wort plants thus have many of the characteristics of invasive plants generally (see Groves 1986 for example).

Given these attributes in common, what aspects of the control of St John's wort may also be general? I suggest that there are four.

1. Only rarely is one method of control effective in limiting the numbers of propagules of invasive plants per unit area. A rare exception seems to be the entomological control of *Opuntia* spp. by *Cactoblastis* and this successful case history has been so widely quoted as to give an incorrect interpretation for the success of entomological control methods generally. More often effective long-term control of weeds such as St John's wort has been achieved by a combination of control methods. Examples of a conscious integration of methods of control of terrestrial weeds are few and even more rarely is such an integrative approach itself integrated with the dynamics of the ecosystem being invaded.

2. Control methods which simplify the ecosystem and reverse the trend towards diversification of the system seem to be more prone to subsequent invasion by other groups of invasive plants, the end result of such actions being to replace one invasion with another. On this basis control methods which add to diversity, e.g. a marked reduction in fire frequency, deliberate promotion of competing plants, use of arthropods and/or fungi, have the potential to produce an ecosystem which may be better able to resist further invasion.

3. Once initiated, control methods have to be maintained. This need for continued action has not always been recognized and a short-term interruption to a control programme for St John's wort, for example, can have disastrous consequences in the longer term.

4. An aspect of previous research on control of weeds is that the monitoring of control is sometimes inadequate, either because it is not done at all or else it is done for too short a time. A further deficiency is that often the index measured may not always be the critical one by which to assess the effectiveness of control in ecological terms. A control programme which measures reduction in yield of St John's wort may be appropriate in pasture research but one which measures the number and viability of seeds per unit volume of soil and the change in cover of associated species (Huffaker & Kennett 1959) may be more appropriate for St John's wort control in a nature reserve.

I conclude with a plea that controllers of weeds should try to understand the biology of the particular weed they wish to control in the context of the ecosystem in which that weed occurs and then devise a strategy that incorporates as many different methods of control as is appropriate for that species and that ecosystem. Only then will weed control move from being a short-term dependence on chemicals to a more truly long-term ecological control. And the latter may even be cheaper in the long term!

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Queensland, 4075

SUMMARY

This Conference's Theme – 'Responsibility, Safety and Benefits' in all weed control aspects could also be the theme of The Weed Society of Queensland (W.S.Q.). It has grown from a small core of keen foundation members in 1975 to some 250 members presently on the mailing list. Our Society has matured in achieving its objectives for members and in gaining public recognition for worthwhile weed related projects as set out in the attached 'Why Join? W.S.Q.' brochure. The W.S.Q. provides a legitimate means by which members can promote community education in weeds and their control in a number of ways. This includes public meetings, field days, seminars, workshops and educational courses on all aspects of the need to manage unwanted vegetation as an integral part of environmental conservation.

Besides the W.S.Q. based in Brisbane, successful branches have been established to cover the Darling Downs-Lockyer and North Queensland activities with possibilities for other worthwhile ventures being limited only by the willingness of members to organize them.

FOUNDATION – PEOPLE

At the 3rd Australian Weeds Conference in Toowoomba in 1965 there was clear enthusiasm for the need for a weed society to accommodate the many interests of weed workers and to provide a more frequent forum for the exchange of information and personal dialogue (Johnston 1982a). Delegates at the inaugural meeting, convened to consider the formation of a weed society, proposed that State weed societies would be set up with similar objectives but with separate constitutions and autonomy of operation.

Like many others, Geof Jacobs [speaking at our 10th A.G.M.], saw the need to extend his knowledge in the field of weeds and weed control. He felt this could be best achieved by regular contact, and the exchanging of ideas, with involved persons within the framework of a Weed Society.

Early in 1975, before I was employed in the weeds field, it became apparent that the only obstacle to the formation of a Weed Society in Queensland was the lack of a catalyst. Geof Jacobs [Inaugural Vice-

President since promoted to Dupont, N.S.W.] enlisted the aid of Rod Wood [Honorary Auditor for our first 12 years] and presented a meaningful proposal with solid support from Maurie Arvier [Inaugural Secretary], Bill Haseler [1st President of Council of Australian Weed Science Societies (C.A.W.S.S.)] and Selwyn Everist.

We are most grateful to Selwyn, one of our first Honorary Life members - since departed to his Garden of Eden. He reminded us that The Weed Society was for the benefit of all interested persons, not just weed scientists, and its success depended on the involvement in and interest offered to all, whether students, educators, contractors, farmers, sprayers, communicators, herbicide and equipment retailers, inspectors, semi and Government officers, researchers or any relevant person or organization. The main ingredients of the W.S.Q., as with any successful Society, are people and communications. Others forming the steering committee from April 1975 who drew up the initial constitution were Greg Harvey [Inaugural President, then Secretary 1977-84 and subsequently C.A.W.S.S. Secretary], John Rawson [Honorary Life Member] and Dr John Swarbrick who was Inaugural Editor of The W.S.Q. Newsletter which is recognized throughout Australia as the best communicator of relevant Weed Society information. John has been congratulated for his editorial efforts with the 'Australian Weeds' Journal by being presented with The Australian Weed Societies Medal.

OBJECTIVES - CO-ORDINATION

The original constitutional W.S.Q. aims have been maintained to advance the understanding and practice of weed control by:

> Promoting wider interest in weeds and their control + 7 other points listed under 'What Is A Weed Society?' in the attached 'Why Join? W.S.Q.' Brochure.

The profile of a weed society is based on its role as a link organization concerned with the many human endeavours affected by weeds realizing that weed societies may mean different things to different people (Johnston 1982b). This profile assists in generating larger membership, stimulating new weed societies or branches, and assisting in evaluation of projects of major interest to members.

ACHIEVEMENTS - GROWTH

There were three meetings at the beginning of each consecutive month before the first W.S.Q. Newsletter was produced in July 1975, when membership was 29. Under the leadership of the initial executive, 1975 and 1976 were years of consolidation as a Society with members developing a quest for knowledge extending outside the Society. Topics ranged from technical discourses, industry products, conservationist's views, life in Central America while looking for Lantana insects, to growing herbs etc., which all served to broaden the mind and appreciation of other people's views (Jacobs 1984).

In 1977 and 1978 Andrew McCarron, a Director of Amalgamated Pest Control was President and ushered in successful field days with increasing involvement by private contractors and industry resulting in valuable learning experiences for us all. Successful socials, a car rally and water-skiing saw membership rise to 59. A survey of members indicated that general meetings should be held on the first Thursday evening of alternate months with executive decisions to be ratified at the A.G.M. Also that alternate months have public field days or social activities of interest to members' families with regular Newsletters to keep all, especially country members, informed of useful developments; which was duly done by our most prolific editor -Geof Jacobs. A further survey produced a members' priority list of 'Queensland's Worst Weeds'.

The period 1979 to 1980 was a time of acceptance with President John Whitehead's executive securing Queensland to host the 6th Australian Weeds Conference at Broadbeach. John is a very able professional who placed emphasis on application equipment availability, use and misuse, plus herbicide performance which was demonstrated at well attended field days and expositions. He went on to become C.A.W.S.S. President and the longest continuous serving executive member of W.S.Q. (1975 to 1987).

Charles Julian's management team of 1981 and 1982 successfully ran the Weeds Conference and associated Public Seminars on 'Weeds as Health Hazards', 'Weed Control' plus field trips and socials. It was an era of maturity with Chas taking the Society into community service with its initiation of The W.S.Q. - Technical And Further Education (T.A.F.E.) Courses in Weed Control for both Supervisors and Operators.

For 1983 and 1984 I had the pleasure of presiding over W.S.Q. and with our management team planned a programme of monthly events where members got involved, worked together, relaxed and learned together as a Society. We introduced book prizes for the best final year student's weed related project, which attracted 9 entries from 4 tertiary institutions. The first 3 day residential workshop on 'Woody Weed Control' at Gympie Forestry Training Centre attracted 43 delegates who each received the full proceedings and helped boost membership to 116.

Clynton Wells organized this and another Urban Weeds' Workshop in 1986 as well as many useful field days. Clynt balanced meeting with the 'Preservationists' with true Conservation while president in 1985. He was presented with the inaugural W.S.Q. Medal Award for his invention of the splatter gun at our A.G.M. during the 'Water Weeds Management Workshop' at the end of 1988. Clynt also introduced the first draft of the attached 'Why Join? W.S.Q.' Brochure which sets out other activities.

President Bert Arends, during 1986 and 1987 finally managed to form branches of W.S.Q. to cover the Darling Downs-Lockyer (D.D.-L.) and later North Queensland with a resulting increase in regional activities boosting membership in these areas. Besides the workshops mentioned above, the W.S.Q. has sponsored, with Department of Education approval, School Field Days for groundsmen, teachers, P. & C.s and others interested in maintenance of vegetation management. Two seminars have been held at Wollongbar in northern N.S.W. with the latest on 5th March 1987 on 'Community Pest Plants and their Control' being cut short by rising flood waters breaking a period of drought and stranding a number of Society members. At the earlier seminar organized jointly by the W.S.Q. and the Weed Society of N.S.W. a resolution was passed which resulted in a quickening of C.S.I.R.O. allowing us to distribute Salvinia insects throughout both States which is helping lessen problem infestations.

In March 1988, during the Presidency of Greg Fraser (who has recently resigned due to his promotion within I.C.I. to Melbourne), a very successful 'Wild Oat Seminar' was conducted by the D.D.-L. Branch of W.S.Q. chaired by Rob Scott, who has just taken over as President of the W.S.Q. executive. By offering a discount to members attending this Seminar along with the attached 'Why Join? W.S.Q.' Brochure, many new members saw the benefits and decided it was worth joining up - thus boosting our membership to over 200.

FUTURE - HOPE

A recent questionnaire, originating from C.A.W.S.S.' concern over South Australian dwindling Weed Society activities and membership voting to be incorporated by the Crop Science Society of South Australia and Western Australian members considering a Plant Protection Society, has been sent with a covering explanation to all W.S.Q. members. Results of this Queensland survey of members are:-

1. Weed Societies should retain control of their own destiny; Weed Science and Weed Control are seen as an integrated discipline but pathology and entomology are considered separate.

2. Recruiting new members is an advantage.

3. W.S.Q. is seen as having a good mix of activities, but geographic isolation puts central Queensland and western Queensland at a disadvantage [possible future Branch regions].

4. We should be more involved with education and should try for a higher public profile by entering the pesticide debate controversy.

5. Important issues to be addressed are:

   (a) Integrated pest management
   (b) Soil/water residues

6. Other important issues are:

(a) Development of strategies to reduce herbicide use
(b) Use of adjuvants
(c) Economic thresholds and weed economics
(d) Herbicide application
(e) Training of applicators and extension staff
(f) Development of bio-herbicides
(g) Herbicide evaluation
(h) Study of herbicide resistance

General Comments:

(a) There should be a greater amount of work done; however time, individual input and financial constraints limit this.
(b) Possibly the effort should be both state and nationally sponsored.
(c) Training of applicators should be compulsory and include licensing.
(d) Applicators should be regularly checked and there should be refresher courses.
(e) Farmer education is equally important (Arends, 1989).

Increasing interest has been generated from people working with weeds in the Northern Territory. The idea of a N.T. Branch of the W.S.Q. has been discussed as an interim move towards starting a full Weed Society (Fraser, 1989). During the Australian Weeds Committee meeting in Darwin later this year, this proposal can be followed up.

W.S.Q. hopes to organize and run the 1993 Asian-Pacific Weed Science Society (A.P.W.S.S.) Conference somewhere in Queensland.

Geof Jacobs has the final say - 'My involvement with W.S.Q. has been most rewarding ..... This friendship has extended into the area of professionalism, allowing me to play a positive role in a number of projects involving improved application techniques and safer use of herbicides ..... I believe that all members, in both their job and Society involvement, have become more conscious of weeds and weed control being only one part of an objective to preserve or create the most desirable ecological situation. As Society members, we are conscious conservationists. To not only all executive members, past and present, but to all members, I congratulate you all on your support which has made the W.S.Q. a solid organization making a meaningful contribution to an important aspect of industry' (Jacobs 1984) .... 'I see the role of the Weed Society as a continuing filter for information and an effective arbitrator in providing rational judgements for sensitive herbicide issues .... To all members who are so well supporting the objectives of the Society, could I encourage you to encourage others, to join, communicate and broaden knowledge in the increasingly important role to be played by the [Weed] Society.'

References:

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Johnston, A.N. (1982a) Australian Weed Societies - Up to the eighties and beyond Part 1. 'Australian Weeds' Vol. 1, No. 4, 17-19.

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WHAT IS A WEED SOCIETY?

The Weed Society of Queensland (W.S.Q.) is an organisation of people who share an interest in weeds and their control. These people may be farmers, scientists, contractors, students, educators, government and council employees, operators, equipment suppliers, communicators, chemical company representatives, herbicide retailers or any interested person or organisation. The Society serves as a forum where these people can meet and share their problems, experience and knowledge.

The Society aims to advance the understanding and practice of weed control by:

- promoting wider interest in weeds and their control
- providing opportunities for those intersted in weeds and their control to exchange information and ideas based on research and practice
- encouraging the investigation of all aspects of weeds and weed control
- encouraging the study of weed science and the dissemination of its findings
- encouraging education in weed science and weed control
- producing and publishing such material as may be considered desirable
- co-operating and, where appropriate, affiliate with other organisations engaged in related activities
- fostering the development of an Australia-wide Weeds Organisation

With these aims and a wide membership the Society can play a valuable role in the field of weed control in Queensland.

WHAT DOES THE SOCIETY DO?

The Society is engaged in a variety of activities:

- The Society holds evening meetings to give the opportunity for members to discuss issues and hear a range of guest speakers.
- New products and equipment Expos are held annually to keep members abreast of the latest technological developments.
- Field days on various topics are held for members to see and gain an understanding of different facets of weed control.
- Public field days are held on various subjects. The Society co-ordinates these days and acts as a neutral source of information.
- Workshops and seminars are held periodically. These are a forum where workers in a particular field can discuss a specific topic.
- The Society is directly involved in conducting TAFE weed control courses in improving education for both operators and supervisors.
- The Society holds at least one social event each year.
- The Society produces a newsletter four times a year for issue to all members.
- The Society presents an annual student prize for final year projects on any aspect of the study of weeds.
- Besides W.S.Q. based in Brisbane, branches have been established to cover Darling Downs-Lockyer and North Queensland activities for members.
- The Council of Australian Weed Science Societies organise triennial conferences and present medals for meritorious service.
- W.S.Q. introduced a Grant to provide financial assistance to workers involved in Weed Science compatible with the Society's objectives.

- W.S.Q. recognizes and rewards outstanding contributions to any aspect of Weed Science in Queensland with an appropriate Medal Award.

HOW TO JOIN

The Society welcomes as members all persons and organisations interested in weeds and weed control. Membership entitles you to participate in all activities and to receive the newsletter. A copy of the Society's constitution can be provided at your request.

If you wish to join please fill in the details below and return. Cheques should be made out to "The Weed Society of Queensland" and marked "non-negotiable". Membership is currently $12-00 per calendar year, which is Tax Deductible, and there is a joining fee of $1-00. Full-time students pay a nominal $5-00 per year.

I hereby apply for membership in the Weed Society of Queensland.

Surname and Initials:

____

First Name (that you prefer to be known by):

____

Occupation (be as descriptive as you like as it could lead to contact from other members):

____

____

Employer (or name of your own business):

____

Work Address: ______________

____

Work Phone No: ______________

Postal Address for W.S.Q. Mail (if different from above):

____

____

____

The Secretary
The Weed Society of Queensland
P.O. Box 36
SHERWOOD Q 4075

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.

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.

Results of Bitou bush control trials

Location: Moruya

(Date: 15.4.1985)

Control after 13 months

Treatment (herbicide water)	Ratio (%)	Control	Comments
Roundup (R)	1:10	100	Very low volume (LPG gun)
(glyphosate)	1:20	100	–"–
	1:20*	100	–"– * (sea water)
	1:40	95	–"–
	1:100	100	High volume
	1:200	95	–"–
Krenite (R)	1:10	40	Very low volume (LGP gun)
(fosamine)	1:20	28	–"–
	1:20*	40	–"– * (sea water)
	1:40	8	–"–
	1:100	77	High volume
	1:200	76	–"–
Garlon (R)	1:20	80	Very low volume (LPG gun)
(triclopry)	1:40	73	–"–
	1:40*	79	–"– * (sea water)
	1:80	71	–"–
	1:480	88	High volume

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	–"–

Location: Jervis Bay
(Date: 8.4.87)

Experiment No. 1

Control and Regrowth after 13 months

Treatment	Ratio herbicide to water)	Control %	Regrowth %	Comments
Roundup(R) (glyphorate)	1:30	50	69	LPG gun
	1:40	33	90	-"-
	1:50	10	96	-"-
	1:50*	64	55	-"-*(Pulse(R)2ml/L)
Brush-off(R) (metasulfuron)	1.0 g/L	100	Nil	-"-
	0.5 g/L	88	21	-"-
	0.5 g/L*	88	14	-"-*Ultrawet(R)2mL/L
GGA-131036 Code No Ciba-Geigy	1.0 g/L	64	71	-"-

Note: Very heavy rain (50 mm) fell few hours after application.

Location: Jervis Bay
(Date: 9.12.1987)

Experiment No. 2

Control and Regrowth after 9 months

Roundup(R) (glyphosate)	1:30	100	Nil	LPG gun
	1:40	94	6	-"-
	1:50	96	5	-"-
	1:50*	84	23	-"-*(Pulse(R)2mL/L)

Note: Due to rain other treatments were not applied.

Location: Jervis Bay
(Date: 16.12.1987)

Experiment No. 3

Control and Regrowth after 9 months

Roundup(R) (glyphosate)	1:30	100	Nil	LPG gun
	1:40	100	Nil	-"-
	1:50	98	1	-"-
	1:50*	99	<1	-"-* (Pulse(R)2m/L/L
Brush-off(R) (metasulfuron)	1.0 g/L	100	Nil	-"-
	0.5 g/L	100	Nil	-"-
	0.5g/L*	100	Nil	-"- * (Pulse 2mL/L)

Note: This experiment was set up as a pair for the 1st testing of tolerance of native species.

Location: Jervis Bay
(Date: 21.6.1988)

Experiment No. 4

Control and Regrowth after 7 months

Roundup(R) (glyphosate)	1:30	100	Nil	LPG gun
	1:40	100	Nil	-"-
	1:50	100	Nil	-"-
Brush-off(R) (metasulfuron)	1.0 g/L	100	Nil	-"-
	0.5 g/L	100	Nil	-"-

Note: Light rain (3mm) fall shortly after application.

Location: Jervis Bay
(Date: 22.6.1988)

Experiment No. 5

Control and Regrowth after 7 months

Roundup(R) (glyphosate)	1:30	100	Nil	LPG gun
	1:40	100	Nil	-"-
	1:50	100	Nil	-"-
Brush off(R) (metosulfuron)	1.0 g/L	100	Nil	-"-
	0.5 g/L	100	Nil	-"-

Note: This experiment was set up as a pair for the 2nd Testing of tolerance of native species.

Tolerance of native spp. to Roundup(R) glyphosate) and Brush-off(R) (metasulfuron)

Location: Jervis Bay.
(Date: 17.12.1987)

Experiment No. 1

Damage to native spp (%)

Native Species	Roundup(R) (1:30)				Brush-off(R) (1.0 g/L)			
	2	5	9	14	2	5	9	14
	months after treatment							
Casuarina	16	14	4	0	76	58	61	60
Coastal heath	38	43	36	28*	90	100	100	100
Coastal tea tree	55	65	75	69	21	21	16	15
Coastal wattle	35	50	49	34	10	5	<1	0
Banksia	59	73	71	70	26	28	25	20
Beard heath	23	38	33	26	48	83	75	64
Lanandra	45	52	48	45	25	26	30	30

* 1 replicate dead, 3 replicates O.K.

Location: Jervis Bay.
(Date: 22.6.1988)

Experiment No. 2

	Ration to water)	% Damage Coastal tea tree		Coastal wattle		Banksia		Lanandra	
		2.5	7	2.5	7	2.5	7	2.5	7
		months after treatment							
Roundup(R) (glyphosate)	1:30	<1	33	16	2	25	12	0	0
	1:40	<2	15	7	<1	12	4	0	0
	1:50	<1	15	7	<1	<2	0	0	0
Brush-off (R) (metasulfron)	1.0 g/L	19	13	2	<1	16	6	<1	8
	0.5 g/L	6	4	1	0	10	6	<1	7

BITOU BUSH CONTROL: BIOLOGICAL CONTROL AND THE BITOU BUSH WORKING GROUP

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INTRODUCTION

Bitou bush (Chrysanthemoides monilifera ssp. rotundata) is an invasive weed of South African origin, confined largely to the coastal zone of eastern Australia. The problems of bitou invasion include: displacement of native plants and animals; long term destabilisation of sand dunes; and altered visual character of the coastline. Bitou bush, and bitou problems, are well documented in the literature (eg. Cooney et. al., 1982; Love and Dyason (eds), 1985; Stanley, 1986).

This paper describes the current status and control of bitou bush in New South Wales, the activities of the NSW Interdepartmental Working Group on Bitou Bush, and progress towards development of biological controls for the species.

BITOU BUSH IN NSW: CURRENT STATUS AND CONTROL

Status

Aerial surveys by the NSW National Parks and Wildlife Service in 1981 and 1982 showed bitou bush to be distributed along some 60% of the coastline. Using this survey and a partial resurvey in 1984, Love (1985) predicted that bitou bush would spread to occupy over 90% of the coastline by the year 2010 and would dominate the native vegetation along two thirds of the coastal fringe. These predictions appear to be supported by a more recent statewide survey by the Soil Conservation Service of NSW (Bergs, 1986) which, while excluding headlands from the survey, suggests significant increases in both the distribution and density of bitou since 1981-82 (see Stanley et. al., 1989)

Chrysanthemoides monilifera is classified as "noxious" under state laws in Victoria, Western Australia, South Australia and Queensland, but **not** in NSW or Tasmania.

Control

Bitou bush is generally restricted to non-agricultural environments, as it is controlled by cattle grazing and by cultivation. Hence the techniques and incentives available to control weeds of agriculture are generally absent for bitou bush.

Love (1985) conducted a survey of bitou bush control programmes current in NSW in 1984, which highlighted the dominant role of state government authorities in bitou control at that time. They ran 40% of all programmes, covering 70% of the total length of coastline subject to control activities, indicating the relatively large scale of the government's projects. In comparison, local government ran 40% of all programmes covering 20% of total length, while volunteers ran the remaining 20% of programmes covering 10% of total length.

While more recent survey information is not available, it is suggested that there has been a significant shift in responsibilities for bitou bush control in NSW since Love's survey. In the early 1980's state and local governments had considerable funds available through employment programmes and a number of large projects incorporating bitou bush controls were undertaken with this money. Soil Conservation Service of NSW projects at Harrington and Windang are examples of those large scale projects. These funds have since become unavailable, and with government finances generally much tighter there has been a shift away from government funded control towards volunteer-based programmes, which however are often supported by state and local government authorities.

A formal mechanism for state government support of voluntary bitou bush control programmes has been developed by the Soil Conservation Service through its Community Dune Care Programme, launched in 1988 by the Minister for Agriculture and Rural AFfairs. Under this programme the Soil Conservation Service provides technical, administrative and promotional support to community groups working on the care and management of beach dunes along the coastline.

Bitou bush control and dune rehabilitation are important activities with most Dune Care Groups. These activities are often supported by the contribution of funds or materials and equipment by local councils and the Lands Department. Since the inception of the Dune Care Programme early in 1988 a total of 16 groups have established statewide. North coast groups and their bitou bush control activities are listed in Table 1.

Volunteer-based control of bitou also occurs in the National Parks and Wildlife Service coastal lands, with the parks service making similar supporting contributions to those of other authorities as described above. A good example is that of the National Parks Association, Mid North Coast Branch which in May 1989 completed 10 years of bitou control on Diamond Head in Crowdy Bay National Park. In that 10 year period annual working bees have removed 10,000 plants, significantly reduced the proportion of large mature bushes in the population, and kept the bitou infestation in check. According to Dodkin (pers. comm.) the work has allowed the parks service to retain the basic integrity of the headland as a highly significant conservation site in the park.

Table 1:

Community Dune Care Groups and Bitou Bush on the NSW North Coast

Community Dune Care Group	**Bitou Bush Control Programme**	**Government Support of Control Programme*** State Govt.	Local Govt.
Fingal Head	Yes	No	No
South Golden Beach	Yes	N.A.	Yes
New Brighton	Yes	N.A.	Yes
Suffolk Park	Yes	N.A.	Yes
Patches Beach	No	—	—
Red Rock	Yes	Lands Dept.	N.A.
Safety Beach	Yes	No	No
Diggers Beach	Yes	N.A.	Yes
Scotts Head	Yes	Lands Dept.	N.A.
Hat Head	Yes	Lands Dept.	Yes
Goolawah Reserve (Crescent Head)	Yes	N.A.	Yes
Lighthouse Beach (Port Macquarie)	Yes	N.A.	Yes
Diamond Beach	Yes	Lands Dept.	Yes

* Funds &/or Materials &/or Equipment
N.A. – Not Applicable to the area

THE BITOU BUSH WORKING GROUP

In order to maintain the impetus of the Bitou Bush and Boneseed Conference held in Port Macquarie in 1984, representatives from several NSW government departments formed an Interdepartmental Working Group on Bitou Bush. The aim of the working group was to provide general support for bitou bush control activities.

The members of the group are:-

Agriculture and Fisheries: Robert Dyason

National Parks and Wildlife Service: Ashley Love
(with Mike Dodkin, an ex-officio member)

Soil Conservation Service: Roger Stanley

The working group's activities, which may be divided into the broad categories of extension and research, are described below:-

Extension Activities

1. Bitou Bush Control Handbook

A major objective of the working group was to produce a handbook which would provide a practical guide to all aspects of bitou bush control in NSW coastal environments. The handbook was In Press as this paper was prepared.

The handbook covers the following aspects of bitou bush: problems; biology; problem assessment and identification of priority areas for control; and control/rehabilitation techniques and costs.

The handbook does not provide specific recipes for control, but presents a range of techniques and ideas which can be used in developing site specific control and rehabilitation programmes. As expert on-site advice is strongly recommended, the Appendix includes a list of contacts where further advice can be obtained.

2. Field Days

The working group has staged 3 field days on the north coast. The first was to create a general awareness of the unique nature of the Diamond Head-Seal Rocks coastline, which the National Parks and Wildlife Service survey identified as being relatively free of bitou bush and hence a priority area for bitou control. The field day brought together state and local government representatives responsible for land management on this coastal stretch, together with National Parks Association and resident groups. As a result of the field day a detailed, landmark survey was planned (see Research Activities below), and the forerunner of the Soil Conservation Service's Diamond Beach Dune Care Group was established.

The second and third field days were held specifically to meet the needs of community groups. Demonstrations of control and rehabilitation techniques were given to Coffs Harbour based conservation group, The Ulitarra Society, which is co-ordinating a shire-wide control programme utilising a whole range of community organisations. A more general presentation to the Yamba Urban Area Committee aimed to assist local residents and the local shire council develop an approach to the bitou bush problem around Yamba.

3. Bitou Bush Poster

The working group has been instrumental in promoting the production of a poster on the problems of bitou bush. Ideas drafted by our National Parks and Wildlife Service members have been put to the Council of Conservation Ministers (CONCOM) Working Group on Bitou Bush and Boneseed, which is seeking poster sponsorship by chemical companies producing herbicides registered for use on bitou bush.

Research Activities

1. Bitou Bush Survey – Diamond Head to Seal Rocks

The working group considers this to be a landmark survey. Following the field day presentation outlined earlier, participating organisations contributed funds which the working group used to employ a consulting botanist to undertake a detailed survey and to make recommendations for management of the bitou problem on this coastline. The following clients contributed: Great Lakes Shire Council; Greater Taree City Council; Booti Booti State Recreation Area; National Parks and Wildlife Service; Department of Lands; Soil Conservation Service; Department of Agriculture and Fisheries; and the Public Works Department.

The survey report (Griffith, 1987) confirmed that bitou bush was threatening, or potentially threatening, to the survival or conservation values of 5 vegetation communities, 7 plant species and 8 landscapes. Based on the surveyed infestations and these threats, each individual infestation was assigned to one of three control priority groups as part of an overall management strategy for the coastline.

The working group has presented the report to a meeting of all clients, who expect it to become the primary planning document for development of bitou bush control programmes in the survey area. It has already been used in funding submissions by one government department.

2. Chemical Control Investigations

The working group has co-operated with the NSW Agriculture and Fisheries Weed Research and Demonstration Unit, Glen Innes, in the establishment of herbicide trials for both bitou bush and a range of off-target spp. common to coastal vegetation communities subject to bitou invasion (see McMillan and Strachan, 1988). As a result of these trials new herbicide registrations have been, or will be, made.

3. University Research

In an endeavour to support the limited research work undertaken by working group member departments, a list of research topics suitable for tertiary study was distributed to universities and colleges of advanced education. To date one study has been undertaken, on the invasion of Casuarina equisetifolia (horse tail oak) communities by bitou bush on the Tweed-Byron coastline.

4. Biological Control

The working group's involvement with current biological control research is outlined in the following section of the paper.

BIOLOGICAL CONTROL

Background

At the 1984 Port Macquarie conference on Chyrsanthemoides, several resolutions were passed in support of proposals to investigate the biological control of bitou bush. As a result a CONCOM Working Group on Bitou Bush and Boneseed was formed and funds were obtained from commonwealth, state and territory governments to commence a biological control research programme. The research programme was able to take advantage of an existing CSIRO Division of Entomology research programme in South Africa on the control of spiny emmex, run by Dr. John Scott. His presence in South Africa facilitated establishment of the programme and allowed some cost savings to be made.

Funding

Financial contributions for the programme have come from: the CSIRO; National Parks and Wildlife Services in Queensland, NSW, ACT, Victoria and SA; the Victorian Department of Conservation Forests and Lands; and the Soil Conservation Service of NSW.

Approximately $340,000 was provided for a 2.5 year programme, commencing January 1987 and terminating on June 30th, 1989. The value of contributions to the total budget by commonwealth, state and territory governments is as follows:-

Government	Value of Contribution (%)
New South Wales	30
Victoria	26
Commonwealth (CSIRO)	16
Queensland	10
South Australia	10
Australian Capital Territory	8
Total	**100**

Research Activities

The research programme involves a number of procedures:–

* **In South Africa**

  - survey and identification of potential control agents
  - rearing and export of agents

* **In Australia**

  - import and testing of agents
  - mass rearing
  - field release and monitoring

These procedures, together with current progress as reported by key research personnel Dr. Scott and Messrs. Field and Adair (Keith Turnbull Research Institute, Frankston, Victoria), are briefly outlined below.

Survey and Identification of Agents: Twelve study sites for Chrysanthemoides monilifera (bitou bush/boneseed) were selected in areas of South Africa similar to weed–infested areas in Australia. The sites have been surveyed regularly for potential biological control agents. Over 100 species of phytophagous (plant "eating") organisms, mostly insects, have been found and identified on the plant. Many insects appear suitable for use as biological control agents. Laboratory rearing and life cycle studies have been undertaken on the most promising species.

Import and Testing of Agents: Import permits have been granted for 5 species of insect, and application made for the importation of a further 2 species (see Table 2).

Target plant specificity and insect biology for all imported species is determined under strict quarrantine conditions at the Victorian Department of Conservation, Forests and Lands' Keith Turnbull Research Institute (KTRI). Specificity testing involves determination of each insect's impacts and ability to survive on 65 selected non–target plant species of economic and ecological importance. Testing has been completed for 2 insects (Table 2), both found to be specific to Chrysanthemoides.

Mass Rearing: Mass rearing of insects is necessary to build up sufficient numbers to allow field release work to proceed. The current programme budget does not allow any mass rearing to be done, as priority must be given to allocation of existing resources to the testing work.

To overcome this problem the CONCOM Working Group has proposed continuing the research programme for a further 4 years, to June 1993. It has asked all current contributors for additional funds to permit the continuation, which would allow both testing and mass rearing work to proceed in parallel. Mass rearing for coastal areas north from Sydney was proposed to be undertaken at the Queensland Department of Lands' Allan Fletcher Research Station, Brisbane, and for areas south from Sydney at KTRI. **Failure to secure the necessary additional funds could jeopardise the whole programme.**

Field Release and Monitoring: Ideally each insect passing the test procedures should be released over as wide a geographical range as possible. To date only one insect, Comostolopsis germana (bitou tip moth) has been released. Because mass rearing has not been possible, only 400 larvae were released at just one location, on the Tweed Coast of NSW.

Monitoring of the field release of insects will be undertaken by individual state and territory authorities. In the case of the bitou tip moth, the NSW Interdepartmental Working Group has agreed to co-ordinate monitoring work, with regular observations being undertaken by local Soil Conservation Service staff and a community volunteer.

Table 2:
Bitou Bush/Boneseed Biological Control Programme, 1989–92*

Potential Control Agent Scientific Name	Common Name	Impact on Plant	Import/ Testing	Field Release #
1. Coastal Areas North from Sydney.				
Comostolopsis germana	Bitou Tip Moth	Larvae eat new leaves and growing tips.	Completed	13/3/89
Ageniosa electoralis	Leaf Eating Beetle	Larvae and adults eat leaves.	3/89 on	9/90
Mesoclanis magnipalpis	Seed Eating Fly	Larvae feed in seeds.	June–Sept 1989 on	3/92
*Eriophyid** *	Mite	?	1990	?
*Pyralid** *	Moth	Larvae destroy fruits.	1990	?
2. Coastal Areas South from Sydney.				
Chrysolina progressa	Leaf Eating Beetle	Larvae and adults eat leaves.	Completed	9/89
Chrysolina hebe	Leaf Eating Beetle	Larvae and adults eat leaves.	Current	3/90
Mesoclanis dubia	Seed Eating Fly	Larvae feed in seeds.	June–Sept '89 on	3/92
Chrysolina dissoluta	Leaf Eating Beetle	Larvae and adults eat leaves.	Dec. '89 on	9/90
Cassic sp.	Leaf Roller	Larvae eat leaves	1990	?
Un-named	Gall Weevil	Galls on	1990	?

*Cerambycid***	Gall Insect	Galls on woody parts	1990	?
*Halticid***	Flea Beetle	Shot holes on leaves	1990	?

* Subject to continued funding
\# Subject to satisfactory test results
** Family only, agent un-named

Biological Control Summary and Future

In just 2 years the programme has seen 7 insects selected, 2 tested and 1 released. While this is seen as somewhat remarkable progress for biological control investigation, programme scientist Dr. Scott sounds words of caution, as only some 25% of all biological control projects succeed.

For this programme to succeed, Dr. Scott believes that at least 10 effective agents should be released, ideally with roughly equal numbers suitable for sub-tropical (north of Sydney) and temperate (south of Sydney) climates. In addition to those agents listed in Table 2, a large range of other potential agents occur in South Africa including root feeders, gall midges, spittle bugs, leaf miners, scale insects and fungal pathogens. **To release at least 10 different agents the programme must be allowed to continue beyond 1989 through provision of additional funds.**

Furthermore even if this number of agents can be released, conventional control techniques may still need to be implemented in conjunction with bio-controls if the bitou bush problem is to be effectively managed. The requirement for other controls will depend on the effectiveness of biological controls. **Certainly active rehabilitation of many areas will be necessary to prevent erosion and the invasion of other weeds.**

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PROGRESS IN THE CHEMICAL CONTROL OF ALLIGATOR WEED

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(Paper presented by G. McCorkelle)

INTRODUCTION

Alligator weed is an alien noxious plant (one of four listed in Tier I by the National Co-ordinating Committee on Aquatic Weeds). It occurs in several thousand hectares of damp pasture near Williamtown, New South Wales. The terrestrial form of the plant is not susceptible to biological control and is very difficult to manage using herbicides. It spreads very rapidly, and is a threat to irrigation systems and to the ecology of rivers and wetlands.

The objective of the project is to devise a strategy for the management of the weed by:

* exploring chemical control methods by screening a wide range of potentially useful herbicides,
* investigating the physiology of resistance with detailed studies of uptake, translocation and degradation of selected herbicides,
* integrating chemical and non-chemical methods (e.g. grazing, cutting and pasture establishment).

HERBICIDE SCREENING

Seven small-plot field trials were established in the Raymond Terrance area as follows (mostly in triplicate):

1. Lavis Lane, Williamtown. Fifty three treatments were applied. Initial treatments were applied in autumn, during 3 visits between 7 April and 28 May 1987.

   Selected treatments were oversprayed in late spring (early December 1987)

2. Fullarton Cove site, off Nelson Bay Road.

   a. Additional autumn treatment of dichlobenil and glyphosate/dicamba were made.

   b. Late summer treatments (3 Feb 1988 included glyphosate (with or without ammonium sulphate additive at high volume); also OUST (sulfometuron methyl); dichlobenil; and HOE 704.

   c. Treatments were applied in spring (9 Nov 1988). Glyphosate at high volume was compared with controlled droplet application (with and without oil); and metsulfuron/glyphosate mixtures. Also STARANE (fluoxypyr) was used with and without 2,4-D.

d. A pasture establishment trial was laid down using larger plots each 4.25 x 10 m in duplicate. Treatments included dichlobenil, bensulfuron, metsulfuron, metsulfuron/glyphosate and bensulfuron/glyphosate. Treatments were applied in autumn (14 Feb 1989), and cultivated and planted 5 weeks later with a Clover, Setaria, Kikuyu mixture (except for bensulfuron and bensulfuron/glyphosate mixtures where treatments had not given sufficient reduction in top growth to allow working).

e. Diquat treatments were also applied on 14 Feb 1989 to scorch the weed and stimulate new growth prior to application of the following treatments on 21 March 1989: bensulfuron, metsulfuron, dichlobenil or diquat.

3. Motto Farm, Raymond Terrace.

a. Again in spring (8 Nove 1988), we compared the sulfonyl ureas sulfometuron-methyl: bensulfuron; chlorsulfuron, metsulfuron.

b. A larger-plot pasture establishment trial was established by initial application of dichlobenil; glyphosate/dicamba with PULSE; and OUST (sulfometuron-methyl).

4. A pot trial was established in a secure, caged, outside nursery at Griffith. The most promising herbicides to date (glyphosate, metsulfuron, fluoxypyr, imazapyr, glyphosate/metsulfuron, sulfometuron methyl, bensulfuron, dichlobenil and bensulfuron) were applied to 8 replicate pots of well-established weed. Some pots will be oversprayed with a later "scorching" treatment, and half will be planted out with pasture species.

Altogether at least 100 different combinations of herbicides were used (Appendix 1).

RESULTS

1. Use of glyphosate

The prospects for improving the performance of glyphosate was investigated because of the use of this compound for control of many other deep-rooted perennial species. Its other potential advantages include excellent toxicology and inactivation in the soil, allowing pasture establishment soon after weed control.

Strategies investigated included:

* Use of diquat to desiccate top growth and stimulate dormant buds prior to glyphosate application.

* Stimulation of meristematic activity by applying various hormone herbicides in combination with glyphosate.

* Adjustment of timing of application. (General knowledge about the ideal treatment for other species is that autumn treatment should be optimal, since the herbicide is carried downwards to the storage

organs as they are formed prior to overwintering). At Lavis Lane, glyphosate was applied in Autumn (7 April to 28 May) and over the top of previous (regrown) treatments in late spring (Dec 1987); and at Fullarton Cove in late summer (22 Feb 1988). Autumn treatments give longer term control, but this may reflect the natural winter dieback and slower growth at low temperatures, rather than more efficient downward translocation.

* The use of additives (ammonium sulphate) and wetters ('PULSE') were investigated at Fullarton Cove in late summer; diquat was also used before applying glyphosate with Pulse additive one month later.

* High volume and controlled droplet application (CDA) were compared at Nelson Bay Road, with application in November. CDA and high volume treatments with and without oil were compared. Results were poor perhaps reflecting the spring application and dryness of the site.

  Unfortunately, none of the treatments gave anything better than a short term setback.

2. Other herbicides

Hormone compounds alone (dicamba; 2,4–D; picloram/2,4–D; clopyralid all gave poor results.

Several herbicides gave top scorch which lasted from autumn treatment to the following spring (mid-September) including imazapyr, sulfometuron-methyl, metsulfuron and dichlobenil.

Of these, only dichlobenil and sulfometuron methyl gave reduction in top growth lasting through to mid-December (Table 1).

At Lavis Lane reduction in underground biomass was measured in 2 Feb 1988 (35 weeks after the initial treatment in April/May 87 and about 2 months after the overtreatment on 1 Dec 87). Viability of fragments was also obtained by chopping into segments between the nodes, and regrowing in potting soil.

Results showed poor control by glyphosate and glyphosate/chlorpyralid. Although imazapyr gave bare ground, viable root fragments were plentiful.

Table 1. Lavis Lane
Treated: April–May 1987 and Dec 1987
Cores: collected 2 Feb 1988

	Underground Biomass kg/m2	Viable fragments No./m2	Tops Scores % kill
Glyphosate*/ chlopyralid	33	8000	94
Sulfometuron	2	500	97
Imazypyr	39	6900	93
Dichlobenil	4	1800	83
Glyphosate**	9	3100	62
	46	24200	0

* 3 L/ha product Roundup; 1.1 kg/ha glyphosate
** 9 L/ha product Roundup; 3.3 kg/ha glyphosate

DISCUSSION

Factors which need to be considered

1. Moisture content of the soil at treatment

It is generally acknowledged that most herbicides work best when plants are actively growing, in moist soil. This seems to be particularly the case for sulfonyl urea herbicides, and may explain the erratic performance of metsulfuron methyl, good results being obtained at Lavis Lane but poor results at Fullarton Cove and Motto Farm.

2. Timing of Application for the foliage-applied translocated herbicide glyphosate is expected to be optimal as senescence begins, and assimilates are transferred to the storage organs. Alligator weed, left ungrazed, appears to flower and senesce much earlier that grazed swards; and we suspect from the appearance of the plant that this occurs mid-summer rather than autumn. Critical information is required on the interaction of temperature, water status of the soil, cutting/grazing, and day length on this process of senescence, and associated translocation of assimilates and herbicides.

The growth and development of Alligator weed is very sensitive to both temperature and photoperiod, and an understanding of its response to these factors is therefore important in relation to the timing of herbicide sprays for maximum effectiveness. In a glass house study which varied both minimum night temperature and photoperiod, shoots were produced more rapidly and in greater numbers when the night minimum was

20 degrees celcius than when it was 15 degrees celcius, while production was least at a night of 10 degrees celcius. When the higher night temperature was combined with a long day (16 hours), given during late winter and early spring by supplementing natural daylength with tungsten lamps, growth and development was very rapid. The number of nodes per stem, the length of the internodes and the size of the leaves were all greater than with natural daylengths and the shoots grew vertically rather than the horizontal habit shown under natural days. These effects of long days were also evident but not quite so marked with night temperatures of 15 degrees celcius and 10 degrees celcius. Flowering was also controlled by daylength – no flowers formed under natural days until the daylength had reached about 12 hours as spring progressed, while all plants with a 16 hour daylength initiated flowers and their development was most rapid at the higher temperatures. No flowers have been known to form viable seed in Australia, but flowering appears to be a natural part of the developmental cycle and the plants which flowered the most were the first to senesce and die back in the late summer.

These results suggest that the warmer the climate the greater is the potential hazard posed by Alligator Weed should it get into water bodies or damp pastures, and that the time of maximum effectiveness for herbicidal sprays will also vary according to the climate. The latter aspect is still being studied.

3. Grazing/cutting seems to affect the time of senescence of the plant. Also the above-ground biomass of the grazed sward appears to be an order of magnitude less than the ungrazed sward (Data is being collected at the Fullarton Road site). The ratio of above-below ground biomass may be affected by grazing, and in turn affect the susceptibility of the plant to chemical control.

4. Spray volume: leaf area ratio.

Literature reports suggest that glyphosate is more effective, for the same rate of treatment per unit ground area, as the concentration in the spray droplets increases. Therefore CDA (droplets of smaller, constant size applied at 1 l/ha) should be more effective than conventional high volume spraying 400 L/ha (more variable droplet size, of larger average surface volume). However, this does not take into account the enormous leaf area of ungrazed swards, so that spray droplet distribution becomes extremely sparse.

For example, leaf coverage from CDA application is tiny: assuming a spray application of 1 L/ha and spray droplet volume of 0.02 L/drop. This is 50 x 106 droplets/ha or 5000 droplets/m2. Ungrazed swards contain approximately 4000 stems/m2 so that a CDA application would give a very sparse distribution of droplets indeed.

5. Comparison of laboratory experiments and field conditions.

One of the experimental difficulties of using radioisotope labelled material is that only small plants can be used – otherwise dilution of the label requires the application of large quantities of label to the leaves, making experiments very expensive. We know very little about the networking of the underground thickened roots in the field. Some underground parts are very woody, so may behave differently from the newly-formed underground rhizomes of smaller individual plants used for experimental purposes. The use of "cold" analytical methods for glyphosate, or application of C-14 labelled carbon dioxide to tagged plants in the field may help to overcome these difficulties. (It would be assumed that labelled sucrose would mimic the movement of glyphosate).

6. Competition effects

At Lavis Lane quite different long-term effects were obtained for the same treatment in different blocks depending on associated plant species. In plots containing pure stands of Alligator Weed the weed regrew luxuriantly after it was scorched off but where plots initially contained an understorey or mixture of wetland species, sedges and rushes, they were able to assume dominance after the weed was suppressed.

Similarly at Motto Farm, bensulfuron appeared more effective where couch and kikuyu were more abundant and were able to suppress the Alligator Weed's regrowth.

Existing grasses have taken over plots treated with dichlobenil at Motto Farm in pasture establishment trials; however, the Nelson Bay Road plots require seeding because of the complete dominance of the weed.

7. Uptake and fate of glyphosate and bensulfuron in Alligator weed. Basic data is being obtained using C-14 labelled compounds, to investigate how the herbicides are taken up into the leaf, translocated, and degraded inside the plant. Initial results from this work suggest that for glyphosate the problem is not one of uptake and translocation since a substantial proportion of the herbicide reaches the rhizome.

FUTURE PROSPECTS

Compounds giving top scorch

So far we have only obtained temporary scorch with glyphosate (as with other herbicides including metsulfuron, imazapyr and fluoxypyr).

With glyphosate we have not managed to improver performance dramatically by any of the strategies investigated so far. Best top scorch is given by an autumn spray. Therefore , success may well depend on obtaining good pasture establishment following treatment. Also, there may still be scope for fine-tuning glyphosate application in relation to:

- ratio of above to below ground biomass
- above ground surface area and application volume
- timing of translocation of assimilates to the root system
- use of other additives (e.g. chelating compounds).

The literature suggests that for other species best results should be obtained using high concentration spray application. Our results with CDA were poor, but application was in spring under dry conditions.

Sulfonyl urea compounds

Sulfometuron–methyl gave good long term performance at Lavis Lane and Fullarton Cover when used in autumn but this herbicide has tocicology disadvantages, and would be difficult to register. The related herbicide, bensulfuron methyl, which is widely used for weed control in rice, deserves further investigation.

Dichlobenil

Dichlobenil has consistently given excellent results. It allows reinvasion of grasses following treatment. Because it evaporates rapidly from wet soil at high temperature, its behaviour in the soil in contrasting conditions may warrant further work, in order to assess reliability in other years.

A promising strategy

Demonstration plots have been established at Motto Farm and Fullarton Cove. Most promising results have been obtained with dichlobenil.

At Motto Farm dichlobenil was used in autumn alone, and existing grasses re–established well. The plot was later oversprayed with metsulfuron to deal with the few shoots of weed which escaped.

At Fullarton Cove the weed was almost elimated with a spray sequence of diquat in autumn, followed by dichlobenil applied 4 weeks later. Next spring, we plan to overspray (if necessary) with metsulfuron and/or glyphosate prior to seeding.

These treatments are clearly extremely expensive. However, it may be possible to reduce costs using other formulations of dichlobenil (a low concentration granule is being used at present).

ACKNOWLEDGEMENTS

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APPENDIX 1

Chemical Name	Product Name
glyphosate	ROUNDUP
ethephon	ETHREL
2,4–D amine	AMICIDE
2,4–D ester	ESTERCIDE
clopyralid	LONTREL
dicamba	BANVEL
triclopyr	GARLON
picloram + 2,4–D	TORDON 50D
amitrole	WEEDAZOL
hexazinone	VELPAR
imazapyr	ARSENAL
chlorsulfuron	GLEAN
metsulfuron methyl	BRUSHOFF
sulfometuron methyl	OUST
bensulfuron methyl	LONDAX
–	LOGRAN
–	HARMONY
–	EXPRESS
–	MATRIX
diquat dibromide	REGLONE
fluoxypyr	STARANE

PROGRESS IN CONTROL OF ALLIGATOR WEED

Presented by Ken Bunn
C.W.O. Port Stephens Shire Council

Before dealing with the main topic of this paper I feel that a brief outline of the current status of Alligator Weed should be made.

As many of you know, Alligator Weed has been in New South Wales since the mid 1940's. Thankfully due to the plant not producing viable seeds the spread has been slow with new infestations and existing infestations becoming bigger due to man either transporting viable pieces of the plant accidentally or on purpose in various ways.

On current information there is approximately 2,000 hectares of land infested with Alligator Weed. This has not increased dramatically in the last two years since the conference at Hawkesbury, but new infestations have been found and some of these are in areas where unless contained, and ultimately eradicated, they could cause serious problems within a short time.

The potential of Alligator Weed to become a major weed of Australia is a real threat. If you look at the map (figure 1) it can be seen that Alligator Weed can grow successfully in almost a third of the continent. This would not only have a detrimental affect to our native environment, but could cause serious economic loss to Australian agriculture.

Despite the resilience of Alligator Weed and its apparent ability to stop herbicides fully translocating through the plant, I feel that it is possible to firstly contain the infestations and in some cases eradicate them. I clarify this statement by saying that it is not something that can be done overnight, it takes patience, perseverance and co-operation.

The avenues available for controlling Alligator Weed are:

Transportation

Infestations are caused primarily by the transport of viable pieces of the plant by various means. To combat this, changes have been made to Ordinance 50 (Part 22) of the Local Government Act making it an offence to transport pieces of the plant. Port Stephens Shire Council has implemented a programme where machinery such as traxcavator and backhoes working in known areas of Alligator Weed will have a sticker attached (figure 2) stating that the equipment must be inspected before removal. Certificates will be given if they are clean, if not the machine must be washed down and the track and track carriages should be sprayed with diesel. With regard to other means of transport such as in turf, again inspections and certificates (figure 3) will be issued.

New Infestations

When new infestations are found, providing they are small and they have not developed the massive root structure which is typical of old infestations, they should be treated by excavation of the site (if possible) to a depth of at least 250 mm below the root zone. The excavation should then be treated with dicamba granules and re-filled. Excavated material containing Alligator Weed should be taken to an area where it can be buried with a minimum of 2 m of soil over the top of it.

It may also be advantageous to treat the excavated material with a residual herbicide before burying. If it is not possible to excavate, it may be possible to treat the infestations by using one of four herbicides covered by pesticide orders (figure 4). The main point being that frequent inspections and treatments will be required to ensure that they are being contained and controlled.

Existing Infestations

Alligator Weed has the ability to establish quickly, building up a strong root structure within a short period of time. Due to this fact, herbicide control of well established plants has not been very successful. It is possible to obtain a reduction in density and regeneration of grasses by using the Dicamba plus MCPA herbicides. We have found that three applications during the growing season will reduce Alligator Weed considerably but unless follow-up applications are made the following season it will eventually become dominant.

CONCLUSION

Despite the measures available, unless the potential of Alligator Weed is acknowledged and positive efforts are made to control this plant it is inevitable that it will continue to spread. I trust that the information contained in this paper will alert Weeds Officers to be aware of the problem and I hope with luch that the current herbicide trials being conducted by CSIRO will provide a treatment which will be effective and economical.

ACKNOWLEDGEMENTS

Mr. Chris Ripper, Water Resources Commission - Map

Alligator Weed Committee - Machinery Warning Sticker

Port Stephens Shire Council - Certificates

IMPORTANT: Pesticides and Allied Chemicals Act, 1978.
Note that you must only use a registered pesticide and 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.

Herbicide recommendations current June 1988.

This appendix details herbicides which may be legally used to control alligator weed in certain situations under provisions of the Pesticides Act.

1. Aquatic Situations: drains and channels; margins of dams; lakes and streams.

Trade name	Active constituent	Rate	Comments
Roundup(R) Glyphosate(R)	Glyphosate 360 g/L	1.0 L/100	Spray when actively growing. Reduced effectiveness may result if more than 1/4 of the above ground portion of the weed is submerged at treatment. Submerging the treated plants following treatment may result in the spray being washed from the plant surface, thus reducing effectiveness.

NOTE: Not registered. Use allowed by Pesticide Order Number PO-GLYP-10

2. Terrestrial Situations.

Pasture or Non-Cropland:
Initial control from these herbicides appears excellent with complete death of above ground plant parts. Regrowth from nodes on underground stem material however, is rapid and requires repeated treatment to maintain control of established infestations.

Buckshot(R) Banvel m(R) One-Shot (R)	Dicamba 80 g/L + MCPA 340 g/L	4.0 L/ha	Apply as an overall spray 3 times per season. First application – Nov/Dec Second application – Jan/Feb Third application – Mar/Apr WITHHOLDING PERIOD: Do not graze, or cut for stock food for 7 days after application. CAUTION: This treatment will damage pasture legumes.

NOTE: Not registered. Use allowed by Pesticide Order Number PO-MCAA-DICA-3.

Trade Name	Active Constituent	Rate	Comments
Banvel 10G Herbicide Granules(R)	100 g/kg dicamba	Apply at rate of 230 grams of PRODUCT per 25 square metres.	Apply as a spot treatment only. Make one application per season applied during NOVEMBER to MARCH. Apply using either a granule spreading machine or a hand held shaker pack.
NOTE: Not registered. Use allowed by Pesticide Order Number PO-DICA-1.			WITHHOLDING PERIOD: Do not graze food producing animals in treated areas within 30 days of slaughter. Do not graze treated areas or cut forage or hay for dairy animals for 60 days after treatment.
Roundup(R) Glyphosate(R)	Glyphosate 300 g/L	1.0L/100L	Spot spray when plants actively growing. Repeated treatments essential to obtain control of alligator weed. First application - Nov/Dec. Second application - Jan/Feb. Third application - Mar/Apr.
NOTE: Not registered. Use allowed by Pesticide Order Number PO-GLYP-10		**NOTE:** Glyphosate is a non-selective herbicide which may kill grasses and other plants growing near alligator weed. Plant bare patches with suitable grasses once alligator weed is controlled.	

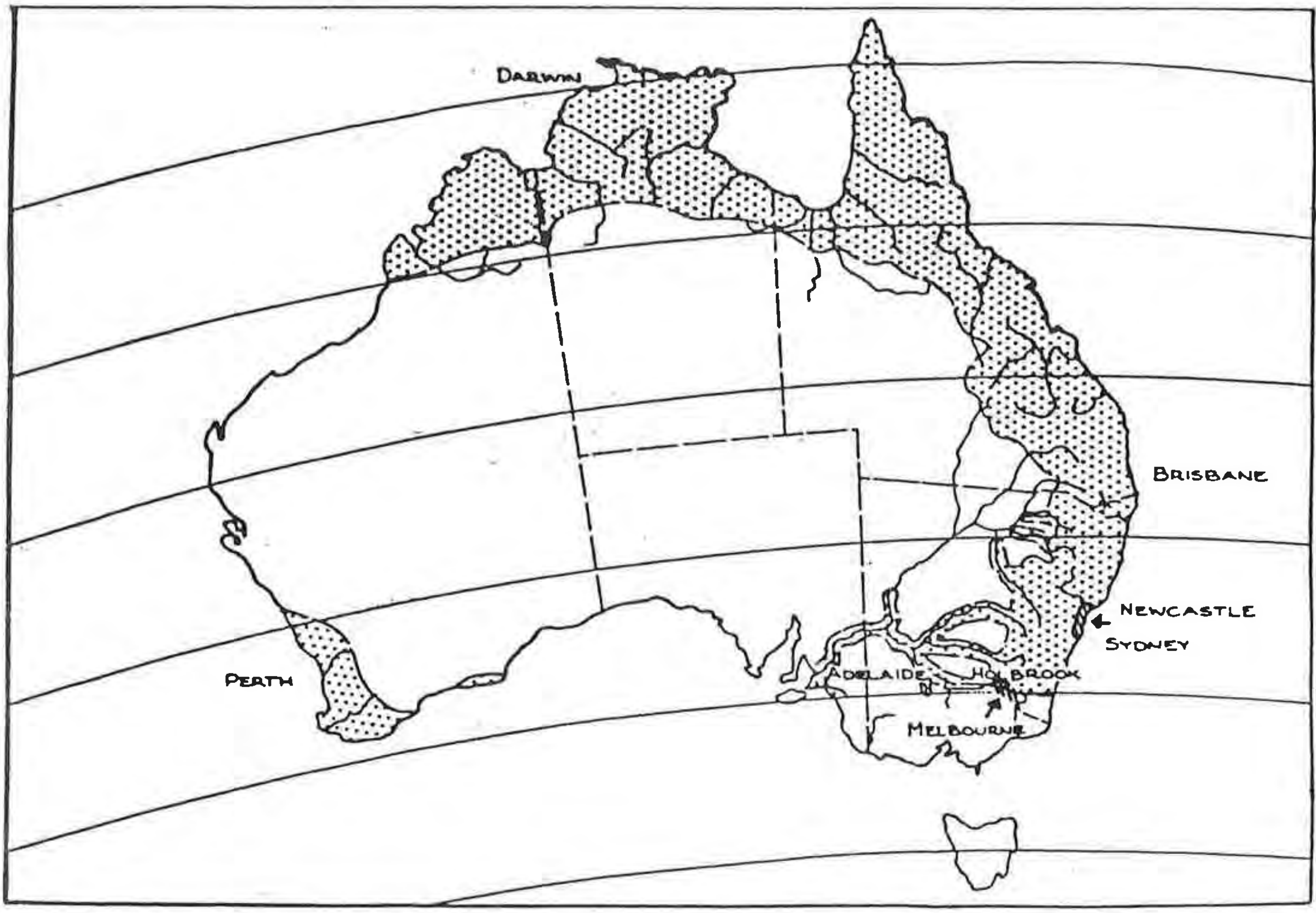

FIGURE 1 CURRENT DISTRIBUTION OF ALLIGATOR WEED IN AUSTRALIA
POTENTIAL DISTRIBUTION

Source C. Ripper
Department Water Resources

FIGURE 2

Port Stephens Shire Council

59 Port Stephens St. Raymond Terrace Tel (049) 83 1333

Telephone Enquiries:

File No:

ALLIGATOR WEED CERTIFICATE

ORDINANCE 50 CLAUSE 8 (2)(C)

The Council of the Shire of Port Stephens certifies that in the opinion of Council the vehicle, machine or thing described in the Schedule below is free from Alligator Weed.

SCHEDULE

Vehicle Type

Registration No

Engine No

Description of Machinery

Note this certificate is only valid for the immediate removal of the item described in the above schedule from premises described below.

Lot No: DP No: Street No:

Street: Parish:

Portion: Town/Locality

Dated this day of 19

J W WALSH
SHIRE CLERK/
GENERAL MANAGER

Per:
S

FIGURE 3

All correspondence to be addressed to the General Manager P.O. Box 42 Raymond Terrace 2324. (DX 7879 Newcastle)
Facsimile (049) 87 3612

APPLICATION FOR ALLIGATOR WEED CERTIFICATE

Name of Applicant ______________________________

Address ______________________________

____

Phone No ______________________________

I/we apply for the issue of a certificate to be issued under Ordinance 50 Clause 8(2) (tick appropriate boxes)

☐ a) a certificate to the effect that land described below is in the opinion of Council free from Alligator Weed.

☐ b) a certificate to the effect that hay, chaff, fodder, or grain described below is in the opinion of Council free from Alligator Weed.

☐ c) a certificate to the effect that a vehicle, machine or thing described below is free from Alligator Weed.

Description of Land (Required for all Certificates)

Lot No ____________ DP ____________ Street No ____________

Street ______________________________

Parish ____________ Portion No ____________

Town/Locality ______________________________

Description of Produce:-

Hay ☐ Grain ☐ Chaff ☐ Fodder ☐

Description of Vehicle/Machine/Equipment

Vehicle: Registration No ______________________________
OR
Engine No ______________________________

Make ______________________________

Model ______________________________

Machinery/Equipment (Please describe in full)

____

____

____

Date ____________ Signed ____________

Fee: $55.00 for each Certificate

LANTANA ISO-COST HERBICIDE TRIAL, LISMORE - SPRAYING DETAILS

Co-Operator:	Mr. E.K. Currie, Dunnon Road, Lismore.
First Application:	20.5.88
Respray Application:	13th-14th July 1989
Conditions:	Fine, 12-20o, 50-60% humidity, excellent soil moisture at both applications.
Application Methods:	(First Application)
High Volume:	Roundup D5 nozzle, 700 kPa to wet leaves only. Brush-off D6 nozzle, 700 kPa to wet leaves only. Tordon 50-D nozzle, 700 kPa to wet leaves and stems. DP60, 2,4-D and Dicamba/MCPA D8 nozzle, 1000 kPa to wet leaves and stems.
Gas Gun:	8003 E nozzle, 280 kPa with addition of white lightening dye.
Spray Additives:	Agral 600 .15% in Brush-off treatments.
Resprays:	All resprays were applied by the same method and at the same concentration as the first application except Roundup high volume which was resprayed with Brush-off (5g/100L) and Roundup 1/10 gas gun which was resprayed with Roundup 1/30 gas gun for seedling control.

LANTANA ISO – COST HERBICIDE TRIAL

AIM: This trial was designed to look at the question:

If I spend a dollar on herbicide "A" and a dollar on herbicide "B", which herbicide will give the best value for money?

METHOD: Each herbicide was applied by high volume handgun to give a chemical cost of 2.1 cents per cubic metre of bush. this was equivalent to applying Roundup (360 g/L glyphosate) at 1.4 ml per cubic metre. Hence the cost of each herbicide for the first year of treatment is identical for all high volume treatments.

In the gas gun treatments, Roundup was applied at an equivalent rate to the high volume treatment and at a lower (50%) and higher (150%) rate. DP 60 (dichlorprop 600 g/L) was applied at an equivalent rate to the high volume treatment and a 50% rate.

Treatments were mixed at concentrations which were convenient for application and spray volumes were applied to give exactly the right dose of herbicide to each bush treated.

There were five bushes treated in each herbicide treatment ranging from very small to fairly large. The five bushes in each treatment had a total volume of about 50 cubic metres.

Bushes were re–sprayed on the 13th and 14th of July (6 days before the field day). Re–spray volumes were recorded.

TABLE 1 – HIGH VOLUME TREATMENTS

Herbicide	Concentr–ation	Rate (ml/M3)	Control Score (14 mat)	Respray Volume (L Total)	Respray Cost (c/M3)	Total Cost (c/M3)
Roundup (Resprayed with Brush–Off)	1/200	1.4	8.2	2.8	0.3	2.4
Tordon 50–D	1/400	1.3	5.4	11.0	0.9	3.0
DP60	1/200	3.3	5.4	9.9	0.6	2.7
2,4–D Amine	1/100	4.6	6.2	11.1	0.9	3.0
Dicamba/MCPA	1/300	2.7	2.3	17.4	0.9	3.0
Brush–Off	5g/100L	20mg	8.7	2.0	0.2	2.3

* All high volume treatments applied at an initial cost of 2.1c/M3.

TABLE 2 – GAS GUN TREATMENTS

Herbicide	Concentr-ation.	Rate (ml/M3)	Control Score (14 mat)	Respray Volume (L total)	Respray Cost (c/M3)	Total Cost (c/M3)
Roundup	1/30	0.7	5.0	830	0.9	2.0
Roundup	1/15	1.4*	9.0	84	0.2	2.3
Roundup	1/10	2.1	10.0	314	0.3	3.4
DP60	1/10	1.7	3.4	980	1.2	2.3
DP60	1/5	3.3*	5.4	695	1.7	3.8

* Equivalent rate to high volume treatments

RESULTS: Results for the high volume treatments are summarised in Table 1 and for the gas gun treatments in Table 2. Results for individual bushes are given in Table 3 which should be used in conjunction with the map to inspect the trial.

Main Points – High Volume Treatments

* Roundup and Brush-off were the most effective herbicides, had the lowest respray volumes and the lowest overall costs.

* Roundup failed to kill the smaller heavily grazed bushes due to their reduced leaf area.

* DP60, 2,4-D Amine and Tordon 5D-D gave similar average scores and had similar average respray requirements in volume terms.

* Dicamba/MCPA had the lowest average score and the highest respray requirement.

* Heavy respray requirements for DP60, Tordon 50-D, 2,4-D and Dicamba/MCPA made these treatments more costly than Roundup or Brush-off.

Main Points – Gas Gun Treatments

* The Roundup treatment equivalent to the high volume rate gave a slightly superior result.

* The 50% rate of Roundup gave relatively poor control but at present is still the cheapest treatment.

* The 150% rate of Roundup gave 100% kill of established bushes but numerous seedlings required retreatment – however they were treated with a 1/30 concentration only.

* DP60 gave very similar results to the high volume treatment at an equivalent rate.

* The 50% rate of DP60 is equal to the cheapest high volume treatments in terms of present cost but will probably require extensive retreatment again next year.

Trial LL884 Lantana 150-cost trial - Lismore

Bush No.	Herbicide	Bush Size (Cu.m)	Control Score (0.10) (10 MAT)	Respray Volume (L)
1	Dicamba/MCPA (high vol)	15	2	4.1
2	2,4-D Amine (high vol)	40	4	9.0
3	Roundup (gas gun)	3.3	8	2.0ml
4	Roundup (gas gun)	12	10	0.0
5	Roundup (high vol)	2.9	4	0.0
6	2,4-D Amine (high vol)	5.7	8.4	0.6
7	Dicamba/MCPA (high vol)	3.1	1	1.2
8	NIL	3.7	0	-
9	Roundup (gas gun)	4.1	1.6	240ml
10	DP60 (gas gun)	23.1	2	445ml
11	DP60 (gas gun)	18	4	2.8
12	Roundup (high vol)	18	10	0
13	Brush-off (high vol)	4.4	10	0
14	2,4-D Amine (high vol)	2.0	8.4	0.3
15	DP60 (high vol)	1.4	9	0.2
16	DP60 (gas gun)	25	5	180ml
17	DP60 (gas gun)	1.9	2	50ml
18	NIL	46	0	-
19	Brush-off (high vol)	15	8	1.5
20	Roundup (gas gun)	8.5	9.4	20ml
21	DP60 (gas gun)	6.2	2	400ml
22	Roundup (gas gun)	15	10	80ml
23	Tordon 50-D (high vol)	27	8.4	1.8
24	Roundup (gas gun)	27	10	136ml
25	Brush-off (high vol)	22	10	0
26	Dicamba/MCPA (high vol)	4.5	3	2.9
27	Tordon 50-D (high vol)	7.0	5	1.3
28	Roundup (gas gun)	4.7	8.4	42ml
29	DP60 (gas gun)	2.5	2	50ml
30	Roundup (gas gun)	4.3	10	74ml
31	Tordon 50-D (high vol)	2.1	8.4	0.6
32	Tordon 50-D (high vol)	4.5	2	3.2
33	DP60 (gas gun)	3.9	3	150ml
34	Roundup (high vol)	4.5	7.6	0.6
35	NIL	4.7	0	-
36	DP60 (high vol)	4.5	6	0.8
37	NIL	2.2	0	-
38	DP60 (high vol)	5.8	4	2.2
39	Roundup (gas gun)	13	8.4	80ml
40	DP60 (gas gun)	12	10	0
41	Roundup (gas gun)	8.5	10	12ml
42	Dicamba/MCPA (high vol)	20.5	2.4	4.9
43	Roundup (high vol)	15	9.0	0.5
44	DP60 (high vol)	22	5.0	3.9
45	2,4-D Amine (high vol)	11	10	0
46	DP60 (high vol)	15	5	200ml
47	Roundup (gas gun)	1.8	1	200ml
48	NIL	15	0	-
49	Dicamba/MCPA (high vol)	9.2	3	4.4
50	Roundup (gas gun)	19	6	290ml
51	2,4-D Amine (high vol)	3.3	5	1.2
52	Roundup (high vol)	10	9.4	1.7
53	DP60 (gas gun)	3.5	3.4	100ml
54	Roundup (gas gun)	2.6	8	40ml
55	Roundup (gas gun)	2.7	10	12ml
56	Brush-off (high vol)	1.4	5	0.5
57	DP60 (gas gun)	11	6	100ml
58	Roundup (gas gun)	22	10	0
59	Tordon 50-D (high vol)	13.1	3	4.1
60	Brush-off (high vol)	5.6	10	0

"THE BIG SCRUB ENVIRONMENT CENTRE'S APPROACH TO NOXIOUS WEED CONTROL"

Anne Close

INTRODUCTION

Hello to everyone. I hope you are all having an enjoyable time here on the beautiful North Coast. As I am not at ease with public speaking, I will read my presentation to you.

Firstly, I should explain for those of you who hail from other parts of the state, that the name Big Scrub refers to the mosaic of subtropical rainforest types which once covered the entire Alstonville Plateau, extending from just southwest of Lismore up to the lower edges to the Mt Warming caldera at Whian Whian and east to the coastal plain.

The getting of red cedar and other valuable cabinet timbers which once grew here was the first European activity on the North Coast, and the Big Scrub rainforest therefore has a strong place in local history. As the area was settled, the rainforest disappeared until, at the present time, only 0.2% of the original area remains, and this is made up of 30 or so scattered small remnants. It was primarily in response to the threatened loss of even more local rainforest, that the Environment Centre was formed.

The Centre was established in Lismore in 1981, and remains an unfunded voluntary conservation organisation, which receives widespread support from the local and regional community. We provide a number of services to the people of the North Coast by maintaining a comprehensive reference library on environmental topics, by compiling information leaflets on a variety of subjects, and by performing a referral service for public enquiries. We also offer support, office facilities and advice to any community group which is working towards our primary aim which is to "promote the conservation, protection and betterment of the environment along sound ecological guidelines."

I am employed as a part-time project officer at the Centre and as such I deal with environmental issues as required, and one of my areas of research has been into the field of toxic chemicals. We receive on average, 2-3 enquiries per day from the public about chemicals; these queries range from farmers wanting to know how to change over to organic methods, to householders wanting information on non-toxic pest control in the home, to distressed landholders and residents who are being subjected to unwanted pesticide drift, to pesticide users who require some background information on the products they are using.

I am not an expert on pests, weeds or synthetic chemicals, however I attempt to provide as much information as I can from the Centre's files which have been compiled from sources in Australia and overseas, from Government departments, other environment groups and manufacturers.

As all of the conference participants will be aware, there has been a steadily increasing concern developing in communities everywhere about damage to the environment. This is an international trend, with people everywhere paying more attention to what's in our food, where our garbage goes, the extent of our remaining natural resources and just how renewable they are. The Greenhouse and Ozone threats are global. Here in Australia we are learning to appreciate our remaining areas of native plants and animals, and people are making it clear to politicians that events like mining in National Parks, massive pollution, and large-scale tourist development are unacceptable.

In May this year, a Sydney Morning Herald poll was conducted to gauge the public concern and interest in environmental issues. They found that 9 out of 10 people felt these issues must be taken seriously and, further, that chemical and pollution issues were felt to be the most important. It's obvious that people living in cities, especially Sydney, are very concerned about air and water pollution because its so apparent before them, but what about the broader concern about chemicals in the environment, and pesticides in particular that is very evident at the moment.

I can list a number of reasons why people are concerned about pesticides:

1) Pesticides are poisons which don't necessarily limit their field of action to the intended target.

2) Past bad experiences with substances such as Thalidomide and 2,4,5-T and the list of chemicals that have been found to be dangerous after years of being in common use.

3) Lack of trust in testing procedures.

4) Concern about effects on wildlife, habitats, natural areas.

5) Lack of information about chemicals generally.

How justified are these reservations? Lets look at them more closely:

1) If you start to think in terms of the science of ecology, which is a way of looking at our environment that is becoming easier for us as the world gets smaller and the effects of our actions become clearer, then it becomes more important to you to think about how seemingly unrelated things tie up with each other.

   Consider the case of pesticides in the environment: chemists, toxicologists and environmental scientists all help the ecologist to unravel the pathways that connect the past application of an organochlorine pesticide onto farmland somewhere in the middle of the US or Europe, to the thinned eggshells of local raptors, the fat of antarctic birds and virtually every major waterbody throughout the world.

   Ecologists study the movement of energy and nutrients through the components of an ecosystem - which could be a forest, a pond or a farm. Whilst these non-living elements of the system are ceaselessly flowing through the bodies of living organisms and back into the environment, the plants, animals, and micro-organisms establish complex relationships and dependencies amongst each other. All organisms, including humans, are dependent for survival upon their environment.

Since all life forms come from similar evolutionary origins, they share many basic chemical pathways. It would not be unusual then for a pesticide, such as a herbicide to affect, damage, or even kill life forms that were not its intended target. For example, the herbicide 2,4,5-T has been shown to kill soil micro-organisms, fish and birds, and to cause cancer in laboratory animals and in humans.

This similarity in chemical pathways is relevant to human health when one is looking at the intended mode of action, e.g. organophosphate and carbamate pesticides are acutely toxic to humans because they affect the enzymes that regulate the nervous system, and these enzymes are common to humans, insects and most other life forms, It is also important when unintended actions are implicated, for example the tendency of organochlorine compounds, including the phenoxy herbicides, to partition into the lipid layer present in all cellular membranes, and to therefore have an impact on all sub-cellular processes.

2) Past experience: On the personal level, there are more and more people suffering the effects of pesticides and becoming wary about further use. I hear frequent comments about symptoms that people have themselves associated with pesticide contact, and as many of you will be aware, there are more than 10,000 people in NSW alone who suffer from M.E. Blood testing of a group of these people has revealed high levels of pesticides, solvents and industrial chemicals - often in people who have had no occupational or obvious environmental contact with these chemicals.

M.E. had long been suspected to be associated with chemical exposure, but many people have been told that they are imagining their illness or that there is no obvious cause for their symptoms. This may be understood in the light of an American doctor's report of a medical school survey: "In a 1979 survey of US medical schools, 70% of the responding schools indicated that they required NO formal instruction in occupational or environmental medicine. Among the 30% that did require such instruction, the median time required was 4 hours during the 4 years of medical education. By 1984, 54% of the schools included such instruction but the median time was still 4 hours" (Dr. Coye, NCAP).

3) Lack of trust in testing procedures is very well justified give the history of problems that have occurred. Aside from poorly designed tests, lack of programmes to test for many factors such as immune and nervous system effects, events such as the falsifying of test data by research companies such as Industrial Biotest in the US, leave little room for confidence. As the research data for over 600 pesticides was thrown into doubt by the discovery of this fraud, the US Environmental Protection Agency is faced with enormous costs to re-examine the safety of these chemicals, which meanwhile remain on the market.

4) Concerns about the environmental effects of pesticides are related to the whole field of pesticide behaviour - what pathways will a particular pesticide travel? Is it fat soluble and therefore likely to accumulate in a food chain? Is it water soluble and therefore likely to be very mobile into watercourses and groundwater? It is likely to volatilise and

contribute to the massive amounts of pesticides which travel atmospherically – studies in Europe have shown that more pesticide may be present in rainwater than in contaminated streams.

What are its metabolites? Are they more or less toxic than the original? The breakdown products of 2,4–D are more acutely toxic than the chemical itself. How persistent is it? How persistent are its metabolites? It is likely to combine with other pesticides, solvents, natural chemicals? Does it have acute dermal effects and therefore is it likely to affect small mammals or reptiles that may pass by? How often has it been used in this area? Is it likely that soil levels are building up?

These and other related questions arise when one considers environmental effects. It is especially difficult to get a good grasp of possible answers to these questions when studies of the effects and behaviour of most chemicals under Australian conditions appears to be minimal.

5) Information about pesticides is difficult for any ordinary person to access easily. It's quite difficult just to get hold of the Material Safety Data Sheets for many products sold in Lismore – it's sometimes even hard to get them when you write to the manufacturer. This doesn't inspire confidence.

Neither do the public record comments by a Medical Services Advisor to the Federal Department of Community Services and Health, who stated that it is important for NH&MRC and its advisory committees to keep confidential information supplied by pesticide manufacturers, when the sort of information involved includes such vital data as what is actually in the product, especially "inert ingredients" which are treated as trade secrets despite the fact that in the U.S. banned substances such as D.D.T. have been found to be included in this group.

To my mind, the above community concerns about pesticide use are reasonable and valid, and they have a bearing on the Big Scrub policy on toxic chemicals. Our policy includes the support of non–chemical methods of agriculture, and in situations where people feel that they need to use pesticides, we recommend that the smallest possible amounts of the least toxic product be used.

PESTICIDE USAGE

The three main areas of pesticide use which come to my attention are domestic, that is in the home and garden, agricultural, and as used by various government agencies in schools, playgrounds, roadsides, under power lines, etc. Each area of use has specific requirements and problems:

Domestic: Part of the growing concern about the environment has centred on household ecology, or the use of non–harmful products in the home whenever possible. Many householders, along with giving up CFC propelled products, plastic bags and detergents, are reconsidering their use of pest control, and with the possible exception of termites, there are simple, non–pesticide remedies for most pests in the home and garden.

Agricultural: There has been a great increase in the interest in organic farming techniques, and information about how to successfully farm with minimum pesticide use is becoming easier to obtain. It is encouraging to note that the Department of Agriculture is undertaking research into organic methods. At a conference in Brisbane earlier this year, I was surprised to see how much enthusiasm and energy is being put into various farming methods and products – and one of the aspects of this trend which is particularly interesting is the use of non-chemical agriculture on the large-scale.

There were several doubts raised at the conference by ag "experts" who said, "oh well, we know organics can work for backyard gardens, but it's not suitable for broadacre farming." They were answered by several farmers who were working properties into the thousands of hectares range, and who futhermore in some cases had not used ag chemicals for up to 20 years.

So what is prompting farmers to seek to reduce their dependency on pesticides? There are many reasons, including the increased demand for "chemical-free" food, but there is also the factor of the costs of chemical use. The vast sum of money spent annually on pesticidal control does not include the "external costs" of pesticides use. These costs include human pesticide poisonings and fatalities, reduction in fish and wildlife populations, livestock losses, some destruction of susceptible crops and natural vegetation, honey bee losses, destruction of insect natural enemies, pesticide resistance in pest populations, and secondary pest problems created by the use of pesticides. (Pimental, et al)

Looking at just pesticide poisoning alone is quite horrific, a 1983 World Health Organisation Report estimated that worldwide incidence of poisoning was 2 million cases per year, including 40,000 deaths. Most of these casualties were farm workers in third world countries, often using pesticides which have been banned for use in Western nations but are still manufactured there for export. The developed countries have their share of casualties however, with poisoning in the US reaching 45,000 cases with 200 deaths annually, during the early eighties.

We all accept the risks of modern life, but at the same time we have a responsibility to minimise hazard to ourselves, the rest of the human community and the biosphere generally. The recent upsurge in acceptance of responsibility for our impacts on the world around us is one of the most positive aspects of the conservation ethic.

Use by Public Bodies: Which public agencies use pesticides? Local councils and bodies such as the Far North Coast County Council, Telecom, Electricity Agencies, Water Resource Agencies, NPWS, Forestry Commission, Schools and Colleges to name some. Many of the delegates to this conference are working for just such agencies, and most of your groups will be using pesticides, especially herbicides to a greater or lesser degree.

There are common factors regarding use by public bodies, including:

- that areas treated are often public places;
- that the work whether it be weed control or insect control is usually funded by the taxpayer;
- that the work is open to public scrutiny;
- and that the public are likely at some point or other to require

information about the work and in some cases to object that it is not in our best interests.

So, it seems to me that public bodies are in a somewhat difficult situation, at the same time as being challenged to respond to changing community attitudes in a positive manner.

I can appreciate the difficulties that managers of public bodies face as they try to achieve their aims, within the limited funding available to them, meanwhile in the case of weed and pest control being caught between public accountability and industry persuasion. I hope that these same managers can appreciate that their sometimes apparent lack of interest in community concern is equally difficult for individuals to deal with.

Later in the conference you will hear a representative from the FNCCC describe what he perceived as the difficulties he had carrying out weed control in the Byrrill Creek area. It would have been very illuminating for all of us here to have been able to discuss this matter with both the FNCCC and some of the residents concerned, however, that opportunity has not arisen and the matter will probably continue to be presented as a classic case of confrontation with the poor old FNCCC just trying to do its job and the Byrrill Creek residents being difficult and causing unnecessary problems.

It will be a shame if this is the case because in my view the Byrrill Creek situation is not an isolated incident of residents opposing chemical spraying by public bodies – it is happening all around the world and will probably increase. And, as such an example of a global trend, there is a lesson to be learnt by us all.

Consider for a moment, if you will, the situation of some of the Byrrill Creek people. They have had to deal with firstly the initial health problems associated with the herbicide 2,4–D. As I am sure many of you know, these include dizziness, headaches, loss of memory, loss of feeling in the extremities and exhaustion. So, having discovered that they are going to be increasingly exposed to this substance which makes them ill, they tried to negotiate with their local council, and offered to cut the offending weeds by mechanical means themselves, despite the fact that it is not their land which is involved.

They further employed a weed ecologist to come and investigate the situation, to determine what are the possibilities of biological control, given that the control agent, the gall fly, is already in the area. Meanwhile they undertook a detailed examination of whatever test data could be found regarding the chemical which has made them ill. Rather than rely on the assurances of safety that are given by the FNCCC and the Department of Agriculture, they sought information from as many sources as possible and discovered to their surprise that there is truckloads of information on 2,4–D, and that a lot of it indicates serious health risk.

They petitioned the owner of the land, their local council, about finding alternative means of controlling the weed and find that a storm of controversy has arisen around the topic. After attempts at negotiation and reasonable discussion failed, they were forced to take legal action to protect themselves and their families. They were then required to raise the large sums of money needed for a court challenge.

Meanwhile the FNCCC has lost a wonderful opportunity to implement its stated policy of integrated pest management. It had there before it the services of a competent weed expert, the biological control agent was already onsite, and if respect had been given to the concerns of the local people, they had stated that they would be very co-operative, in fact they would have provided an enthusiastic working group to help with the project. It could have been a wonderful experiment in both integrated control of grounded and community co-operation.

Instead we have a group of residents who have been maligned and isolated, the public has forked out huge sums of money to cover the legal costs, especially of the two councils involved, a good experiment has been lost and the weeds are still there.

I attended parts of the Byrrill Creek hearing in Sydney, and it was clear to me that whatever the judgement turns out to be in the case, it has certainly focussed a lot of interest and discussion on the use of pesticides by public bodies.

One of the most important aspects to the use of pesticides is the area of occupational health and safety. Many of the delegates to this conference will be in the position of co-ordinating spraying programmes and organising the workers to carry them out. No doubt if you are in this position, you will ensure that anyone who comes into contact with pesticides is suitably protected and that on-going testing of workers is carried out.

You will no doubt be aware that some of the FNCCC spray operators were found to have levels of 2,4-D in their urine which exceeded WHO safety levels.

This points out the need for ongoing monitoring of workers health, during the time they are involved in spray work and for subsequent years where possible. It also raises the issue of worker protection - Are the present controls good enough? Are they being followed properly? How can they be improved?

As has been reported by physicians in the field of occupation health, pesticide workers often act like the canaries in the mines for the rest of the community. During the Senate Inquiry into the passing of a "Right to Know" Bill in Oregon State in the US, a union representative commented that: "the workplace is the early warning system for the rest of the environment. The hazards created by our industrial processes show up first in those people who work with toxic chemicals on a regular basis. Many illnesses extend beyond the factory gate to the family." (AFC-CIO rep report to Oregon State Senate Inquiry into "right to Know" Bill).

In order to reduce this risk to workers, their families, the community and the wider environment, there have been increasing calls for non-chemical pest control. I have been pleased to see scheduled in this conference considerable discussion on biological control and IPM and although I have not been able to attend much of the conference I look forward to reading the papers when they appear.

On the local level there have been approaches made to Councils to consider non-chemical roadside management and I think most North Coast Councils are very conscious of community concerns, although we are a long way from having detailed roadside vegetation management strategies. Various attempts have been made overseas to incorporate community participation, low maintenance programmes that use an ecological approach to dealing with weeds rather than on-going maintenance.

We can all see clearly the detrimental effects of the current roadside spray programmes – soil erosion, fire hazard, loss of native plants and probably animals – and that's even before we look at possible health risks.

The Environment Centre has offered to participate in devising a management plan for the Lismore Shire roadsides and I feel confident that the future will bring greater community responsibility and involvement with the local councils for the benefit of all people on the North Coast.

New Zealand Trip Report
April 26 to May 12 1988
By J.E. Cherry

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(1) THE 1988 DU PONT NEW ZEALAND TRAVEL AWARD

By J.E. Cherry,
Central Northern County.

First, I would like to thank the sponsors – Du Pont Australia, for initiating and sponsoring the study tour exchange programme of Weeds Officer's between New Zealand and Australia. It is valuable in that methods, types and each others approach to weed control can be examined and analysed to further the advances of weed control on our respective countries.

I would also like to thank Du Pont New Zealand for their hospitality shown while in various parts of New Zealand.

The individuals of Du Pont whom I would like to personally thank, include Mr. Jim O'Shea, Mr. Frank Noone, Mr. Bernie Horsfield and Mr. Lyndsay Wilson, al of Australia, and Mr. Fergie Sumich, Mr. Mark Christie, Mr. Graham Iggo, Mr. Tom Whitehead and Mr. Paul Dunn, all of New Zealand. without the efforts and co-ordination by these people, such a tour would not be as productive or memorable.

The welcome given me by the New Zealand Institute of Noxious Plants Officers Incorporated and its outgoing President, Mr. Kevin Worsley and incoming President Mr. David Brown, and their friendship was greatefully accepted. A special thankyou must also be given to a few of our Kiwi Noxious Plants Officers who opened up their homes during my stay. These include Mr. David Rossiter, Mr. Eric Eden, Mr. Dick Healy, Mr. Jack Craw and Mr. Rod Smart and their respective families.

I would also like to thank my own Council, Central Northern County, for giving me the support they did in making the study tour a success.

The weeds officers of New Zealand are a close knit group of people with the one and same cause. They have been part of a recognized Institute for some 39 years, as well as being incorporated.

My report has been separated into several distinct areas for consideration:–

* Authority for Noxious Plants Control
* New Zealand Institute of Noxious Plants Officers Inc.
* Training of Noxious Plants Officer
* Weed Control Methods
* Weed Field Days and Public Relations
* Future of Weed Control in New Zealand

(2) AUTHORITY FOR NOXIOUS PLANT CONTROL

The Noxious Plants Act 1978 gives authority to the Noxious Plants Council which operates under the ACT to formulate policy to be carried out by District Noxious Plants Authorities.

Some definitions might assist in understanding these terms. The Noxious Plants Act 1978 is an updatd version of our 1919 Local Government Act. Noxious Plants Council is equivalent to the Noxious Plants Advisory Committee and the District Plants Authority is equivalent to our N.S.W. County Council, being made up of City, County (Shire) and Borough Councils.

There are several requirements under this Noxious Plants Act 1978 which the District Noxious Plants Authorities carry out.

1. Employ fuli time Noxious Plants Officers to carry out the functions of the District Authority.
2. Publish a District Programme (Policy).
3. Provide advice and assistance to landowners.
4. Keep written records of work carried out on each property which are made available to the Noxious Plants Council which inturn reports to the government.
5. Foster public interest and awareness through education and publicity.
6. To make occupiers generally responsible for the control and eradication of noxious plants.
7. Encourage people to report sightings of new or unusual plants.
8. To require landowners to submit written reports on their own proposed noxious plant control programme, aimed at preventing the spread and reducing the incidence of noxious plants which may cause serious economic loss to any person or harm the environment.

Noxious Plants have been categorized into 5 sections. A noxious plant under the Act is "a plant which causes or may cause serious economic loss to any person or harm to the environment because of the effect of that plant on any person, domestic animal, crop (whether agricultural, horticultural or silvicultural), pasture, native flora, aquatic habitat (whether natural or artificial) or to the general environment". This definition covers plants growing in a wide range of landuse patterns including exotic forests, native habitats, water bodies as well as the general agricultural and urban situation.

The first class of noxious plants, known as Class A Noxious Plants are of the most serious concern to the Authorities in New Zealand. The class includes Cape Tulip, Johnson Grass, Salvinia, Water Hyacinth and Water Lettuce. The eradication programme for Class A Plants is carried out by the Government Department M.A.F. who generally hire local contractors to treat infestations. M.A.F. maintain the records of action and progress and fund all acitvities.

The second class know as Class B Noxious Plants have been divided into three sub-groups. These Class B plants are the responsibility of the District Authority and landowner or occupier. Class B "Target" noxious plants are of limited distribution, and where eradication is possible, a suitable and sustained programme is implemented. Class B "Target" noxious plants vary from district to district, but include such things as Australian Sedge (Carex longebrachiata) nodding thistles, woolly nightshade and Old Mans Beard (Clèmatis vitalba). Class B "Surveillance" noxious plants refers to areas where the "Target" plants have been eradicated and continued surveillance of the area is required. If any regrowth does occur, then the plants become "Target" noxious plants.

The third group are know as Class B "Widespread" noxious plants. They include a similar range of our own declared noxious plants, and are widely distributed and abundant, and have colonized suitable habitats. The aim of their programmes is to prevent the plants from spreading to new areas or onto neighbouring properties.

Each District Noxious Plant Authority has the responsibility to monitor the presence and movement of other non-declared noxious plants. In time, and due to certain conditions, these may become declared plants.

The fourth group are known as Class B "Aquatic" noxious plants, and depending upon the area, they are not permitted to be grown. They include eel grass, Egeria, Hornwort, Hydrilla and Lagarasiphon.

My observation in both the North and South Islands indicate that some of their noxious plants are allowed to be grown in certain restricted situations. The plants I am talking about are those used for hedges. They include Gorse, African Boxthorn and Barberry. In the hedge situation, they are allowed to be grown if the hedge is trimmed and maintained on a biennial programme.

Many of the noxious plants have been introduced purposely or accidently. Gorse for instance after burning, as was done last century, displayed good regrowth for feeding the fledgling sheep industry. Every two to five years, when it becomes too high for the grazing animal, it was burnt again. There are several native pampas grass species in New Zealand. They grow fairly sparsely, however, the grazing industry authorities could see an advantage by growing two more vigorous varieties from Chile. These are now widespread throughout both islands, invading all types of agricultural, urban, native and exotic forests, and unused areas. The same story is repeated for many other weeds. A plant which was accidently introduced, occurred in the North Island, when some maize seed was introduced for sowing. It originated in the Tamworth region of N.S.W. and was contaminated with Noogoora Burr seed. The unknown plant was not treated for a couple of seasons, until it had a good hold in some agricultural areas.

Generally speaking, the District Noxious Plant Authorities have no spraying equipment and do not carry out any spraying. If they are required to carry out treatment of noxious plants, then they hire reputable local contractors. The noxious plant officers job is for inspectorial and regulatory duties only.

The local contractor is a jack-of-all-trades. Apart from spraying weeds, he may do contracting for various other agricultural type jobs including earth moving, fencing, ploughing and land preparation and treatment of sheep for external and internal parasites.

Landholders responsibility for noxious plant control is not just limited to areas within his boundary fence. He is responsible for his share of adjoining water bodies as well as roadside areas outside of his fenced boundary. His riparian right takes him to the centre of the road. The District Authority often forces the landholder to take action in these areas. It was ironic to see a landholder in one particular area had sprayed Blackberry on his riparian right on the roadside (forced by the Authority to do so) but had not attempted to treat several hectares of the same problem on his own property which was seriously reducing production from his property. Other landholders make good use of this roadside area by stringing electric fence wires along guideposts to graze the roadside area.

(3) NEW ZEALAND INSTITUTE OF NOXIOUS PLANTS OFFICERS INC.

The Institute is 39 years old and is currently very active with almost 100% of weeds officer as members. Those 2 or 3 who are not members are in trouble with their Council and by now would not have a job. Membership is also tied in with Training. No training, no membership. This is well recognized by the institute as well as employing authorities.

The Institute has it's Annual General Meeting each May, in conjunction with the Weeds Conference, and is an official part of the day time proceedings of the Conference. The conference runs for 3 days and most Weeds Officers from both islands attend.

The Institute has been set up with official officers such as President, Immediate Past President, Vice President, Secretary, Treasurer, Newsletter Editor, Executive Members and Life Members.

The Executive Members, of which there are nine, are the presidents of the regional groups covering all of New Zealand. Regional groups meet 4 times annually. If there is any urgent business arising, then a special meeting of the executive is called, otherwise the executive meet at the conference.

The Institute is active in assisting and supporting members and by giving them training. It has worked closely with government departments including Ministry of Agriculture and Fisheries (MAF) and Local Government Training Board (LGTB).

(4) TRAINING OF NOXIOUS PLANTS OFFICERS

The New Zealand Noxious Plants Officer is accepted as a professional in his service to the community, and especially the agriculture sector, by his promotion of noxious plant control. This status was not easily achieved. It was only by the forging ahead of the Institute and by close liaison with the Noxious Plants Council and training of Officers that achieved this.

With the co-operation of the Local Government Training Board, a Noxious Plants Officer Training network has been established which is responsible for on the job training and competancy assessment. The training is carried out by the occupational group which allows for the establishment and maintenance of consistant and comparable standards. Five training managers, spread through the five regions of New Zealand carry out a communication and co-ordinating role between the executive of the board and individual training officers in the field. These 5 training managers are themselves Noxious Plants Officers.

Effectively trained and developed Noxious Plants Officers results in improved efficiency, greater job satisfaction and a better service to the community. The main objectives of the programme include:- develop the officers competence through improved skills and knowledge; help the officer develop the right attitudes to the job, achieve his full potential and gain personal benefit; promote noxious plant control as a career service in local government; and ensure District Noxious Plant authorities implement effective noxious plant control programmes through, competent well trained staff. New Zealand authorities have recognized that training does not just happen. The right environment for learning has to be created and this is a joint responsibility of the trainee, the trainer and the employing authority.

Training means that the new employee does not just turn up to work and be a competent controller of noxious plants.

There are incentives provided to encourage Noxious Plants Officers to undertake a training programme. These include:- improved status, job security and satisfaction; and a financial one recieved at the completion of training.

Self examination and reviewing ones personal responsibilities should stimulate the noxious plants officer into action for development. Training is ongoing. Some guidelines we should all think about include:- set specific short term and long term goals for work, career and family; be honest and identify personal strengths and weaknesses; take responsibility for personal training and self development; write a personal job description; carry out an annual review of our job performance and effectiveness; develop a personal training and development plan; take some responsibility for the training of others; and have a positive outlook because it is your own future.

Training then is achieved through a 4 step procedure, which generally run simultaneously with each other. Basically a 2 to 3 year period is allowed to complete these steps after which the newly trained officer receives a certificate of proficiency (C.O.P.) The C.O.P. is backed up by regular and continuing in-service training conducted by the Local Government Training Board. Each trained Noxious Plants Officer is expected to participate in these refresher course each 3-5 year period.

The steps for the initial training programme follow the following format.

Step 1: Induction

This lasts for the first week of employment and is aimed at making the first impressions of the job memorable. The thrust is directed towards both the employing authority and introduction to the job. Points to consider include:- conditions of appointment such as hours of work, holidays, pay, deductions, overtime, grievance procedures, sickness, housing and insurance; general welfare including canteen and similar facilities saving schemes, telephone and other allowances, clothing, first aid kit, memberships of N.P.O. Institute, social club, medical society, office facilities (telephone, filing system, typing, library); introduction to job including meeting other staff, reviewing council structure, organisation, management, supervision and council policy, and job content; and an introduction to the N.P.O.'s training programme, drawing up the employees personal training programme.

It should be noted that this section covers a lot of areas generally overlooked by the employer as well as the employee, but if they are systematically checked off, then both sides will benefit greatly.

Step 2 – Secondment

For the new N.P.O. to be effective in the shortest period of time from commencement of work, a 4 week initial training period is undertaken being supervised by a designated regional N.P.O. trainer.

The goal is on the job instruction aiming at introducing basic and essential skills with some theoretical background. This occurs in the regional trainer's district away from the new officers employing authority.

One important aspect of this secondment period is "work priority planning". I am sure that some of us in Australia would benefit greatly by introducing and applying some of these points into our own councils when planning work's programmes and trying to utilize that "elusive" time factor effectively. Some of the key factors studied by our New Zealand counterparts include, seasonal plants priorities; closing dates for grants and subsidies; deadline date for their C.O.P. exams, pesticides exams, conference, training course, branch meeting, District Noxious Plants Authority meetings, Regional Co-ordinating Committee Meetings, field days, Farmers meetings and trainer requirements as well as the daily routine of the job.

Step 3 – On the Job

On the job training is an expansion of the secondment period lasting for up to 2 or 3 years, and is completed with the attainment of a certificate of proficiency.

During this time the Noxious Plants Officer trainer will make at least 3 followup personal visits to the new employee. Each visit lasting 1–2 days. The trainer is available at all times for consultation by the trainee, especially when questions of doubt arise and he requires reasurrance or help in completing various courses or projects.

It is also important that the technical correspondence course covering all theoretical aspects of the job be completed during this period. The course is made up of three stages, covering similar subjects to that covered in the NSW TAFE Weed Control Practice Course. The big difference is the bulk of course material which is about three times greater than that from TAFE.

The pratical, on the job training with occupationally skilled trainers, coupled with the theory from the correspondence course fully equips the new officer for the job. During this training period, the Noxious Plants Officer becomes conversant with legislation, and is able to demonstrate a practical application of the Noxious Plants Act 1978, Noxious Plants Council's policy, the District Noxious Plants Authority's programme and administration, carry out liaison and public relations with various government bodies and individuals including property owners, be effective in property identification and inspection, be able to recognize noxious plants and many of the other common weeds common to the region, and know how to control them, as well as keep good programme and property records. The officer will also receive training in legal aspects of the job including notice for control and court action.

Through all of this, the trainee needs to demonstrate an awareness of environmental factors governing weed control practices.

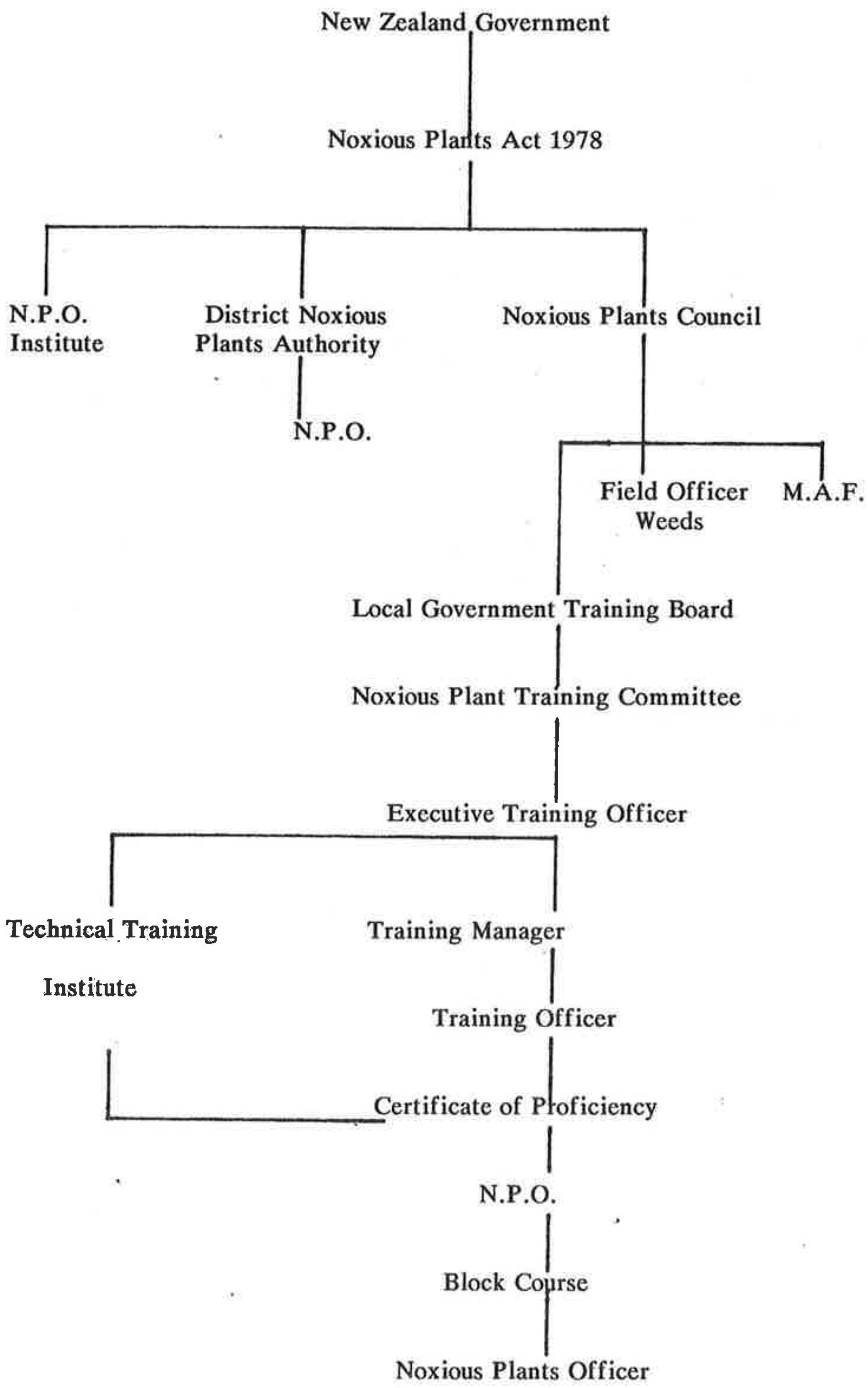
Reports from the trainer on training progress will be submitted to the Noxious Plants Officers Training Committee as well as the trainee's employing authority. The trainer has a standard to work by and when he gauges that progress is not up to scratch, or recognizes the trainee is unsuitable for the job, a recommendation stating these facts is reported to the relevant authorities.

Step 4 – Certificate of Proficiency

This is the final stage. The Noxious Plants Officer trainers have guided and coached their trainees through to an acceptable level of competancy. The new Noxious Plants Officer is recognized so by the issue of a certificate and usually by a financial reward from the employing authority.

Financial subsidies to District Noxious Plant Authorities from M.A.F is dependent upon the employment of a trained and competent noxious plants officer.

(4.1) Flow Chart for Noxious Plants Officers.



(5) WEED CONTROL IN NEW ZEALAND

New Zealand is a close neighbour, climatically speaking. Therefore similar weeds, in similar situations receive similar types of treatment. However, similar results are not always achieved.

(1) Weed Control Using Mechanical Means

The use of ploughs and other cultivating equipment and slashers are common place for the control of noxious and other unwanted plants.

One interesting piece of equipment is the hedge trimmer. This unit, which is tractor mounted is required to proceed adjacent to the hedge at least once every 2 years to trim and keep in check the width and height of hedge. The impenetrable thicket of gorse, boxthorn or barberry is virtually impossible to keep in shape using labour intensive non–mechanical means. The tractor trimmer needs to treat both sides of the hedge consecutively.

(2) Weed Control Using Chemical Means

Technological advancement in the 1940's realized great steps for agriculture in providing another means to help slow and stop the onslaught by weeds. New Zealand was able to boast its own manufacturer of agricultural herbicides which commenced as a private enterprise in 1944. The company Ivon–Watkins–Dow Ltd, manufactured and marketed the new post–war generation of agricultural herbicides, the best known being the phenoxy–herbicides such as 2,4–D and 2,4,5–T. The company holds the record for producing 2,4,5–T for the longest time period, only ceasing to do so a couple of years ago. IWD now has close ties with the Dow Chemical Company.

New Zealand still relies heavily on the use of agricultural chemicals for the control of weeds. However, environmentally sensitive issues are frequently raised and alternative methods for control are being investigated.

Chemical companies and herbicide formulations are similar for both New Zealand and Australia. I am thankful for the assistance given by the various chemical representatives who were able to outline some of the differences which became obvious.

The big difference observed was the increased application rates for active constituents of various herbicides. These ranged from about 50% increase up to 300% increase for some of the New Zealand herbicides over their Australian counterparts. There are basically two reasons for these differences.
Firstly, New Zealand has a once only concept of one treatment. This concept is slowly eroding away as it is being recognized that continued followup and surveillance is required and that total herbicide usage at lower rates is usually less than the once–off high rate.

Secondly, New Zealand's position of being coastal with high average rainfalls, requires a proportionally higher rate of herbicide application.

The other, rather intriguing difference, is the trade name of various herbicide. It is obvious that some of the chosen names have more impact on one country than the other and so the different names have been accepted locally and are unique. However, it is disconcerting when the same names are used in both countries but refer to two totally different herbicides. Some form of name standardization should have been adopted, so that confusion or a serious mistake in application does not occur.

Our New Zealand counterparts carry out a similar role as we do. They often become associated with the trialing and demonstration for use of new and old herbicides. Weed control is constantly changing and with the advent of new formulations, there will always be new uses. New Zealand is not alone in having new, numeralized identity herbicides to work with. It is possible that after an expenditure of tens of thousands of dollars, one of a batch might succeed in getting one of those ambiguous names. Generally speaking, it depends upon the performance of the herbicide in the Noxious Plants Officers hands, whether it gets the final nod.

(3) Weed Control Using Biological Means

Biological means for weed control is popular in New Zealand at present. The New Zealand Department of Scientific and Industrial Research (DSIR) which is equivalent to our CSIRO is very active in research and release of bio–agents for the authorities of various plants.

New Zealand has worked closely with Australian authorities, and often, a release in one country has been repeated by the other. One such example is for St John's Wort. Since 1943, several bio–agents have been released, including the Chrysolmela beetle and Zeuxidiplosis galling midge fly. Results have not been quantified, but the visual impression of lack of St Johns Wort on susceptible pastures areas is obvious. At the same time here in Australia we see St Johns Wort continually spreading into new areas. St Johns Wort is visible in many areas of New Zealand but because of the relative control achieved by biological agents, it is not currently declared noxious.

The DSIR works closely with the District Noxious Plants Authorities in a co–operative programme for the rearing and distribution of insects for the biological control of weeds, during the annual conference hands on experience occurred in catching and identifying insects from the field, working with rearing cages and releasing of insects.

The current co–operative programme is investigating Alligator weed (releasing Vogtia molloi moth), Ragwort (cinnibar moth), Californian thistle, Nodding thistle (releasing crown weevil), Gorse and Broom. Results have been slow and mixed however, through their persistence, long term results will be a benefit to the agricultural community. Some of the biological work is funded directly from the Noxious Plants Council, industry, such as the railways and electricity commisson and some of the District Noxious Plants Authorities. Following are copies of the release site information sheets supplied to the Noxious Plants Officers by the DSIR prior to their receiving shipments of biological agents.

An alternative means for controlling weeds as outlined in the following example is by handweeding and grubbing.

The lodge pole pine (Pinus contorta) was first introduced in the 1880's for timber production. Its timber qualities did not prove acceptable. Soon after, a serious problem was recognised with it. It is a very free seeder and soon large tracts of forest, native forest and parkland reserves were being invaded by this plant in the South Island. Effective control of seedlings which are popping up in areas away from the established lodgepole forests are being effectively controlled by hand pulling and grubbing.

(1) I BIOLOGICAL CONTROL WEEDS – RELEASE SHEET

1. Species released ____________________________

2. Site name __________________ 3. County/DNPA ________

4. Grid Reference _______________________

5. Description and location of site (attach map if appropriate, or sketch below)

____

Details of Release:

6. Date _______ 7. Number released _____ 8. Stage released__

9. Person responsible for release _________

10. Others present ________________________________

11. Name of farmer or owner of property _____________________

12. Noxious Plants Officer _____________________________

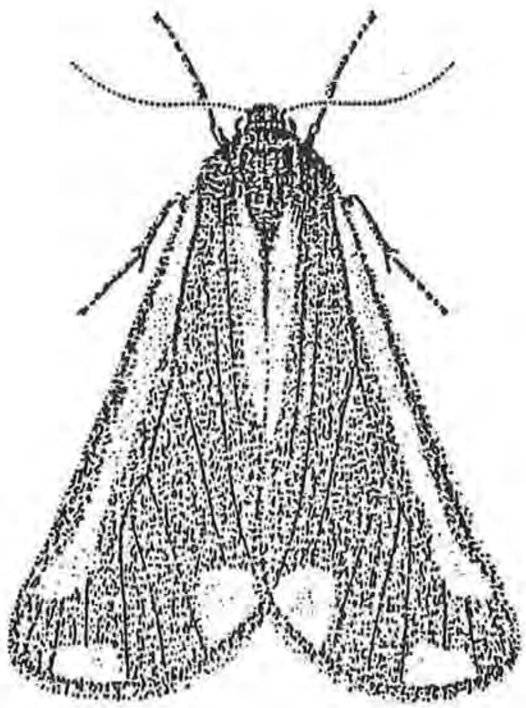
(2) CHOOSING A RELEASE SITE FOR CINNABAR MOTH

The cinnabar moth is usually released as caterpillars in December and January. Large caterpillars are easy to collect in large quantities and their mobility means they spread themselves around the ragwort very readily.

A good release site for cinnabar moth should meet the same criteria as needed for ragwort fleabeetles with two important exceptions:

- cinnabar caterpillars need a high density of ragwort but the plants can be at any stage as the caterpillars eat flowers as well as foliage.

- cinnabar moths spend up to 9 months in the pupal stage. The pupae are very susceptible to drowning in wet conditions and will travel considerable distance to find dry sheltered pupation sites e.g.: sheds or haybarns, hedges, stone walls, fallen logs and other debris on the ground . Bush or scrub growing next to the ragwort usually provides plenty of good pupation sites.



CHOOSING A RELEASE SITE FOR THE RAGWORT FLEABEETLE

The ragwort fleabeetles, (Longitarsus jacobaeae), are released as adults usually in March and April just as they are starting to lay eggs on ragwort rosettes. A good release site should meet the following criteria:-

- the ragwort needs to be reasonably widespread and persistent. As a target species, you need to do your best to eradicate it. Similarly, a few small isolated patches are possible to eradicate even if the weed is neither Class "A" or Class "B". Where eradication is possible, biological control is not so appropriate.

- there needs to be a high density of ragwort rosettes when the fleabeetles are released i.e., at least 1 plant per square metre over an area 20 m x 20 m and scattered rosettes over at least a hectare. Release sites should be connected to neighbouring ragwort areas by occasional plants so that once the insects establish, they can move to other areas.

- the ragwort site should not be heavily stocked and with cattle or deer rather than sheep.

- herbicides should not be used at the release site for 5 years if that is possible.

- have well drained soil that's not waterlogged in winter. The site must not be prone to flooding as that will kill the insects.

- be warm and sunny.

As with other release sites, reasonably easy road access makes it much easier for DSIR or NPO's to check the insects progress at the site.

(3) CHOOSING A RELEASE SITE FOR THE THISTLE CROWN WEEVIL

The thistle crown weevil (Trichosirocalus horridus) requires much the same sort of release site as the more familiar receptacle weevil (Rhinocyllus conicus) does but with one very important difference. The thistle crown weevil is active in winter – it needs nodding thistle rosettes, not bolting or flowering plants.

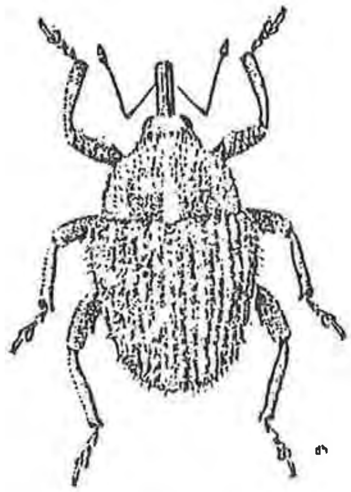
A good release site should meet the following criteria:-

- it should be an extensive and persistent area of nodding thistle with a high density of plants at the release point.

- rosettes must be present in late summer–autumn when the adult weevils start laying eggs. Overseas literature indicates the females prefer the larger rosettes to lay eggs on. These rosettes must persist right through winter as the grubs spend the winter eating out the crown of the rosette. Thistles that bolt to a late autumn flowering are not suitable.

- the site should be warm and sheltered from strong cold winds.

- it should not be prone to flooding or waterlogged conditions.



(4) CHOOSING A RELEASE SITE FOR THE ALLIGATOR WEED MOTH

The alligator weed moth, (Vogtia malloi), can survive in drier situations than the beetle, (Agasicles hygrophila) so a much wider range of habitats are suitable for release sites. Chris Winks has released eggs and larvae on the weed in lakes, creeks, drains, swamps and also in terrestrial situations where the alligator weed encroaches on to farmland. Nevertheless some basic criteria need to be applied when selecting sites.

A good release site should meet the following criteria:-

- an extensive area of healthy alligator weed. The moth can go through several generations in a year with numbers building up rapidly over summer. It is important to give them plenty of room to spread and establish over a wide area.

  herbicides and other control measures (e.g. mechanical clearance) should not be used at the site in the 12–18 months following a release and preferably, not for the next 2–3 years.

  - stock should be excluded from the release site, at least until the moth is well established. cattle especially, feed on alligator weed unintentionally eating any insects inside the stems. The stock problem can be overcome by releasing Vogtoa malloi on weed around an island or in an area beside a dam or lake that has been fenced off, perhaps to protect trees.

– not be prone to severe flooding which may damage the weed and insects in it. However the alligator weed moth is generally able to survive minor flooding quite well.

These criteria will become less important as the alligator weed moth becomes more numerous and widespread. Until then though, the insects are too valuable to risk anywhere other than a good site.

(6) Weed Field Days and Public Relations

It was pleasing to see so many Noxious Plants Officers having access to or using video to record and promote various problems or techniques for control of noxious plants.

One particular Officer purchased several blank tapes and supplied them to high schools within his Authority's area. After giving each school a weed based talk, the competition was set for the best video on why noxious plants are so bad. Apart from some of the amateur drama they contained, the message, using various visual skills, illustrated that these young minds are very impressionable and can be used to our advantage.

Another Noxious Plants Officer had deverloped a weeds educational unit for primary schools, and this has been accepted by the Department of Education and is expected to be widely used across New Zealand.

A field day – known as the Mystery Creek Connection – was held in conjunction with the 19th National Agricultural Field Days at Hamilton in 1987. Being national, support came from all Noxious Plants Officer, the aim of the field day, using the theme "Weed Control – Ask Us" was to improve the public understanding of the principle of noxious plant control, and to promote the various methods of control that are available. Components of the display included: biological control insects; aquatic plant control; controlled grazing management; manual; mechanical and chemical control; goats and gorse control; a noxious plants competition; and a display panel of photographs; information pamphlets and brochures. All of this was achieved in an 8 x 3 m display area. The impact on the public had the desired effect.

Officers are also regular contributors to newspaper items, however, I did not see any evidence of radio or television interviews. To my way of thinking, this is a very vital and necessary public relation avenue and needs pursuing.

(7) FUTURE OF NOXIOUS PLANT CONTROL IN NEW ZEALAND

Changes in Governments and ideas will also see changes in responsibility for various state organizations, and weeds come under this category.

There have been many changes in recent years, the foremost being the formation of the equivalent to our County Council system, known as the District Noxious Plants Authority.

Further, amalgamation is currently being investigated. The future for our counterparts is fairly uncertain with the proposed amalagamation of the local authority with weed and vertebrate pest control units of the government. Regionalisation seems to be the thing in New Zealand with a proposal of several District Authorities amalgamating to form a regional authority based on some climatic or watershed system, and each district to have the one and some noxious plant policy and work towards the aim of the region.

Two Field Officers, equivalent to the Noxious Plants Advisory Officers with NSW Agriculture and Fisheries, continue to be the vital link between government Noxious Plants Council, and the Noxious Plants Officers. They act as inspectors and auditors for the Council as well as in an advisory capacity to the District Authorities. Like our N.P.A.O.'s they are there to assist and give opinions about a Weeds Officer proposed plans and programmes. Good public relations is vital to forge the link between Weeds Officer and Council. Their reports and ideas about current trends, assist in giving overall direction to the Noxious Plants Council. It is unfortunate, however, the whims of Government often overide the plans of mice and men.

(8) GLOSSARY OF NEW ZEALAND TERMS

New Zealand – the place on the other side of the Tasman Sea.
Maori – the native aborigine of New Zealand
Ponga (Prounounced Punga) – Tree Fern
Tutu – not the out building but a poisonous shrub
Tarn – Glacial Lake
N.P.O. – Noxious Plants Officer – has similar character to us.
N.P.C. – Noxious Plants Council – same as Noxious Plants Advisory Committee
D.N.P.A. – District Noxious Plants Authority – same as our County Council
M.A.F. – Ministry for Agriculture and Fisheries
L.G.T.B. – Local Government Training Board
C.O.P. – Certificate of Proficiency
L.U.L.U. – Name of the report on progress submitted by the N.O.P. trainer.
KIWI – a smaller example of our emu. (It lays the same sized eggs as an emu does though.)

(9) CONCLUSION

Once again I would like to thank the sponsors, Du-Pont, for their support of this exchange programme.

It has been a pleasure in being the inaugural recipient of this Award, and I hope that the Award Committee has been pleased with the presented report.

The two nations, closely linked because of their relative position on the earth, similar climates and being settled by new world explorers in recent centuries, have a lot in common to offer for the advancement of weed control and the development of their respective Noxious Plants Officers. I can recommend that this exchange programme be continued.

To forge closer links with our New Zealand counterparts, the New Zealand Institute of Noxious Plants Officers Inc, has bestowed associate membership to the Noxious plants Officers Association of N.S.W.

After considering this report, should you require further explanation on any topic, please do not hesitate in contacting me at Quirindi.

PESTICIDES AND ALLIED CHEMICALS ACT, 1978

SUMMARY

OF

REQUIREMENTS FOR MAKING APPLICATIONS FOR

PERMITS AND PESTICIDE ORDERS.

Paper presented by Col Byrnes,
NSW Agriculture & Fisheries, Sydney

This document is offered as general guidance only. The Act and Regulation should be consulted for the exact wording of the provisions.

Individual applications may be discussed with the Agricultural and Veterinary Chemicals Section by phoning (02) 217-5472.

Issued by:-

The Registrar of Pesticides
Agricultural and Veterinary
Chemicals Section
NSW Agriculture & Fisheries
McKell Building
Rawson Place
SYDNEY NSW

Address all correspondence to:

The Registrar of Pesticides
Agricultural and Veterinary
Chemicals Section
NSW Agriculture & Fisheries
PO Box K220
HAYMARKET NSW 2000

Document AVCS.2

SECTION 1 - GENERAL

1.1 INTRODUCTION

The Pesticides and Allied Chemicals Act 1978, amongst other things, provides for the registration of pesticides, pesticide labels and approval of pesticide containers.

One of the purposes of registration is to ensure that pesticides, when used according to registered label directions, will not be ineffective and not present an undue hazard to humans (by way of direct contact or residues in food), livestock, target and non-target crops or desirable plants, beneficial insects, fish, wildlife, the environment or adversely affect export markets.

Applicants for registration of pesticide products are required to present evidence/data/argument to demonstrate this effectiveness and lack of hazard before inclusion of any claim on a registered label is granted.

This means that any claim or direction for use not appearing on a registered label may, or may not, have been evaluated at registration. That claim or direction therefore may, or may not, be effective and/or present a significant level of hazard.

Under the Pesticides and Allied Chemicals Act 1978 it is an offence to possess or use an unregistered pesticide or use a registered pesticide contrary to its registered label directions unless specific approval has been granted by issue of a permit or pesticide order.

The Registrar of Pesticides can issue permits or pesticide orders, under the Act, to allow persons to do, or omit to do, a number of things which would otherwise be offences.

The broad aim of these provisions is to allow legal use of pesticides for genuine research purposes; to cope with emergency situations (such as the outbreak of an exotic pest in New South Wales); for pest management in crops grown on a small scale, or crops of new varieties, where registered pesticide label recommendations do not exist; and to allow manufacturers, formulators, packers, importers and carriers of pesticide products to conduct certain activities and transactions within the normal course of their respective businesses.

The Registrar of Pesticides is required, under the Pesticides and Allied Chemicals Act 1978, to carefully evaluate applications for issue of permits. Permits and pesticide orders can only be issued where, amongst other things, the interests of public safety and the protection of the environment allows.

1.2. PERMITS AND PESTICIDE ORDERS

A permit or pesticide order may be issued following evaluation of an application for issue of a permit.

PERMITS are issued to an individual or a number of persons named in the permit document. The maximum period for which a permit can remain in force is 12 months. Permits may, however, be renewed for further periods, not exceeding 12 months, upon application.

PESTICIDE ORDERS are issued, subject to certain requirements, where there is widespread need and the issue of individual permits is impractical. The pesticide order is published in the NSW Government Gazette. No maximum period for which a pesticide order may remain in force is prescribed, however, pesticide orders are generally issued for periods of between 1 and 3 years.

1.3. CATEGORIES OF PERMIT APPLICATIONS

Permit applications fall into a large number of categories with varying permutations of requirements under the Pesticides and Allied Chemicals Act 1978.

For example, at one end of the scale there may be the proposition of a qualified research worker desiring to test a few milligrams of a new compound under strict laboratory conditions; whereas, at the other extreme, large scale use of a pesticide by farmers and others is proposed on food crops grown over a large area of the State.

The type and extent of information required to accompany an application for issue of a permit will vary greatly from one proposal to another. General guidelines for "RESEARCH" PERMITS, "USE/CLAIM" PERMITS and "MISCELLANEOUS" PERMITS under the Act are provided in Sections 3, 4 and 5 of this document.

The following list gives examples of the organisations/persons and purposes for which permits are required to be sought:

1.3.1 Manufacturers, Formulators, Packers, Importers, Carriers of Pesticides

* Purpose – have in possession an unregistered pesticide;

  – have in possession a pesticide in an unapproved container or bearing an unregistered label;

  – sell or supply an unregistered pesticide or a pesticide in an unapproved container; with an unregistered label;

  – other.

NOTE: Pesticide orders have been issued to allow manufacturers, formulators, packers, importers and carriers of pesticides to do certain things which are necessary for the conduct of various activities in the ordinary course of their respective businesses.

For further details and relevent terms and conditions, the pertinent pesticide orders must be consulted.

1.3.2 Research Organisations/Officers

* Purpose – use a registered pesticide contrary to its registered label directions.

  – have in possession and use an unregistered pesticide for a specific purpose.

NOTE: Guidelines for submission of "research" permits are outlined in SECTION 3 of this document.

1.3.3 **Advisors, Endusers** (e.g. growers, pest control operators, consultants etc)

* Purpose – use a registered pesticide contrary to its registered label directions

– have in possession and/or use an unregistered pesticide for a specific purpose;

– tender advice that a registered pesticide may be used contrary to its registered label directions;

– tender advice that an unregistered pesticide may be used for a specific purpose.

NOTE: Guidelines for submission of "use/claim" permits are outlined in SECTION 4 of this document.

1.3.4 **Dealers, Wholesalers, Suppliers of Pesticides**

* Purpose – sell or supply an unregistered pesticide;

– tender advice that an unregistered pesticide may be used for a specific purpose;

– tender advice that a registered pesticide may be used contrary to its registered label directions.

– Other.

NOTE: Guidelines for submission of "use/claim" permits are outlined in SECTION 4 of this document.

1.3.5 **Miscellaneous**

An outline of other types of permits is presented in SECTION 5 of this document.

SECTION 2 – APPLICATIONS FOR PERMITS

2.1 WHERE TO LODGE APPLICATIONS

Applications must be lodged with:

The Registrar of Pesticides
Agricultural and Veterinary Chemicals Section
NSW Agriculture and Fisheries
McKell Building
Rawson Place
SYDNEY NSW 2000

Address all correspondence to:

The Registrar of Pesticides
Agricultural and Vterinary Chemicals Section
NSW Agriculture & Fisheries
PO Box K220
HAYMARKET NSW 2000

2.2 DOCUMENTATION

The following documentation is required to be lodged as an APPLICATION FOR ISSUE OF A PERMIT:

(i) **a completed FORM 1;** (a sample of which is provided as ATTACHMENT 1 to this document. Further copies are available from the Agricultural and Veterinary Chemicals Section).

(ii) **adequate supporting data*;**

(iii) **a fee of $10.00** (except where a specific exemption applies, i.e. the applicant is a bona-fide primary producer or an employee of the crown or of a State governmental authority.)
Refer FORM F, a sample of which is provided as ATTACHMENT 7 to this document. Further copies are available from the Agricultural and Veterinary Chemicals Section.

* The type and extent of information required to support an application is outlined in SECTIONS 3, 4 and 5. A series of "convenience" forms have been prepared by the Agricultural and Veterinary Chemicals Section for the assistance of applicants. Further copies of these Forms can be obtained from the Agricultural and Veterinary Chemicals Section. Submission of the prepared forms is not compulsory. Use of word processing facilities or other methods of presentation of supporting information is acceptable so long as complete and adequate information is presented.

2.3 WITHDRAWAL OR AMENDMENT OF AN APPLICATION

An application may be withdrawn or amended, by the applicant, at any time prior to the actual issue of the permit.

The applicant should make the request for withdrawal or amendment in writing, stating the reason for the request.

Please note that the fee paid will not be refunded when the application is withdrawn by the applicant.

2.4 NEW INFORMATION CONCERNING AN APPLICATION

When any new information about a pesticide comes to the knowledge of a person who is, or has been, an applicant for a permit, and that information contradicts or modifies any previous information given by him in an application for issue of a permit, the applicant must immediately supply the new information to the Registrar of Pesticides.

2.5 REJECTION OR CANCELLATION OF PERMITS OR PESTICIDE ORDERS

The Registrar of Pesticides may reject or cancel a permit or pesticide order at any time where information indicates that such action is necessary.

In the event of a permit being rejected or cancelled, the grounds on which the rejection or cancellation was based will be stated to the applicant.

2.6 PROCESSING OF APPLICATIONS FOR ISSUE OF PERMITS BY THE AGRICULTURAL AND VETERINARY CHEMICALS SECTION

Applicants must make due allowance for the time necessary to evaluate applications when planning particular activities.

It will be appreciated that time taken for evaluation of permits will vary depending on the type of permit and the extent of information supporting the application.

It will also be appreciated that inadequately supported applications may result in additional correspondence which may extend the total time of processing. Applicants should therefore ensure that complete and relevant information accompanies an application.

In general, every effort will be made to process "research" permits within 5 working days of receipt.

Where applications need to be referred to appropriate experts (eg. companies marketing the pesticide, NSW Agriculture & Fisheries reviewers, the Division of Occupational Health, the National Parks and Wildlife Service, the National Health and Medical Research Council, or other appropriate experts), the time taken to evaluate applications may extend to several months.

Applications for permits should therefore be made at the earliest possible date to allow for adequate time for evaluation.

Should specific urgent situations arise where issue of a permit is required contact the Agricultural and Veterinary Chemicals Section for further advice.

SECTION 3 – "RESEARCH" PERMITS

Any organisation or individual wishing to conduct experiments or research trials with pesticides, in NSW, must make application for, and be issued with, a permit prior to the commencement of the experiment or research trials.

3 categories have been identified for the purposes of application for, and issue of "research" permits:

(i) RESEARCH ON RESEARCH STATIONS, IN RESEARCH LABORATORIES OR FACILITIES, RESEARCH GLASSHOUSES, UNIVERSITIES OR SIMILAR INSTITUTIONS.

(ii) FIELD TRIALS

(iii) COMMERCIAL EVALUATION TRIALS

The type and extent of information required to support an application for issue of a "research" permit will depend on the trial type, size, design, location, development stage of the pesticide and other factors.

Guidelines for submission of applications for each category are provided below.

3.1 RESEARCH ON RESEARCH STATIONS, IN RESEARCH LABORATORIES OR FACILITIES, RESEARCH GLASSHOUSES, UNIVERSITIES OR SIMILAR INSTITUTIONS

This category includes pesticide screening tests, laboratory assessments and other research conducted and controlled by technically qualified and competent persons to generate scientific data or information within the confines of a Research Station, Research Laboratory or Facility or Research glasshouse, University or similar institution.

3.1.1 Information Required to Support an Application

* Name(s) and complete address(es) of the organisations and premises where the research is to be conducted.

* Further information may be required by the Registrar of Pesticides at his discretion.

This information may be provided in a signed statement or be included on FORM R1, a sample of which is provided as ATTACHMENT 2 to this document. Further copies may be obtained from the Agricultural and Veterinary Chemicals Section, if required.

Applicants may lodge a single application (FORM 1 and FORM R1 or equivalent, and a fee of $10.00, if applicable,) to cover this category of research for a 12 month period.

Further additions or changes to the nominated details can be provided, in writing, for inclusion in the schedule of the permit as these details come to hand.

The permit must be renewed prior to expiry, if applicable.

Specific term(s) and/or condition(s) relating to this category of research are specified in the permit document.

3.2 FIELD TRIALS

This category includes detailed field trials conducted by or under the supervision of technically qualified and competent persons to generate efficacy, residue, crop/animal safety data or other scientific information.

3.2.1 Information Required to Support an Application

The nature and extent of information required to support an application for this category of research permit is detailed on FORM R2, a sample of which is provided as Attachment 3 to this document. Further copies may be obtained from the Agricultural and Veterinary Chemicals Section, if required.

This information may be provided in a signed statement or included on and with FORM R2.

Where trials are proposed to be conducted with pesticides which are not registered under the Act a SAFETY INFORMATION SHEET, or equivalent information, must accompany the application.

It is intended that the person(s) supplying experimental pesticide formulations, such as Agricultural Chemical Companies, provide this information to person(s) conducting field trails either prior to or at the time of forwarding such samples.

Specific term(s) and/or condition(s) relating to this category of research are specified in the permit document.

3.3 COMMERCIAL EVALUATION TRIALS

This category includes commercial evaluation of specific pesticide products under practical field conditions. The pesticide will either be registered under the Act for other purposes or be at final stages of development for registration puıposes.

The size or scale of Commercial Evaluation Trails will be limited to that necessary for the applicant to obtain genuine information on practical field use of the pesticide.

3.3.1 Size or scale of Commercial Evaluation trails:

Trials will be limited to a scale or size that is necessary for the applicant to obtain genuine information on practical field use of the pesticide.

The size or scale of trials may vary with the type of crop/animal being treated, situation, usepattern or other particular circumstances. It is therefore essential that applicants provide adequate justification for the size or scale of proposed trials.

3.3.2 Information Required to Support an Application

The nature and extent of information required to support an application for this category of research permit is detailed on FORM R3, a sample of which is provided as Attachment 4 to this document. Further copies may be obtained from the Agricultural and Veterinary Chemicals Section, if required.

This information may be provided in a signed statement or included on and with FORM R3.

3.3.3. Information to trial co-operators

If the pesticide product is not registered under the Act two copies of the draft proposed label for the product must accompany the permit application. The labels must include the following statement, prominently displayed on the principal panel:

FOR EXPERIMENTAL USE ONLY
THIS PESTICIDE IS NOT REGISTERED
UNDER THE PESTICIDES AND ALLIED
CHEMICALS ACT 1978 (NSW)

If the pesticide product is registered under the Act, two copies of a draft proposed information leaflet for trial co-opertors must accompany the permit application. The information leaflet must include pertinent details of the usepattern and the following statement prominently displayed:

FOR EXPERIMENTAL USE ONLY
THIS USEPATTERN IS NOT REGISTERED UNDER THE PESTICIDES AND ALLIED CHEMICALS ACT 1978 (NSW)

Specific term(s) and/or condition(s) relating to this category of research are specified in the permit document.

SECTION 4 – "USE/CLAIM" PERMITS/PESTICIDE ORDERS

Generally, this category of permit applies only to products which are registered under the Pesticides and Allied Chemicals Act 1978 where issue of a permit is sought to allow a person or persons to:

(i) Prepare for use and/or use a registered pesticide contrary to its registered label directions; and/or

(ii) Tender advice that a registered pesticide may be prepared for use and/or used contrary to its registered label directions

NOTE: Under some specific circumstances 'USE/CLAIM' permits or pesticide orders may be issued for products which are not registered under the Act. Further advise may be obtained by contacting the Agricultural and Veterinary Chemicals Section.

Applicants for this category of permit could include Advisors, Consultants, End-users, Dealers and Suppliers of pesticides under circumstances where, for instance, no products are registered to allow control of a pest in or on a particular crop, animal or situation.

4.1 INFORMATION REQUIRED TO SUPPORT AN APPLICATION

The nature and extent of information required to support an application is detailed on FORM UC1, a sample of which is provided as Attachment 5 to this document. Further copies can be obtained from the Agricultural and Veterinary Chemicals Section, if required.

This information may be provided in a signed statement or be included on and with FORM UC1.

4.1.1 Justification for proposed use

- A brief statement is required of the importance and prevalence of the problem it is proposed to treat
- Indicate the geographical or regional distribution of the potential use

- Indicate whether alternative treatments, including registered pesticides are available

- Where an alternative registered pesticide treatment is available it is essential to give an assessment of the technical advantage offered by the proposed treatment

- A very strong case indicating particular circumstances is required to allow issue of a permit or pesticide order where an alternative registered pesticide is available

Specific term(s) and/or condition(s) relating to this category of permit are specified in the permit document or pesticide order.

SECTION 5 – "MISCELLANEOUS" PERMITS

Other permit situations not previously outlined in this document may include:

- A pest control operator proposing formulation, packaging, labelling of a pesticide and use of that pesticide (by himself or his employees) for a bona fide pest control

- A supplier proposing bulk shipment and/or bulk storage of a pesticide at the site of proposed use.

- Use of specialized systems or methods of application of pesticides

- Other

In general such applications should be accompanied by

* Details of the pesticide (including formulation, packaging and labelling; if applicable)

* Justification for the proposal

* Details of the proposal

* Pertinent supporting technical or other information

* Other information considered necessary for evaluation of the proposal

Individual applications may be discussed with the Agricultural and Veterinary Chemicals Section to determine suitability of the proposal and pertinent requirements.

NSW Agriculture & Fisheries

FORM 1

(CLL.5, 13, 14, 15)

PESTICIDES AND ALLIED CHEMICALS ACT 1978

APPLICATION FOR REGISTRATION/APPROVAL/PERMIT

1. Name of pesticide:
2. Name and complete address of applicant (not a post office box address):
3. Address for service of notices: Telephone: Facsimile Number:
4. Type of application: * ☐ New product * ☐ Additional label * ☐ Additional container * ☐ Permit * ☐ Renewal or transfer of a permit
5. Fees: * ☐ The prescribed fee accompanies this application * ☐ I claim exemption from payment of the prescribed fee

* (insert "x" where appropriate)

The particulars required by the Pesticides and Allied Chemicals Regulation 1979 and any instructions issued by the Registrar of Pesticides accompany this application.

I declare that the information contained in this application and accompanying documentation is complete and true to the best of my knowledge.

Signature:

Name:

Position Held:

Date:

See over for instructions on completing this form.

INSTRUCTIONS FOR COMPLETING FORM 1

1. **Name of pesticide:**

   - Show the full name of the product as appearing on the label. Include words which describe the usage, eg INSECTICIDE, and the company name or other words or figures as needed to differentiate the product from other registered products. However, it is preferable not to show trade mark acknowledgements, eg TM,*, ®, so that these may be changed on product labels without constituting a "New Product".
   - **For permits only,** it is permissible to show the active constituent name or code number rather than individual product names; or to refer to attachments, where permits are sought for more than one pesticide product.

2. **Name and complete address of applicant:**

   - Show the full name of the applicant (company, Government Department or, if the application is being lodged by an individual on his or her own behalf, the person's full name), and the complete street address. In the case of applications for registration, this information must also appear on the product label. Do not use post office box addresses here.

3. **Address for service of notice:**

   - Show your postal address here, or insert "as above".
   - You may also include a phone number and facsimile machine number where shown.

4. **Type of application:**

   - Mark the appropriate box(es).
   - You may apply for more than one category of application on a single Form 1 (eg for both an additional label and an additional container on the one form), or for more than one additional label, additional container, permit, permit renewal or transfer. If more than one application for a particular category is being made, insert the number of applications in the appropriate box (eg show 2 additional containers as " $\boxed{2}$ Additional container").
   - A New Product application automatically includes its labels and containers.
   - More than one proposal for a permit may accompany a single Form 1. A separate Form 1 is not necessary for each proposal.

5. **Fees**

   - Mark the appropriate box(es).
   - If exemption is claimed, full reasons must be provided.
   - A document listing current fees is available from the Registrar's office.
   - If more than one category of application is being made on a single Form 1, ensure the appropriate total fee accompanies the application.

6. Remember to sign the form (unsigned applications CANNOT be accepted), show the name and position held of the person who signs the form, and the date of signing.

FOR OFFICE USE ONLY

Date Received	Fee Received	Initials	Reference Number

ATTACHMENT 2

NSW Agriculture & Fisheries

FORM R1

PESTICIDES AND ALLIED CHEMICALS ACT 1978

RESEARCH PERMIT: RESEARCH FACILITY

Information to accompany an application for issue of a permit to conduct pesticide experiments/assessments within the confines of a research laboratory or research facility; research glasshouses; research station; university or similar institution.

Name(s) and complete address(es) of organization(s) and premises(s) where research is to be conducted.

If insufficient space the information may be provided in a signed attached statement.

Signature: ....

(person signing FORM 1)

Date: ....

NSW Agriculture & Fisheries

FORM R2

PESTICIDES AND ALLIED CHEMICALS ACT 1978

INFORMATION TO ACCOMPANY AN APPLICATION FOR ISSUE OF A PERMIT TO CONDUCT FIELD TRIALS

1. **Identity of the Pesticide**

1.1 Name of pesticide

1.2 Active constituent(s); content in formulation; formulation type:

1.3 The pesticide is registered under the Pesticides and Allied Chemicals Act 1978

☐ YES—proceed to Item 2

☐ NO—a completed "SAFETY INFORMATION SHEET" is attached.

2. **Broad Aim of Trial**

3. **Trial Details**

3.1 Crop/animal/situation:

3.2 Rates(s) and number of applications:

3.3 Method of application (eg boomspray, knapsack sprayer, helicopter, etc):

3.4 Total area/number of animals to be treated:

3.5 Total quantity of pesticide product to be used in trials:

3.6 Expected commencement and completion dates of trials:

3.7 Location(s) and numbers of trials:

4.	**Trial co-operators:** (Persons who may have the pesticide in possession/custody; be preparing for use and/or using the pesticide who are not employees of the applicant).	
4.1 ☐	Not applicable	
4.2 ☐	Not yet finalised. Name(s) and complete address(es) of trial co-operator(s) will be provided not later than 90 days following commencement of the trial.	
4.3 ☐	Name(s) and complete address(es) of trial co-operator(s) are attached.	
5.	**Produce/animals resulting from trial(s):**	
5.1 ☐	Not applicable.	The proposed use is non food. This includes 'industrial' or 'non crop' or 'non animal' situations. 'Non food' does **NOT** include seed dressings for food crops; or pre-plant, pre-emergent or post-emergent soil applications for food crops or pastures (proceed to Item 7).
5.2 ☐	Applicable—proposed method of disposal of produce or animals resulting from trials:	
	5.2.1 ☐	By destruction (proceed to Item 7)
	5.2.2 ☐	By sale of treated produce/animals for human/animal consumption or by grazing of treated areas (complete Item 6).
6.	**Residues in food for humans or animals**	
6.1 ☐	Evidence/data/argument is attached to demonstrate that the existing Maximum Residue Limit (MRL) or Experimental Residue Limit (XRL), established by the National Health and Medical Research Council (NHMRC), would not be exceeded when the pesticide is used as proposed.	
	OR	
6.2 ☐	I certify that NO produce or animals resulting from the trials, including pasture or vegetation within treated areas, will be made available for human and/or animal consumption unless an appropriate MRL or XRL for the produce or animal has been established by NHMRC and any residues present at time of sale or consumption do not exceed the MRL or XRL, as applicable.	
6.3 ☐	The manufacturer/supplier of the pesticide has been contacted and will be supplying information on residues, in support of this application, direct to the Registrar of Pesticides.	

7. I certify that the containers for the pesticide comply with the requirements of Clause 25(1) of the Pesticides and Allied Chemicals Regulations 1979.

Signature: ....
(person signing FORM 1)

Date: ....

EXPERIMENTAL PESTICIDE SAFETY INFORMATION SHEET

1. **Identity of pesticide**

   1.1 Code number/tradename:

   1.2 Active constituent(s); content in formulation; formulation type:

   1.3 Manufacturer/Supplier

   Name:

   Complete address:

   Phone number:

THIS PESTICIDE IS AN EXPERIMENTAL COMPOUND/FORMULATION WHICH HAS NOT BEEN FULLY EVALUATED AT REGISTRATION. THIS PESTICIDE IS NOT REGISTERED UNDER THE PESTICIDES AND ALLIED CHEMICALS ACT 1978 (NEW SOUTH WALES)

2. **Summary of toxicology** of active constituent; and formulated product, if applicable.

3. RECOMMENDED SAFETY DIRECTIONS FOR OPERATORS

4. RECOMMENDED FIRST AID TREATMENT

5. PRECAUTIONS FOR PROTECTION OF THE ENVIRONMENT

6. RECOMMENDATIONS FOR DEALING WITH SPILLAGE AND UNWANTED PRODUCT

7. DATE OF COMPILATION OF THIS FORM

NSW Agriculture & Fisheries

FORM R3

PESTICIDES AND ALLIED CHEMICALS ACT 1978

RESEARCH PERMIT: COMMERCIAL EVALUATION TRIALS

Information to accompany an application for isue of a permit to conduct commercial evaluation trials.

1. **Identity of the pesticide**

1.1 Name of pesticide:

1.2 Active constituent(s); content in formulation; formulation type:

1.3 The pesticide is registered under the Pesticides and Allied Chemicals Act 1978.

1.3.1 ☐ YES—proceed directly to Item 4

1.3.2 ☐ NO—complete further items on this page.

2. **Formulation of the pesticide**

2.1 ☐ The formulation of the pesticide is attached.

2.2 ☐ The formulation of the pesticide will be provided by the manufacturer of the pesticide whose name and complete address is given below:

Company name:

Complete address:

3. **Toxicology**

3.1 The pesticide has been scheduled or is exempt from scheduling by the National Health and Medical Research Council (NHMRC).

3.1.1 ☐ An appropriate entry has been included in Schedule .... of the STANDARD FOR UNIFORM SCHEDULING OF DRUGS AND POISONS (SUSDP) issued by the Commonwealth Department of Health.

3.1.2 ☐ The pesticide has been evaluated by NHMRC and has been exempted from Schedules. An appropriate entry appears in APPENDIX B of the SUSDP.

OR

3.1.3 ☐ A copy of a letter from the Secretary, Drugs and Poisons Schedule Committee (DPSC), advising of recent consideration for scheduling is attached.

NOTE: Commercial evaluation trials will NOT be approved in the absence of prior consideration for scheduling by the National Health and Medical Research Council.

4.	**Justification for conduct of the trial(s):**
5.	**Total quantity of product to be used in trials:**
6.	**Broad locations of the trials:**
7.	**Trial co-operators:** 7.1 ☐ Not yet finalised. Name(s) and complete address(es) of trial co-operators will be provided not later than 90 days after commencement of the trial(s). 7.2 ☐ Name(s) and complete address(es) of trial co-operators are provided below (if insufficient space add an attachment).

8. **Labelling and packaging of the pesticide:**

8.1 ☐ Two copies of the draft proposed label (for a product not currently registered under the Act) or information leaflet (if product is registered under the Act) are attached.

8.2 ☐ I certify that the containers for the pesticide, to be used during the trials, comply with the requirements of Clause 25(1) of the Pesticides and Allied Chemicals Regulation 1979.

8.3 The net contents of the container(s) are ....

9. **Efficacy**

9.1 ☐ Evidence/data/argument is attached to demonstrate that the pesticide would be effective for the purposes claimed.
(A brief summary of information is sufficient).

10. **Crop or animal safety**

10.1 ☐ Not applicable (non crop or non animal treatment).

10.2 ☐ Evidence/data/argument is attached to demonstrate that application of the pesticide will not cause unacceptable phytotoxicity to the crop(s) being treated; or unacceptable toxicity to the animal(s) being treated.
(A brief summary of information is sufficient).

11. **Residues in animals/produce resulting from trial(s)**

11.1 ☐ Not applicable (non crop or non animal treatment)

11.2 ☐ Applicable

11.2.1 ☐ A Maximum Residue Limit (MRL) or Experimental Residue Limit (XRL) has been established by the National Health and Medical Research Council for the pesticide(s) in the animals or produce to be treated.

11.2.2 ☐ Evidence/data/argument is attached to demonstrate that the MRL or XRL, as applicable, would not be exceeded in any treated produce or animals when the pesticide is used as proposed.

11.2.3 ☐ Other (specify).

Signature: ....
(person signing FORM 1)

Date: ....

NSW Agriculture & Fisheries

FORM UC1

PESTICIDES AND ALLIED CHEMICALS ACT 1978

PERMIT/PESTICIDE ORDER USE OF A REGISTERED PESTICIDE CONTRARY TO ITS REGISTERED LABEL DIRECTIONS

Information to accompany an application for issue of a permit or pesticide order to allow a person or persons to prepare for use and/or use a registered pesticide contrary to its registered label directions; and/or to allow a person or person(s) to tender advice that a registered pesticide may be used contrary to its registered label directions.

1. **IDENTITY OF THE PESTICIDE(S)**

Tradename (*)	Manufacturer	Active constituent(s) (#); content in formulation (+); formulation type (x)

OR

A number of products containing the same active constituent(s) and of the same formulation type are currently registered. Application is made for all products containing (complete column opposite)	Active constituent(s) (#): content in formulation (+); formulation type (x)

NOTES:

(*) Tradename: The manufacturer's name of the product. The name by which it is known, promoted, advertised.

(#) Active Constituent: The component in a pesticide product which is principally responsible for the biological effects and is shown as the active constituent on a pesticide product label. Pesticide products contain one or more active constituents.

(+) Content in Formulation: The amount of active constituent contained in a given volume or weight of the pesticide (g/kg or g/L).

(x) Formulation Type: The form of the pesticide as purchased, eg dust, granule, bait, wettable powder, emulsifiable concentrate, suspension concentrate, aerosol, etc.

2. **Justification for proposed use:**

3. **Proposed usepattern(s)-refer notes below**

Crop/Animal/Situation	Pest/Disease/Weed	Rate of application*	Critical comments**
Special precautions for safety to target crop(s)/animals***			

* Rates of application: Be specific. Give rate of application of PRODUCT per hectare; or PRODUCT per volume of water (usually 100 litres of water); or other specific details.

** Critical comments: Give complete directions; including time and frequency of applicaton. Directions must be adequate to clearly indicate how the product(s) is/are to be used.

*** Special precautions for safety to target crop(s) or animal(s): State any precautions necessary, not included on the registered label for the product, which are pertinent to the proposed usepattern. Take into account knowledge of any possible phytoxicity to sensitive varieties of the target crops or animal sensitivity.

4. **Efficacy**

Submit evidence/date/argument to demonstrate that the pesticide(s) would be effective for the intended purposes.

5. **Crop or animal safety**

Submit evidence/data/argument to demonstrate that the pesticide(s) will not cause unacceptable phytotoxicity to the crops being treated; or unacceptable toxicity or sensitivity to the animals being treated:

6. **Earliest and latest dates of application**

Application of the pesticide(s) could be made from ....
(insert month)
to ....
(insert month)

7. **Pesticide residues in animals or produce**

7.1 ☐ Not applicable: The proposed use is nonfood. This includes "industrial" or "non crop" situations. Nonfood does not include seed dressings for food crops; or pre- plant, pre-emergent or post-emergent soil applications for food crops or pastures.

7.2 ☐ Applicable

7.2.1 ☐ Maximum number of applications ....

(Indicate the maximum number of applications of the pesticide that could be made to the crop(s) or animal(s) in a season of severe pest/disease/weed pressure).

7.2.2 ☐ Maximum withholding period .... day(s)
(Indicate the maximum withholding period that would be possible between the last application of the pesticide and harvest, grazing or slaughter).

7.2.3 ☐ Evidence/data/argument is attached to demonstrate that the appropriate Maximum Residue Limit (MRL), established by the National Health and Medical Reseach Council (NHMRC), for the produce/animals would not be exceeded when the pesticide is used as proposed.

7.2.4 ☐ No information is provided to support/justify the acceptability of any residues which may occur in food for human and/or animal consumption.

8. **Number of endusers**

Indicate the approximate number of persons who might use the pesticide product(s) for the proposed purpose:

Number of endusers ....

If known, give the name(s), initial(s) and complete address(es) (not being a post office box number) of these person(s). (If insufficient space add an attachment).

Signature: ....
(person signing FORM 1)

Date: ....

NSW Agriculture & Fisheries

FORM F

PESTICIDES AND ALLIED CHEMICALS ACT 1978

PERMIT APPLICATIONS: CLAIM FOR EXEMPTION FROM PAYMENT OF FEE

Exemption from payment of the prescribed fee pursuant to clause 16 of the the Pesticides and Allied Chemicals Regulation 1979.

This accompanies my application for issue of a Permit for the following pesticide(s):

1. Name of pesticide(s) ....

....

2. I certify that I am (*tick* ☑ *as appropriate*):

☐ **primarily** engaged in the growing of an agricultural or horticultural product.

The name (if applicable) and the complete address of each property owned, occupied or leased by me or the company (as the case may be) on which use of the pesticide(s) (indicated in Item 1 above) is/are proposed; and the agricultural or horticultural product(s) grown on each property is/are:

Name and complete address of each property	Agricultural or horticultural product grown

☐ an officer or employee of the Crown or a Governmental Authority and this application is made in the course of my emloyment by the Crown or that Authority.

Signature: ....
(person signing FORM 1)

Date: ....

USING BRUSH-OFF(R) FOR BRACKEN CONTROL

Bernie Horsfield, Consultant
Industrial Weed Control, Du Pont (Australia) Ltd

TIMING:

SPRAY WHEN:

1. The maximum number of fronds are emerged as rhizomes cannot be killed if it's fronds are not emerged.

2. The Maximum translocation into the Rhizome system occurs from green mature fronds, hence ensure more than 70% of fronds are green.

   BRUSH-OFF(R) does not need slashing first, in fact older fronds help with translocation to root system. However after slashing, ensure the fronds are not too young before spraying.

SLASHING MAY:

* Increase the uniformity of stand age.

* Increase the uniformity of stand height.

* Remove older fronds which other chemicals could not kill.

* Delete rhizome reserves, again to assist chemical control.

FOR GOOD BRACKEN CONTROL WITH BRUSH-OFF(R) APPLY:

1. Handgun - 10g/100L water

2. Boom - 60 g/ha
   Use 200 L/ha water on heavy stands if possible

3. Always add a surfactant 0.1% - Pulse or Du Pont Surfactant and ensure

   - Majority of fronds are green
     Most fronds are unfurled
     Don't spray under stress conditions e.g. frosts (late Autumn), drought stress (over summer months)
     Don't spray too early after slashing

AFTER FROND DEATH:
PASTURE IMPROVEMENT IS ESSENTIAL

Fertilize as soon as possible to encourage:

- competition from grasses
- trampling by stock

Using BRUSH-OFF(R) has little effect on perennial grasses.
Legumes will be removed until soil residue is dissipated.
Don't spray and sow - do spray and fertilize.

CURRENT REGISTRATIONS

RESTRAINTS

* **DO NOT** spray if rainfall is expected within four (4) hours.

DIRECTIONS FOR USE:

GROUND APPLICATION

SITUATION	WEEDS CONTROLLED	STATES	BOOM g/HA	HANDGUN g/100L	RATE GASGUN g/L
Pastures, rights of way, commercial and industrial areas	Common Bracken	QLD, NSW, TAS, WA, SA only	60	10	
	Blackberry	QLD, NSW, TAS, WA SA only		10	1
	Sweet Briar	NSW, TAS, SA only		10	1
	Australian Blackthorn	NSW, QLD only		10	1
	Hawthorn	NSW only			
	Privet	QLD, NSW only		10	1
	Boneseed & Bitou Bush	QLD, NSW, TAS only		10	1
	Rubber Vine	QLD only		15	

AERIAL APPLICATION

SITUATION	WEEDS CONTROLLED	STATES	RATE g/HA
Pastures, rights of way, commercial and industrial areas.	Blackberry	NSW, TAS only	160

DU PONT BRUSH-OFF(R) BRUSH CONTROLLER

ACTIVE CONSTITUENT:
600/kg Metsulfuron Methyl

PACK SIZE:
20 g, 200 g and 500 g

BRUSH-OFF(R) is a sulfonylurea herbicide and is a new generation brush controller for the control of Blackberry, Bracken Fern, Sweet Briar, Rubbervine, Australian Blackthorn, Hawthorn, Privet, Bitou Bush and Boneseed, in pastures, rights of way, commercial and industrial areas.

BRUSH-OFF(R) can be applied by boom, sprayed as a traditional high volume hand gun application, or with a low volume gas gun technique which allows a given volume of spray to cover more bushes, saving on chemical, time and labour.

BRUSH-OFF(R) is a unique, highly concentrated, dry flowable herbicide formulation with the 200 gram pack making up to 2,000 litres of spray mix or a 20 gram pack for knapsack sprayers.

Rainfall within 4 hours of spraying may reduce effectiveness.

Stock do not need to be removed from areas being treated.

BRUSH-OFF(R) is not a hormone type spray. It is a very potent and rapid inhibitor of cell division and plant growth. It works at the growing points of both roots and shoots. Since it affects amino acid production through enzymes found only in plants the product has proved safe to man, wildlife and the environment, when used in accordance with label directions. BRUSH-OFF(R) is mainly absorbed by the foliage, but some root uptake does occur.

Symptoms are slow to appear on woody bushes (Blackberries; Sweet Briar etc.) yellowing of the leaves and distortion of the growing tip of canes and branches are the first sign of activity. Leaves will progressively drop off after turning Autumn colours.

With Bracken Fern the first effects are dead squares on the edges of the fern which slowly ingress over the leaf until brown out occurs. This can take up to three months under adverse conditions, e.g. drought.

GENERAL INSTRUCTIONS

* Apply when bushes/plants are actively growing. Where treatment is delayed or bushes/plants are not actively growing due to adverse conditions or if partial spray coverage occurs, results may be slow to appear and subsequent regrowth may appear.

* Should regrowth occur, re-treatment at the recommended rate is advised. Re-treatment of blackberries should only be undertaken once regrowth has reached one (1) metre tall - this may not be until two (2) years after the initial application.

* For control of bushes previously sprayed with other brush control herbicides ensure twelve (12) months has elapsed.

* Legumes will be removed from pasture if over-sprayed with BRUSH-OFF(R).

* Due to the widespread picking of blackberries by the public, it is recommended that the product is not applied to bushes bearing mature fruit. Spraying bushes which bear mature fruit will not effect the efficacy of BRUSH-OFF(R).

BENEFITS OF BRUSH-OFF(R)

* Economical to use - reduces the need for repeat application.

* Unique packing and measuring system saves time and labour.

* Unique ease-of-use and safety features.

* Non volatile.

* No unpleasant smells.

* Reduces freight, storage and handling costs.

* Easy to dispose of containers.

SPRAY PREPARATION

* To ensure thorough mixing BRUSH-OFF(R) should be premixed with water prior to adding to spray tank. This is particularly important when using cold water.

* BRUSH-OFF(R) is a dry flowable formulation to be mixed with water and applied as a spray. Partially fill the spray tank with water. Using the measuring cone provided measure the amount of product required for the volume to be sprayed. Add the correct amount of product to the spray tank with the agitation system engaged. Top up to the correct volume withwater.THEMATERIALMUSTBEKEPTINSUSPENSIONATALLTIMESBY CONTINUOUS AGITATION.

* Where prepared spray solutions have been allowed to stand even for a short time, thoroughly reagitate before using.

USE OF SURFACTANT (WETTING AGENT)

Always add Du Pont Surfactant at 100 mL/100L of final spray volume (0.1% non-ionic active constituent).

DEGRADATION

BRUSH–OFF(R) breaks down in the environment to form non–toxic, non–residual compounds. Chemical hydrolysis represents the major breakdown pathway. Breakdown occurs most rapidly under the following conditions:

(a) Low soil pH (acid to neutral)

(b) High soil temperatures

(c) Adequate soil moisture

(d) High microbial activity

Photo decomposition and volatilisation play minor roles in rate of disappearance.

An amount of BRUSH–OFF(R) is also degraded in the process of killing the plant.

Average half–life in the soil is 4–6 weeks.

WEED CONTROL ON PROTECTED LAND

R.D. Attwood
Soil Conservation Service, Grafton.

INTRODUCTION

The management of land to ensure sustainable landuse without resource loss is paramount to our survival. The community now expects it and economics demand it.

The short European habitation of 200 years in this country has resulted in the destruction of two thirds of Australia's native forests and woodlands. This destruction allowed or has directly contributed to:

- a general degradation of our agricultural lands with reduced productivity and environmental amenity.
- erosion of much of our productive farming land;
- sedimentation of our streams, rivers and lakes;
- acidification of our soils; and
- local salinity, widespread salinity, such as in the Murray/Darling Basin.

Land degradation is the decline in the condition or quality of the land, as a consequence of misuse or overuse. Some land is more vulnerable to degradation, depending on its position in the landscape and the pressures of landuse imposed on it. Protected land is regarded as sensitive land, more subject to degradation and erosion if stringent precautions are not taken to protect it.

The control of weeds, which normally includes destruction and removal is an important function of any land management strategy. If the weed is woody or more precisely "a tree" as defined in the Soil Conservation Act, 1938, and is located on protected land, the legislative controls can apply to its destruction.

PROTECTED LAND – ITS DESCRIPTION, IDENTIFICATION AND ADMINISTRATION

* The simple description of protected land is:

  "That land considered to require protection against uncontrolled tree destruction".

* Protected land is identified on a map in the following categories:

  Category (a) – land within a catchment area, being land of which the surface generally has, a slope greater than 18 degrees from the horizontal.

  Category (b) – any land in or within 20 metres of the bed or bank of any part of a river, lake, lagoon or swamp.

Category (c) – any land considered to be environmentally sensitive or affected or liable to be affected by soil erosion, siltation or land degradation.

Land that is environmentally sensitive can include:

(i) land in arid, semi-arid, landslip or saline areas;
(ii) land containing rare or endangered fauna or flora;
(iii) land containing sites of archaeological or historical interest;
(iv) land containing bird breeding grounds;
(v) wetlands; and
(vi) areas of scenic beauty.

Maps illustrating protected land are deposited at the local offices of the Soil Conservation Service, Lands Department, Forestry Commission and some local Court Houses. They are a legal document.

* The organisation responsible for administration of protected land is the Catchment Areas Protection Board.

THE CATCHMENT AREAS PROTECTION BOARD AND THE SOIL CONSERVATION ACT

History

The Catchment Areas Board, the forerunner to the Catchment Areas Protection Board was constituted in 1935 by the Crown Lands Consolidation Act, 1913. Its primary function was control over the use, leasing, acquisition and disposal of any land reserved from sale for the purposes of a catchment area.

The Board was reconstituted in 1938 as the Catchment Areas Protection Board with the passing of the Soil Conservation Act. Its functions were changed to make it responsible for the use, leasing, acquisition and disposal of land within an area of erosion hazard. The landmark came in 1972 with transfer of control of tree destruction of Category (b) land to the Board from the Forestry Commission. The provisions were included in the Water Act. Category (a) land was also identified and placed under the Board's authority at this time. In July 1987 Category (c) land was determined and provisions of the Water Act applying to Category (b) land were transferred to the Soil Conservation Act.

Its current functions are:

* Development of guidelines for clearing, logging and tree removal

* Liaison with land user organisations to establish an understanding of environmental management issues and to enlist their support for self regulation.

* Consideration of special vegetation requirements that are important for the protection of specific values within a catchment.

* Directing the preparation of maps, and

* Educating the community on the important role of catchments to the welfare of individuals and the community as a whole.

Composition

The Board is a statutory body consituted under Section 32 of the Soil Conservation Act, 1938 and has the responsbility of administering Division 2 of Part IV of the Soil Conservation Act. It consists of twelve members comprising:

Chairman	–	Minister for Agriculture and Rural AFfairs, The Honourable Ian Armstrong OBE MP.
Deputy Chairman	–	Commissioner of the Soil Conservation Service, Mr. Bob Junor.
Members	–	Secretary, Department of Lands (Mr. Rex Jackson) Director–General, Agriculture & Fisheries (Mr. Rex Bowen) Director, Public Works (Mr. John Tainsh) Director, Forestry Commission (Mr. Hans Drielsman) Director, Department of Water Resources (Dr. Steven Lees) Director, National Parks and Wildlife Service (Mr. Andrew Bond) Director, Department of Planning (Mr. Charles Hill) Director, State Pollution Control Commission (Mr. John Court) or their nominees ( ) and two rural Industries Representatives, Mr. Stan Pitkin, Grafton and Mr. Bruss Gibson, Hay.

All policy, administrative, clerical, secretarial, technical and legal support for the Board is provided by the Soil Conservation Service. Most of the field work is also provided by the Service but with assistance from the Department of Water Resources for assessing non–tidal Category (b) land and Department of Public Works for tidal Category (b) land. With the addition of some category (c) land at the recommendation of the National Parks and Wildlife Service it is anticipated field staff from the National Parks and Wildlife Service will also be assessing proposals for tree destruction.

In any land development and management programme, there is a need to remove trees. Activities such as clearing easements for service corridors, commercial logging, removing non–commercial regrowth and de–snagging rivers will continue. However, it is vital that trees are retained where they should be and are destroyed/removed from areas where they can be, without environmental effect. In addition, the methods of destruction or removal should ensure minimum soil disturbance.

Guidelines have been prepared for officers to assess proposals for authorities. Officers have local delegation to approve proposals within specific guidelines. Sets of standard conditions apply to various categories of tree destuction to ensure authority holders are conversed with and aware of their obligations.

Generally, the legislation and regulations are to ensure a sensible strategy to tree management and destruction on protected land and not prohibition.

The Board is a determining authority under Sections 111 and 112 of the Environmental Planning and Assessment Act, 1979 and as such, assesses the environmental impact of proposals before approval.

"TREES" AS "WEEDS"

The definition of a tree in the Soil Conservation Act is – a perennial plant having a self supporting woody main stem or trucnk which usually develops woody branches. A tree includes sapling, shrub or scrub.

It is clear that a "tree" under the Soil Conservation Act includes many "weeds".

Section 21C of the Act states that:

(1) A person shall not –

(a) ringbark, cut down, fell, poison or otherwise destroy, or cause to be ringbarked, cut down, felled, poisoned or otherwise destroyed; or

(b) top, lop, remove or injure, or cause to be topped, lopped, removed or injured,

any tree on any protected land, except in accordance with an authority issued under section 21D in relation to that land.

Other legislation restricting tree destruction applies under the following Acts:

The Environmental Planning and Assessment Act 1979
The Heritage Act 1977
The Forestry Act 1916
The National Parks and Wildlife Act 1974
The Western Lands Act 1901
The Fisheries and Oyster Farms Act 1935

However, legislation under the Soil Conservation Act, 1938 prevails over all other legislation involving the destruction of trees.

EXEMPTIONS

From February, 1989, all exemptions in the Soil Conservation Act were repealed. In future, exemptions of any type will be made by regulation or by Order of the Catchment Areas Protection Board. They currently apply to Category (a) and Category (b) land but there are no exemptions on Category (c) land.

Category (a) Land

An authority is not required in any period of one year:

* By a person who is required or authorised to do so by or under any Act or by any license, permit, authority or consent granted or issued under any Act. This applies to the occupier of the land (i.e. a person required) as well as a weeds' inspector (a person authorised) in respect of noxious weeds.

* If no more than 7 trees per hectare are to be destroyed.

* To destroy the trees growing on no more than 2 hectares of each separate area of protected land where this area does not comprise more than a quarter of the separate area of protected land if such area is not for the development of a banana plantation, horticulture or the growing of crops.

* Where the trees comprising a banana plantation or orchard are destroyed for harvesting or management purposes, except for complete destruction.

Category (b) Land

There are no general exemptions for this land.

* The exemption gazetted on 3rd February, 1989, applying to noxious weeds states that the plant must be a declared noxious plant in that area listed in the Local Government Act. The destruction or removal must be by hand, by poisoning, or mechanical methods that do not disturb the soil and by a person who is required or authorised to do so.

  Care should be taken to ensure that other trees are not destroyed with the noxious weeds, particularly when using non-selective weedicides or mechanical methods. If the destruction on non-noxious "trees" is unavoidable, and no other exemption is applicable, then an authority is required.

* The exemption gazetted on 3rd February, 1989 applying to weeds under power lines states that trees can be lopped or topped or if under three metres in height, poisoned or destroyed, for the purpose of maintaining the necessary safety clearances under or within 15 metres of an existing power line.

DESTRUCTION METHODS ON PROTECTED LAND

To fulfil the objective of minimising soil disturbance, the preferred methods of destruction are:

1) Removal By Hand - this permits selective destruction without exposing the ground surface. It usually has limited application on weeds of low density or in small areas.

2) Grazing Pressure - Animals are used to control weeds.

   The Soil Conservation Service administers foreshore land surrounding major water storages and has been using goats on these areas for general weed control. They have proven to be an effective and efficient method on protected land. Unless the weeds are noxious, an authority is required.

3) Poisoning – By using a selective herbicide, large areas of non-commercial regrowth/non-environmental amenity trees/non-habitat trees, can be controlled on grazing country. This method has wide application and is widely used.

The use of non-selective weedicides does not satisfy the general principles for the maintenance of trees on specific sites and is discouraged. Aerial use of these weedicides is considered inappropriate. It is impossible to target specific species for removal while retaining desirable ones on sites nominated.

4) Mechanical –

(i) Slashers – This method is very effective on small weeds. Slope constraints limit the usage on areas over 25 degree slope. Electricity supply authorities have hydraulic slashers mounted on track type machines to clear weeds from easements.

(ii) Bulldozers – These are effective on large weeds, however they can cause large soil surface disturbance particularly if a root rake is not used.

REVEGETATION

Revegetation is essential when:

(a) Mechanical methods leave the soil exposed and vulnerable to erosion; and

(b) Removal of the weed canopy proceeds at a faster rate than natural regeneration of desirable species.

Appropriate species and fertilizer recommendations for revegetation are supplied with authorities.

CONCLUSION

The control of weeds on all land is essential. On protected land it has special significance because of the sensitivity of the land and its vulnerability to degradation and erosion.

Methods of destruction and removal are available that will ensure the sustainability of the land resource, while satisfying the legislative controls that apply.

<u>Chemical Control of Sifton Bush</u>
(*Cassinia arcutata* R.Br.)

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

Sifton bush (biddy bush, Chinese scrub) is a native shrub, which grows to about 2 m high. Its leaves are very small and narrow. The flowerheads are yellowish and cover half to two-thirds of the surface areas of the plant. It is widely distributed in Southern N.S.W., South Australia and Victoria. It grows on poorer soils, often in ragged and difficult terrain.

My involvement with Sifton bush started in 1987. A trial was set up in Goulburn, testing eight herbicides. Five herbicides at various rates were included in replicated part of the trial and three in non-replicated observation trials (Table 1).

The results show that Grazon (triclopyr + picloram) at 1:10 ratio was the only treatment from the main replicated trail which gave 100% control, with no regrowth after 13 months.

The other two herbicides which performed well in the non-replicated observation trial were Velpar (hexazinone) and Arsenal (imazapyr). The problem with the last two herbicides is that they are non-selective residual herbicides, killing the undergrowth and leaving a bare area for considerable period. In case of Velpar (hexazinone) there is a problem with its mobility in soil, causing damage to non-target species (e.g. Eucalyptus trees) down slope at considerable distance. The undergrowth is also damaged by Roundup (glyphosate) but because it is a non-residual herbicide, new species will re-establish quickly.

The generally accepted procedure for the application of translocated herbicides, e.g. glyphosate, is at the time when the plant stops active growth, and flowering and seed production commence, while it is still actively photosynthesizing and the surplus photosyntate moves into underground parts. The herbicide, of course, is carried along with it.

However, the first trial with Sifton bush indicated that this accepted procedure does not always work the way it would be expected, and its highlighted a number of problems associates with chemical control of this plant species, such as:

- inadequate coverage
- uptake and translocation

The growing habit of Sifton bush is such that the the massive inflorescence/seed heads are effectively sheltering the green leaves of the plants, or about 50–80% of the visible (spray accessible) surface area, thus preventing sufficient deposition of herbicide droplets.

This could be the reason for the inadequate control achieved during the trial as shown in Table 1. To test this hypothesis, three indentical trials were set up near Bathurst (see Tables 2, 3, and 4).

In these trials, the herbicide Code GGA–131036 was left out because of its very poor control results. The Brush–off (metasulfuron) was retained for further testing, even though it had given similarly poor control. Its mode of action is different from that of glyphosphate or triclopyr and it was thought that the different time of the year for its application could improve its effectiveness.

The first trial was set up before the flowers appeared (November 1988), the second one during the actual flowering stage (February 1989), and the third trial during the seed production stage (May 1989).

The results, as presented, are not complete as yet. However, there are some indications that the timing of herbicide applications should coincide with individual plant growth stages in order to improve the level of control by certain herbicides.

At present, I can make a final conclusion only in respect of Brush–off (metasulfuron), It is not suitable for the Sifton bush control due to the fact, that the variation within each treatment and replication is unusually large (e.g. in a cluster of three bushes there was one dead and two with no effect whatsoever). The reason for this very erratic and inconsistent control is not known.

The inclusion of an additive, such as the wetting agent Ultra wet or a penetrant Pulse , showed only some positive effect in the Goulburn trial and no effect or even a reverse effect in the Bathurst trials. Since the trials near Bathurst are not yet ready for the final evaluations, no final recommendation could be made about the chemical control of Sifton bush.

Chemical Control of Sifton Bush
(with LPG powered spray-gun)

Location: Goulburn | **Date**: 23.3.1987

Treatment	Ratio (herbicide to water)	Control % after 2 (months)	Control % after 5 (months)	Control % after 13 (months)	Regrowth % after 2 (months)	Regrowth % after 5 (months)	Regrowth % after 13 (months)	Comments
Garlon(R) (triclopyr)	1:20	76	81	88	0	4	21	
	1:30	58	68	69	0	18	63	
	1:40	30	34	40	0	21	26	
Grazon(R) (triclopyr+ picloram)	1:10	83	90	100	0	3	0	
	1:20	51	58	99	0	6	1	
	1:30	31	31	54	0	24	49	
Brush-off(R) (metasulfuron)	2.0 g/L	20	40	40	0	59	85	}2 mL/L
	1.5 g/L	36	53	55	0	53	58	}Ultra Wet(R)
	1.0 g/L	33	35	35	0	63	76	}
	1.0 g/L	21	28	29	0	69	76	Nil wetter
Roundup(R) (glyphosate)	1:10	92	99	99	0	5	6	}2 mL/L
	1:20	70	83	83	0	25	40	}Pulse(R)
	1:30	80	94	94	0	13	31	}
	1:30	52	73	73	0	38	67	Nil Pulse(R)
CGA-131036 (Ciba-Geigy Code Number)	2.0 g/L	33	48	48	0	58	75	
	1.5 g/L	10	13	13	0	48	100	
	1.0 g/L	10	13	13	0	90	100	
Observation trial (non-replicated)								
Lontrel(R) (dicloropicolinic acid)	1:20	20	30	30	0	45	60	
	1:30	15	15	15	0	50	60	
	1:40	15	15	15	0	50	95	
Arsenal(R) (imazapyr)	1:30	90	100	100	0	0	0	
	1:60	80	100	100	0	0	0	
	1:90	20	40	40	0	40	50	
Velpar(R) (hexazinone)	1:10	90	100	100	0	0	0	
	1:20	98	100	100	0	0	0	
	1:30	98	100	100	0	0	0	

Location: Bathurst

Experiment No.1. **Date:** 30.11.1988

Treatment	Ratio (herbicide to water)	Control % after 2½	4½	7	12	15 (months)	Regrowth % after 2½	4½	7	12	15 (months)	Comments
Garlon(R) (triclopyr)	1:20+	99	100	100	100	100	0	0	0	0	0	}2 mL/L
	1:30+	72	98	99	99	100	0	6	10	13	14	}Pulse(R)
	1:30	98	100	100	100	100	0	6	6	4	6	Nil Pulse(R)
Grazon(R) (triclopyr+ picloram)	1:20+	78	100	100	100	100	0	9	14	20	25	}2 mL/L
	1:30+	79	95	95	95	95	0	25	36	41	51	}Pulse(R)
	1:30	*	*	*	*	*	*	*	*	*	*	Nil Pulse(R)
Roundup(R) (glyphosate)	1:10+	100	100	100	100	100	0	0	0	0	0	}2mL/L
	1:20+	100	100	100	100	100	0	<1	0	0	0	}Pulse(R)
	1:30+	93	94	94	100	100	0	14	21	11	14	}
	1:30	90	96	96	99	100	0	11	12	4	0	Nil Pulse(R)
Brush-off(R) (metasulfuron)	2.0 g/L+	34	48	52	53	53	0	35	58	58	60	}2 mL/L
	1.5 g/L+	26	48	53	53	53	0	56	76	79	64	}Pulse
	1.5 g/L	36	54	56	56	56	0	59	65	69	86	Nil Pulse(R)
Observation trial (non-replicated)												
Starane(R) (fluroxypyr)	1:20	99	100	100	100	100	0	15	35	45	60	
	1:30	55	98	100	100	100	0	25	20	5	15	
	1:40	60	95	95	95	95	0	25	40	45	70	
	1:60	20	80	80	80	80	0	40	50	80	90	
Velpar(R) (hexazinone)	1:30	100	100	100	100	100	0	0	0	0	0	
	1:40	100	100	100	100	100	0	0	0	0	0	
	1:60	75	85	95	95	95	0	20	8	5	15	
	1:90	35	70	70	75	75	0	35	50	75	90	

* missing treatment

Location: Bathurst

Experiment No.2. Date: 15.2.1989

Treatment	Ratio (herbicide to water)	Control % after 2	4½	9	12 (months)	Regrowth % after 2	4½	9	12 (months)	Comments
Garlon(R) (triclopyr)	1:20+	84	100	100	100	0	3	2	3	}Pulse(R)
	1:30+	43	96	97	97	0	7	20	32	}2 mL/L
	1:30	60	90	100	100	0	3	13	34	Nil Pulse(R)
Grazon(R) (triclopyr+ picloram)	1:20+	44	90	100	100	0	5	7	13	}Pulse(R)
	1:30+	36	91	91	91	0	4	51	70	}2 mL/L
	1:30	31	94	94	94	0	2	30	50	Nil Pulse
Roundup(R) (glyphosate)	1:10+	98	100	100	100	0	1	0	0	}Pulse(R)
	1:20+	93	96	96	96	8	10	10	16	}2 mL/L
	1:30+	98	100	100	100	0	3	0	0	
	1:30	91	96	97	99	<2	3	13	15	Nil Pulse
Brush-off(R) (metasulfuron)	2.0 g/L+	43	44	44	44	31	55	83	85	}Pulse(R)
	1.5 g/L+	38	38	53	60	35	55	80	93	}2 mL/L
	1.5 g/L	41	56	56	56	15	35	73	81	Nil Pulse(R)
Observation trial (non-replicated)										
Starane(R) (fluroxypyr)	1:20	5.5	100	100	100	0	0	10	10	
	1:30	8.5	90	90	90	5	5	35	45	
	1:40	6.0	99	99	99	0	0	20	45	
	1:60	3.5	90	90	90	10	10	55	80	
Velpar(R) (hexazinone)	1:30	99	99	99	99	15	25	40	50	
	1:40	90	90	90	90	10	40	50	75	
	1:60	80	90	90	90	40	50	60	80	
	1:90	80	80	80	80	30	80	90	100	

Location: Bathurst

Experiment No.3. Date: 4.5.1989

Treatment	Ratio (herbicide to water)	Control % after 2 (months)	Control % after 6 (months)	Control % after 9 (months)	Regrowth % after 2 (months)	Regrowth % after 6 (months)	Regrowth % after 9 (months)	Comments
Garlon(R) (triclopyr)	1:20+	66	100	100	0	1	0	Pulse(R)
	1:30+	71	100	100	0	8	11	2 mL/L
	1:30	75	100	100	0	11	14	Nil Pulse(R)
Grazon(R) (triclopyr+ picloram)	1:20+	73	100	100	0	1	0	Pulse(R)
	1:30+	63	100	100	0	2	1	2 mL/L
	1:30	23	99	100	0	4	0	Nil Pulse(R)
Roundup(R) (glyphosate)	1:10+	100	100	100	0	0	0	}Pulse(R)
	1:20+	100	100	100	0	<1	0	}2 mL/L
	1:30+	100	100	100	0	0	0	}
	1:30	100	100	100	0	<2	1	Nil Pulse(R)
Brush-off(R) (metasulfuron)	2.0 g/L+	26	91	93	0	14	16	Pulse(R)
	1.5 g/L+	11	70	73	0	29	75	2 mL/L
	1.5 g/L	3	86	86	0	19	41	Nil Pulse(R)
Observation trial (non-replicated)								
Starane(R) (fluroxypyr)	1:20	70	100	100	0	2	0	
	1:30	45	100	100	0	8	0	
	1:40	20	100	100	0	25	45	
	1:60	15	100	100	0	30	45	
Velpar(R) (hexazinone)	1:30	100	100	100	0	0	0	
	1:40	95	100	100	0	7	0	
	1:60	90	99	99	1	30	30	
	1:90	70	98	100	15	10	0	

Sifton Bush Control with LPG Powered Spray-Gun - Bathurst, NSW - 1988.

Applied: 30.11.88. Experiment No. 1. Page 1.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size Paces x height (m)	No. of shots (50mL/shot)	Control/Regrowth assesed after 2.5	4.5	7 months	12	15	Cost $
Garlon (R)	1:20+	1	12 x 1.7	7 (350 mL)	9.9/-	10/-	10/-	10/-	10/-	0.84
(triclopyr)	1:20+	2	8 x 1.6	3 (150 mL)	9.9/-	10/-	10/-	10/-	10/-	0.36
+Pulse(R) 2mL/L	1:20+	3	9 x 1.2	2.5 (125 mL)	9.9/-	10/-	10/-	10/-	10/-	0.30
12c/shot	1:20+	4	9 x 1.6	4 (200 mL)	9.9/-	10/-	10/-	10/-	10/-	0.48
Garlon (R)	1:30+	5	9 x 1.3	3 (150 mL)	5.0/-	9.9/1.5	9.9/2.0	9.9/4	9.9/5.0	0.24
(triclopyr)	1:30+	6	9 x 1.5	2 (100 mL)	6.0/-	9.5/0.5	9.9/1.0	10/-	10/-	0.16
+Pulse(R) 2mL/L	1:30+	7	11 x 1.6	4 (200 mL)	8.0/-	9.8/0.5	10/0.3	10/0.8	10/-	0.32
8c/shot	1:30+	8	10 x 1.7	4 (200 mL)	9.6/-	10/-	10/0.5	10/0.5	9.9/0.5	0.32
Garlon (R)	1:30	9	12 x 1.5	4 (200 mL)	9.0/-	9.9/0.5	9.9/2.0	9.9/1.5	9.9/2.5	0.31
(triclopyr)	1:30	10	5 x 0.5	1 (50 mL)	10/-	10/1.5	10/-	10/-	10/-	0.08
Nil pulse (R)	1:30	11	6 x 1.0	2 (100 mL)	10/-	10/-	10/-	10/-	10/-	0.16
7.8c/shot	1:30	12	11 x 1.7	4 (200 mL)	10/-	10/0.5	10/0.3	10/-	10/-	0.31
Grazon (R)	1:20+	13	7 x 1.3	1.5 (75 mL)	*	-	-	-	-	0.09
(triclopyr)+	1:20+	14	8 x 1.5	3 (150 mL)	7.5/-	10/0.5	10/0.1	10/2.0	10/1.5	0.18
picloram)	1:20+	15	18 x 1.8	9 (450 mL)	8.0/-	9.9/2.0	9.9/3.5	9.9/4.0	9.9/6.0	0.54
+Pulse(R) 2mL/L	1:20+	16	9 x 1.4	3 (150 mL)	8.0/-	10/0.2	10/1.0	10/-	10/-	0.18
6c/shot										
Grazon (R)	1:30+	17	9 x 1.4	4 (200 mL)	8.0/-	10/1.0	10/-	10/-	10/-	0.16
(triclopyr)+	1:30+	18	6 x 0.9	1.5 (75 mL)	7.5/-	10/2.5	10/3.0	10/2.0	10/3.0	0.10
picloram)	1:30+	19	18 x 1.8	9 (450 mL)	8.0/-	9.0/3.0	9.0/6.5	9.0/8.5	9.0/9.5	0.54
+Pulse(R) 2mL/L	1:30+	20	9 x 1.4	3 (150 mL)	8.0/-	9.0/3.5	9.0/5.0	9.0/6.0	9.0/8.0	0.18
4.1c/shot										
Grazon (R)	1:30	21	18 x 1.9	10 (500 mL)	0/-**	-	-	-	-	0.38
(triclopyr)+	1:30	22	6 x 0.8	1 (50 mL)	0/-	-	-	-	-	0.04
picloram)	1:30	23	8 x 1.4	3 (150 mL)	0/-	-	-	-	-	0.11
Nil Pulse (R)	1:30	24	12 x 1.2	6 (300 mL)	0/-	-	-	-	-	0.23
3.8c/shot										
Roundup (R)	1:10+	25	8 x 1.6	3 (150 mL)	10/-	10/-	10/-	10/-	10/-	0.26
(glyphosate)	1:10+	26	8 1.7	3.5 (175 mL)	10/-	10/-	10/-	10/-	10/-	0.30
+Pulse (R)	1:10+	27	17 x 1.6	9 (450 mL)	10/-	10/-	10/-	10/-	10/-	0.77
2mL/L	1:10+	28	14 x 1.6	10 (500 mL)	10/-	10/-	10/-	10/-	10/-	0.85
8.5c/shot										
Roundup (R)	1:20+	29	10 x 1.6	4.5 (225 mL)	10/-	10/-	10/-	10/-	10/-	0.20
(glyphosate)	1:20+	30	10 x 1.8	7 (350 mL)	10/-	10/0.1	10/-	10/-	10/-	0.31
+Pulse (R)	1:20+	31	9 x 1.6	5 (250 mL)	10/-	10/-	10/-	10/-	10/-	0.22
2mL/L	1:20+	32	9 x 1.7	7 (350 mL)	10/-	10/0.1	10/-	10/-	10/-	0.31
4.4c/shot										

* bush was destroyed.
** probably no herbicides in mixture.

Sifton Bush Control with LPG Powered Spray-Gun - Bathurst, NSW - 1988.

Applied: 30.11.88. Experiment No.1 Page 2.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size Paces x height (m)	No. of shots (50mL/shot)	Control/Regrowth assesed after 2.5 months	4.5	7	12	15	Cost $
Roundup (R)	1:30+	33	6 x 1.0	1 (50mL)	10/-	10/0.1	10/0.5	10/-	10/-	0.03
(glyphosate)	1:30+	34	12 x 1.5	9 (450 mL)	9.0/-	9.0/2/5	9.0/3.0	10/-	10/-	0.27
+Pulse(R)	1:30+	35	10 x 1.5	6 (300mL)	9.8/-	10/0.1	10/-	10/-	10/-	0.18
2mL/L	1.30+	36	8 x 1.6	4 (200mL)	8.5/-	8.5/3.0	8.5/5.0	10/4.5	10/5.5	0.12
3c/shot										
Roundup(R)	1:30	37	12 x 1.5	5 (250mL)	9.5/-	9.9/0.8	9.9/0.5	10/-	10/-	0.14
(glyphosate)	1:30	38	8 x 1.7	5 (250mL)	805/-	8.5/2.0	8.5/3.0	9.5/1.5	10/-	0.14
NIL Pulse(R)	1:30	39	13 x 1.8	6 (300mL)	9.0/-	10/1.0	10/0.5	10/-	10/-	0.16
2.7c/shot	1:30	40	6 x 1.2	1 (50mL)	9.0/-	10/0.5	10/1.0	10/-	10/-	0.03
Brush-off(R)	2g/L+	41	18 x 1.6	10 (500mL)	4.5/-	6.0/4.0	6.0/7.0	6.0/6.0	6.0/7.5	0.93
(metsulfuron)	2g/L+	42	10 x 1.5	5 (250mL)	8.0/-	10/-	10/-	10/-	10/-	0.47
+Pulse(R) 2mL/L	2g/L+	43	6 x 1.8	2 (100mL)	0.5/-	2.0/4.0	3.0/7.0	3.0/5.0	3.0/6.5	0.19
	2g/L+	44	9 x 1.8	3.5(175mL)	0.5/-	1.0/6.0	2.0/9.0	2.0/10	2.0/10	0.33
9.3c/shot										
Brush-off(R)	1.5g/L+	45	8 x 1.8	4 (200mL)	3.0/-	6.0/4.0	6.0/7.0	6.0/8.0	6.0/9.0	0.28
(metsulfuron)	1.5g/L+	46	4 x 1.2	1 (50mL)	1.5/-	3.0/8.0	3.0/9.0	3.0/10	3.0/2.0	0.07
+Pulse(R)	1.5g/L+	47	9 x 1.7	3.5(175mL)	1.0/-	1.0/8.0	3.0/8.0	3.0/9.5	3.0/9.5	0.25
2mL/L	1.5g/L+	48	10 x 1.7	5 (250mL)	5.0/-	9.0/2.5	9.0/6.0	9.0/4.0	9.0/5.0	0.36
7.1c/shot										
Brush-off(R)	1.5g/L	49	15 x 1.6	7 (350mL)	0.5/-	2.0/8.0	3.0/8.5	2.0/9.0	2.0/9.5	0.48
(metsulfuron)	1.5g/L	50	14 x 1.7	7 (350mL)	4.0/-	5.0/6.0	5.0/6.0	5.0/6.0	5.0/7.0	0.48
Nil Pulse(R)	1.5g/L	51	13 x 1.8	5 (250mL)	4.0/-	6.0/5.0	6.0/6.0	6.0/7.5	6.0/8.0	0.34
	1.5g/L	52	17 x 1.6	9 (450mL)	6.5/-	8.5/4.5	8.5/5.5	8.5/10	8.5/10	0.61
6.8c/shot										

Observation Trial (non-replicated)

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size Paces x height (m)	No. of shots (50mL/shot)	2.5	4.5	7	12	15	Cost $
Starane(R) (fluroxypyr)										
8c/shot	1:20	53	14 x 1.7	7 (350mL)	9.9/-	10/1.5	10/3.5	10/4.5	10/6.0	0.56
5.3c/shot	1:30	54	12 x 1.7	6 (300mL)	5.5/-	9.8/2.5	10/2.0	10/0.5	10/1.5	0.32
4c/shot	1:40	55	10 x 1.5	5 (250mL)	6.0/-	9.5/2.5	9.5/4.0	9.5/4.5	9.5/7.0	0.20
2.6c/shot	1:60	56	10 x 1.8	5 (250mL)	2.0/-	8.0/4.0	8.0/5.0	8.0/8.0	8.0/9.0	0.13
Velpar(R) (hexazinone)										
4.5c/shot	1:30	57	10 x 2.0	7 (350mL)	10/-	10/-	10/-	10/-	10/-	0.32
3.4c/shot	1:40	58	9 x 1.5	7 (350mL)	10/-	10/-	10/-	10/-	10/-	0.24
2.3c/shot	1:60	59	15 x 1.9	12 (600mL)	7.5/-	8.5/2.0	9.5/0.8	9.5/0.5	9.5/1.5	0.26
1.5c/shot	1:90	60	9 x 1.5	4 (200mL)	3.5/-	7/3.5	7.0/5.0	7.0/7.5	7.5/9.0	0.06
Nil treated control	-	61	12 x 1.7	-	-	-	-	-	-	-
	-	62	9 x 1.0	-	-	-	-	-	-	-
	-	63	11 x 1.6	-	-	-	-	-	-	-
	-	64	12 x 1.5	-	-	-	-	-	-	-

* = al previous regrowth is dead or dying.

Sifton Bush Control with LPG Powered Spray-Gun - Bathurst, NSW - 1989

APPLIED: 4.5.89

PAGE 1

Experiment No. 3.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size paces x height (m)	No.of Shots (50mL/shot)	Control/Regrowth after 2 months	6	9	Cost $
Garlon(R)	1:20+	1	10 x 1.5	5 (250 mL)	7.0/-	10/-	10/-	0.60
(triclopyr)	1:20+	2	9 x 1.6	4 (200 mL)	6.0/-	9.9/0.5	10/-	0.48
+Pulse(R) 2mL/L	1:20+	3	11 x 1.4	4 (200 mL)	6.0/-	10/-	10/-	0.48
12c/shot	1:20+	4	12 x 1.8	6 (300 mL)	7.5/-	10/-	10/-	0.72
Garlon(R)	1:30+	5	10 x 1.8	5 (250 mL)	8.0/-	10/-	10/-	0.41
(triclopyr)	1:30+	6	10 x 1.6	5 (250 mL)	8.0/-	10/0.5	10/1.5	0.41
+Pulse(R) 2mL/L	1:30+	7	17 x 1.6	9 (450 mL)	6.5/-	10/1.0	10/1.5	0.73
8.1c/shot	1:30+	8	14 x 1.6	8 (400 mL)	6.0/-	10/1.5	10/1.5	0.65
Garlon(R)	1:30	9	12 x 1.7	7 (350 mL)	8.5/-	10/1.5	10/2.5	0.55
(triclopyr)	1:30	10	9 x 1.8	3.5 (175 mL)	8.5/-	10/2.0	10/1.5	0.27
Nil Pulse(R) 2mL/L	1:30	11	14 x 1.8	10 (500 mL)	8.0/-	10/0.5	10/-	0.78
7.8c/shot	1:30	12	9 x 1.5	2 (100 mL0	5.0/-	10/0.5	10/0.5	0.16
Grazon(R)	1:20+	13	10 x 1.6	3 (150 mL)	6.0/-	10/0.5	10/-	0.18
(triclopyr +	1:20+	14	10 x 1.5	4 (200 mL)	6.5/-	10/-	10/-	0.24
picloram)	1:20+	15	15 x 1.8	10 (500 mL)	8.0/-	10/-	10/-	0.60
+Pulse(R) 2mL/L	1:20+	16	12 x 1.9	11 (550 mL)	8.5/-	10/-	10/-	0.66
6c/shot								
Grazon(R)	1:30+	17	14 x 1.8	10 (500 mL)	8.5/-	10/0.4	10/0.5	0.41
(triclopyr +	1:30+	18	11 x 1.9	6 (300 mL)	7.0/-	10/-	10/-	0.25
picloram)	1:30+	19	12 x 1.6	6 (300 mL)	6.0/-	10/-	10/-	0.25
+Pulse(R) 2mL/L	1:30+	20	9 x 1.6	4 (200 mL)	3.5/-	10/0.5	10/-	0.16
4.1c/shot								
Grazon(R)	1:30	21	9 x 1.5	3 (150 mL)	1.5/-	9.8/1.0	10/-	0.11
(triclopyr +	1:30	22	8 x 1.6	2.5 (125 mL)	3.0/-	10/0.2	10/-	0.10
picloram)	1:30	23	11 x 1.7	6 (300 mL)	3.5/-	10/0.2	10/-	0.23
Nil Pulse	1:30	24	10 x 1.5	7 (350 mL)	1.0/-	10/-	10/-	0.27
3.8c/shot								
Roundup(R)	1:10+	25	9 x 1.6	5 (250 mL)	10/-	10/-	10/-	0.43
(glyphosate)	1:10+	26	11 x 1.8	7 (350 mL)	10/-	10/-	10/-	0.60
+ Pulse(R)	1:10+	27	8 x 1.6	3 (150 mL)	10/-	10/-	10/-	0.26
2mL/L	1:10+	28	10 x 1.6	6 (300 mL)	10/-	10/-	10/-	0.51
8.5c/shot								
Roundup(R)	1:20+	29	8 x 1.4	3 (150 mL)	10/-	10/0.2	10/-	0.13
(glyphosate)	1:20+	30	13 x 1.9	10 (500 mL)	10/-	10/-	10/-	0.44
Pulse(R)	1:20+	31	12 x 1.8	9 (450 mL)	10/-	10/-	10/-	0.40
20mL/L	1:20+	32	11 x 2.0	10 (500 mL)	10/-	10/-	10/-	0.44
4.4c/shot								

APPLIED: 4.5.89

Experiment No. 3.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size paces x height (m)	No.of Shots (50mL/shot)	Control/Regrowth after 2 months	6	9	Cost $
Roundup®	1:30+	33	13 x 1.9	7 (350 mL)	10/-	10/-	10/-	0.27
(glyphosate)	1:30+	34	14 x 2.0	9 (450 mL)	10/-	10/-	10/-	0.27
+Pulse(R) 2mL/L	1:30+	35	13 x 1.9	9 (450 mL)	10/-	10/-	10/-	0.27
3c/shot	1:30+	36	10 x 1.8	5 (250 mL)	10/-	10/-	10/-	0.15
Roundup(R)	1:30	37	6 x 1.6	3.5 (175 mL)	10/-	10/-	10/-	0.09
(glyphosate)	1:30	38	13 x 1.4	9 (450 mL)	10/-	10/0.5	10/0.5	0.24
Nil Pulse(R)	1:30	39	14 x 2.0	12 (600 mL)	10/-	10/0.1	10/-	0.32
2.7c/shot	1:30	40	7 x 1.3	2 (100 mL)	10/-	10/-	10/-	0.05
Brush-Off(R)	2g/L+	41	10 x 1.6	6 (300 mL)	3.0/-	7.5/2.0	7.5/3.0	0.59
(metsulfuron)	2g/L+	42	4 x 1.7	5 (250 mL)	1.5/-	9.5/1.5	10/-	0.47
+ Pulse(R) 2mL/L	2g/L+	43	12 x 1.7	6 (300 mL)	4.0/-	10/0.5	10/1.0	0.59
9.3c/shot	2g/L+	44	9 x 1.9	5 (250 mL)	2.0/-	9.5/1.5	9.5/2.5	0.47
Brush-Off(R)	1.5g/L+	45	12 x 1.9	7 (350 mL)	1.0/-	7.0/3.0	7.0/8.0	0.50
(metsulfuron)	1.5g/L+	46	11 x 1.7	(350 mL)	2.5/-	7.0/3.0	7.0/7.0	0.50
+Pulse(R)	1.5g/L+	47	9 x 1.5	2.5 (125 mL)	0.5/-	8.0/3.0	8.0/8.0	0.18
2mL/L	1.5g/L+	48	6 x 1.4	2 (100 mL)	0.5/-	7.0/2.5	7.0/7.0	0.14
7.1c/shot								
Brush-Off(R)	1.5g/L+	49	11 x 1.6	6 (300 mL)	0.5/-	7.0/2.5	7.0/4.5	0.41
(metsulfuron)	1.5g/L+	50	9 x 1.6	3 (1.5 mL)	1.5/-	8.5/3.0	8.5/7.0	0.20
Nil Pulse(R)	1.5g/L+	51	9 x 1.4	3 (150 mL)	1.0/-	9.0/2.0	9.0/5.0	0.20
6.8c/shot	1.5g/L+	52	8 x 1.6	2.5 (125 mL)	9.0/-	10/-	10/-	0.17
Observation Trial (non-replicated)								
Starane(R) (fluroxpyr)								
8c/shot	1:20	53	12 x 1.6	8 (400 mL)	7.0/-	10/0.2	10/-	0.64
5.3c/shot	1:30	54	11 x 1.7	6 (300 mL)	4.5/-	10/0.8	10/-	0.32
4c/shot	1:40	55	12 x 1.8	7 (250 mL)	2.0/	10/2.5	10/4.5	0.28
2.6c/shot	1:60	56	9 x 1.8	7 (350 mL)	1.5/-	10/3.0	10/4.5	0.08
Velpar(R) (hexazinone)								
4.5c/shot	1:30	57	10 x 1.7	4 (200 mL)	10/-	10/-	10/-	0.18
3.4c/shot	1:40	58	11 x 2.0	8 (400 mL)	9.5/-	10/0.7	10/-	0.27
2.3c/shot	1:60	59	10 x 1.5	5 (250 mL)	9.0/0.1	9.9/3.0	9.9/3.0	0.12
1.5c/shot	1:90	60	11 x 1.6	6 (300 mL)	7.0/1.5	9.8/1.0	10/-	0.10
Nil treated	-	61	-	-	-	-	-	-
control	-	62	-	-	-	-	-	-
	-	63	-	-	-	-	-	-
	-	64	-	-	-	-	-	-

Sifton Bush Control with LPG Powered Spray-Gun - Bathurst, N.S.W. - 1989.

Applied: 15.2.89 Experiment No. 2. Page 1.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size Faces x height (m)	No. of shots (50mL/shot)	Control/Regrowth after 2 months	4.5 months	9 months	12 months	Cost $
Garlon (R)	1:20+	1	12 x 1.4	4 (200 mL)	9.5/-	10/-	10/-	10/-	0.48
(triclopyr)	1:20+	2	12 x 1.7	4 (200 mL)	10/-	10/-	10/-	10/-	0.48
+Pulse (R) 2mL/L	1:20+	3	14 x 1.4	4 (200 mL)	6.0/-	10/-	10/-	10/-	0.48
12c/shot	1:20+	4	15 x 1.5	5 (250 mL)	8.0/-	10/0.1	10/0.8	10/1.0	0.60
Garlon (R)	1:30+	5	15 X 1.7	5 (250 mL)	7.0/-	9.9/0.1	10/1.5	10/2.0	0.41
(triclopyr)	1:30+	6	16 x 1.8	9 (450 mL)	5.0/-	9.0/0.1	9.0/3.0	9.0/4.0	0.73
+Pulse (R) 2mL/L	1:30+	7	9 x 1.5	3 (150 mL)	1.0/-	9.5/-	10/2.5	10/6.0	0.24
8c/shot	1:30+	8	6 x 0.9	1 (50 mL)	4.0/-	9.9/0.1	9.9/1.0	9.9/1.0	0.08
Garlon (R)	1:30	9	7 X 1.4	1.5 (75 mL)	3.0/-	6.0/1.0	9.9/4.0	9.9/6.0	0.12
(triclopyr)	1:30	10	11 x 1.6	5 (250 mL)	5.5/-	9.9/0.1	9.9/4.0	9.9/6.0	0.39
Nil Pulse (R)	1:30	11	5 x 1.2	1 (50 mL)	8.5/-	10/-	10/-	10/-	0.08
7.8c/shot	1:30	12	9 x 1.6	4 (200 mL)	7.0/-	9.9/0.1	10/1.0	10/1.5	0.31
Grazon (R)	1:20+	13	6 x 1.4	1.5 (75 mL)	6.0/-	10/-	10/-	10/-	0.09
(triclopyr)+	1:20+	14	11 x 1.7	5 (250 mL)	4.0/-	9.0/-	10/-	10/-	0.30
Picloram)	1:20+	15	15 x 1.7	6 (300 mL)	5.0/-	8.0/0.1	10/0.1	10/-	0.36
+Pulse (R) 2mL/L	1:20+	16	10 x 1.5	3 (150 mL)	2.5/-	9.0/0.1	9.8/2.5	9.8/5.0	0.18
6c/shot									
Grazon (R)	1:30+	17	7 x 1.3	1.5 (75 mL)	5.5/-	9.9/1.0	8.0/7.0	8.0/80	0.06
(triclopyr)+	1:30+	18	7 x 1.4	1.5 (75 mL)	5.0/-	10/0.2	10/4.5	10/9.0	0.06
Picloram)	1:30+	19	8 x 1.8	4 (200 mL)	3.0/-	9.5/0.1	9.5/1.0	9.5/1.0	0.16
+Pulse (R) 2mL/L	1:30+	20	6 x 1.3	1.5 (75 mL)	1.0/-	8.0/0.3	8.0/8.0	8.0/9.0	0.06
4.1c/shot									
Grazon (R)	1:30	21	8 x 1.7	6 (300 mL)	2.0/-	9.5/0.5	9.5/4.0	9.5/8.0	0.23
(triclopyr)+	1:30	22	9 x 1.8	6 (300 mL)	1.0/-	9.0/0.3	9.0/5.5	9.0/8.5	0.23
picloram)	1:30	23	14 x 1.2	4 (200 mL)	6.5/-	9.9/0.1	10/-	10/-	0.15
Nil Pulse	1:30	24	10 x 1.4	4 (200 mL)	3.0/-	9.0/-	9.0/2.5	9.0/3.5	0.15
3.8c/shot									
Roundup (R)	1:10+	25	10 x 1.8	5 (250 mL)	10/-	10/-	10/-	10/-	0.46
(glyphosate)	1:10+	26	7 x 0.8	1 (50 mL)	9.0/-	10/-	10/-	10/-	0.09
+ Pulse (R)	1:10+	27	14 x 2.0	7 (350 mL)	10/-	10/0.3	10/-	10/-	0.60
2mL/L	1:10+	28	7 x 1.5	2 (100 mL)	10/-	10/0.1	10/-	10/-	0.17
8.5c/shot									
Roundup (R)	1:20+	29	14 x 1.7	8 (400 mL)	8.5/0.5	9.5/1.0	9.5/1.5	9.5/3.0	0.35
(glyphosate)	1:20+	30	7 x 1.5	2 (100 mL)	9.5/0.5	10/0.5	10/1.0	10/1.0	0.09
+ Pulse (R)	1:20+	31	8 x 1.5	2 (100 mL)	9.0/2.0	9.0/2.0	9.0/1.5	9.0/2.5	0.09
2mL/L	1:20+	32	11 x 1.8	6 (300 mL)	10/-	10/0.5	10/-	10/-	0.26
4.4c/shot									

Sifton Bush Control with LPG Powered Spray-Gun
- Bathurst, N.S.W. - 1989.

Applied: 30.11.88. Experiment No. 2. Page 2.

Treatments & cost/shot	Ratio (herb. in water)	Plot No.	Bush size Paces x height (m)	No. of shots (50mL/shot)	Control/Regrowth after 2 months	4.5 months	9 months	12 months	Cost $
Roundup (R)	1:30+	33	9 x 1.4	5 (250 mL)	9.0/-	9.9/1.0	10/-	10/-	0.15
(glyphosate)	1:30+	34	12 x 1.8	8 (400 mL)	10/-	10/-	10/-	10/-	0.24
+ Pulse (R)	1:30+	35	7 x 1.5	2 (100 mL)	10/-	10/-	10/-	10/-	0.06
2mL/L	1:30+	36	10 x 1.4	5 (250 mL)	10/-	10/0.1	10/-	10/-	0.15
3c/shot									
Roundup (R)	1:30	37	9 x 1.5	4 (200 mL)	8.5/0.2	9.9/0.3	9.9/2.0	9.9/3.5	0.11
(glyphosate)	1:30	38	9 x 1.5	3 (150 mL)	10/-	10/-	10/-	10/-	0.08
Nil Pulse (R)	1:30	39	12 x 1.4	7 (350 mL)	9.0/0.2	9.5/0.3	10/1.5	10/1.0	0.19
2.7c/shot	1:30	40	8 x 1.4	4 (200 mL)	9.0/0.2	9.0/0.3	9.9/1.5	9.9/1.5	0.11
Brush-Off (R)	2g/L+	41	6 x 1.5	2.5 (125 mL)	9.0/2.5	9.0/3.5	9.0/4.0	9.0/4.0	0.23
(metsulfuron)	2g/L+	42	9 x 1.4	5 (250 mL)	1.0/0.5	1.5/4.0	1.5/9.5	1.5/10	0.56
+ Pulse (R) 2mL/L	2g/L+	43	5 x 1.1	1 (50 mL)	2.5/6.0	2.5/8.5	2.5/10	2.5/10	0.09
9.3c/shot	2g/L+	44	14 x 1.8	8 (400 mL)	4.5/3.5	4.5/6.0	4.5/9.5	4.5/10	0.74
Brush-Off (R)	1.5g/L+	45	10 x 1.6	3 (150 mL)	2.0/4.0	2.0/5.0	2.0/6.0	2.0/9.0	0.21
(metsulfuron)	1.5g/L+	46	9 x 1.5	3 (150 mL)	4.0/5.0	8.5/2.5	8.5/9.0	8.5/9.5	0.21
+ Pulse (R)	1.5g/L+	47	20 x 1.5	11 (550 mL)	5.0/5.0	9.5/2.0	9.5/7.5	9.5/9.0	0.78
2mL/L	1.5g/L+	48	8 x 1.8	3 (150 mL)	4.0/2.5	6.0/4.7	6.0/9.5	6.0/9.5	0.21
7.1c/shot									
Brush-Off (R)	1.5g/L	49	11 x 1.8	5 (250 mL)	0.5/0.5	2.5/5.0	2.5/9.0	2.5/9.5	0.34
(metlsulfuron)	1.5g/L	50	12 x 1.6	4 (200 mL)	7.0/2.5	8.5/2.5	8.5/7.0	8.5/8.0	0.27
Nil Pulse (R)	1.5g/L	51	11 x 1.8	5 (250 mL)	7.0/1.0	9.5/2.0	9.5/3.5	9.5/5.0	0.34
	1.5g/L	52	9 x 1.5	4 (200 mL)	2.0/2.0	2.0/4.5	2.0/9.5	2.0/10	0.27
6.8c/shot									
Obersvation Trial (non-replicated)									
Starane (R) (fluroxypr)									
8c/shot	1:20	53	7 x 1.7	1.5 (75 mL)	5.5/-	10/-	10/1.0	10/1.0	0.12
5.3c/shot	1:30	54	14 x 1.8	8 (400 mL)	8.5/0.5	9.0/0.5	9.0/3.5	9.0/4.5	0.42
4c/shot	1:40	55	10 x 1.3	3.5 (175 mL)	6.0/-	9.9/-	9.9/2.0	9.9/4.5	0.14
2.6c/shot	1:60	56	12 x 1.8	6 (300 mL)	3.5/1.0	9.0/1.0	9.0/5.5	9.0/8.0	0.16
Velpar (R) (hexazinone)									
4.5c/shot	1:30	57	12 x 1.7	8 (400 mL)	9.9/1.5	9.9/2.5	9.9/4.0	9.9/5.0	0.36
3.4c/shot	1:40	58	10 x 1.5	4 (200 mL)	9.0/1.0	9.0/4.0	9.0/5.0	9.0/7.5	0.14
2.3c/shot	1:60	59	10 x 1.5	3.5 (185 mL)	8.0/4.0	9.0/5.0	9.0/6.0	9.0/8.0	0.08
1.5c/shot	1:90	60	10 x 1.8	4 (200 mL)	8.0/3.0	8.0/8.0	8/9.0	8.0/10	0.06
Nil treated	-	61	12 x 1.7	-	-	-	-	-	-
control	-	62	9 x 1.0	-	-	-	-	-	-
	-	63	11 x 1.6	-	-	-	-	-	-
		64	12 x 1.5	-	-	-	-	-	-

The numbers on tags are underlined 1, 2, 3, ...

S.R.A. REORGANISATION

A.B. McLennan,
Agronomist,
State Rail Authority of N.S.W.

No doubt you have all heard either through the grapevine, or media that the State Rail Authority is being re-structured.

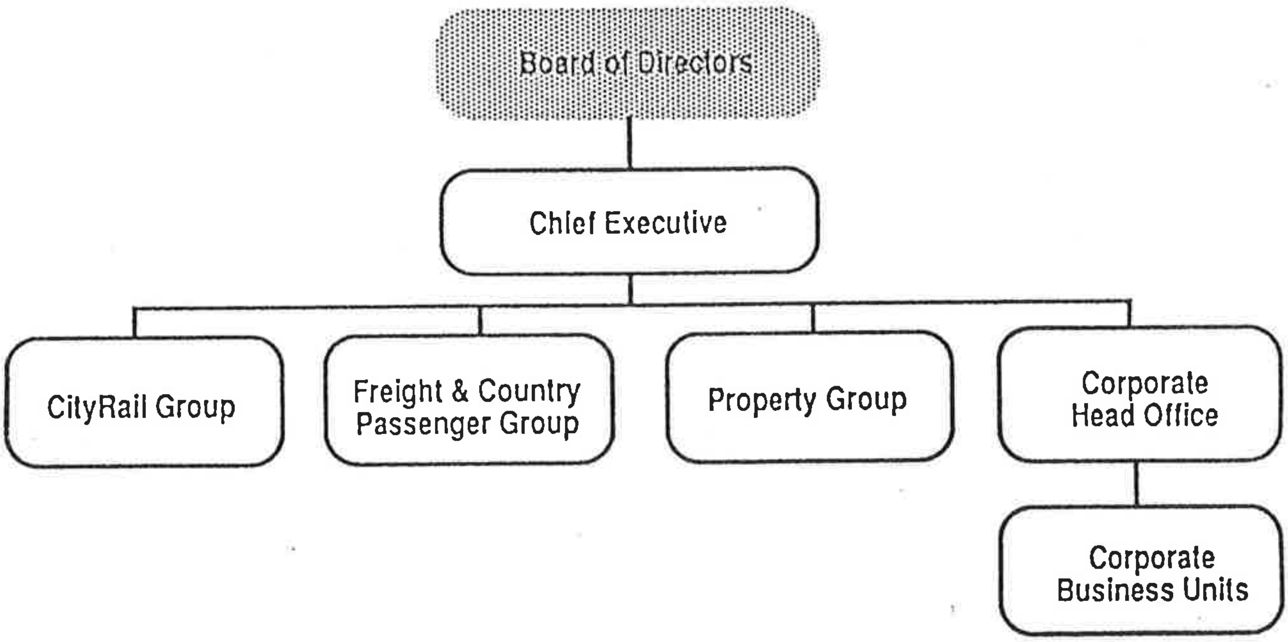
The in-house term is "being devolved".

In simple terms it means change.

State Rail has been divided into two (2) business orientated groups.

Refer to diagram:

NEW CORPORATE STRUCTURE



The two groups in this corporate structure which will be of interest to you are:-

* FREIGHT AND COUNTRY PASSENGER GROUP

* CITYRAIL

The stated aim of these two groups is to:

- aim for freight commercial viability
- City Rail – minimum Government support for agreed service
- reduce levels of management
- decentralise decision making

and also to provide easier access to management within rural areas for faster and more responsible services. Further, the "persons" responsible for providing the service will be located in country regions and not part of a remote bureaucracy in the "Green House" system.

Because today we are in beautiful down-town LISMORE, let us now look at the structure of the FREIGHT AND COUNTRY PASSENGER GROUP, TRACK AND STRUCTURES AREAS.

In diagram 2 you will see that the line of authority runs from the Group General Manager to the recently appointed Regional General Managers located as follows:

SOUTHERN REGION	MR. DICK SMITH, WAGGA WAGGA
WESTERN REGION	MR. IAN HILL, ORANGE
NORTHERN REGION	MR. BRUCE HALL, NEWCASTLE
METROPOLITANREGION	MR. BOB O'LOUGHLIN, SYDNEY TERMINAL

The Rail Network map indicates the geographic regional boundaries.

THE SOUTHERN REGION

Encompasses GOULBURN to ALBURY including CANBERRA, WAGGA WAGGA and the RIVERINA.

THE NORTHERN REGION

Stretches from NEWCASTLE to the QUEENSLAND BORDER and Northwest to WERRIS CREEK – MOREE and WALGET and also ARMIDALE.

THE WESTERN REGION

Extends from LITHGOW through to BATHURST thence BROKEN HILL and Northwest to NYNGAN and COBAR and also the MUDGEE AREA.

As in the past some Councils/Shires will still be involved with more than regional or Divisional areas.

Within each Region there still remains the Division Engineer structure located as the map shows. Some changes may be effected in the future as to the number of Divisional Offices.

From the Organisation Diagram you will be able to obtain addresses and phone numbers.

Each Region has the services of a Technical Officer (Vegetation) and their names and addresses are included.

Now turning to the CITYRAIL Group.

In general terms the Group consists of all the electrified lines within the urban interurban network. However, some goods lines and yards belong to the Freight and Country Passenger Group.

The structure of Cityrail has been divided into 4 maintenance regions with Regional General Managers:-

* NORTHERN -STRATHFIELD - NEWCASTLE (INCLUDING SHORE)
* WESTERN -CLYDE - BOWENFELS
* SOUTHERN -STRATHFIELD - MACARTHUR
* ILLAWARRA -SYDNEY - NOWRA

Refer to Cityrail Diagram for details of areas covered.

Confusion may arise as there is also a Line General Manager handling somewhat similar areas but responsible for passenger travel and train running.

Technical Officer (Vegetation) Ulf Lorenz based in Sydney should be able to assist should difficulties be experienced in handling vegetation problems.

City Rail Group

Group General Manager
Rob Schwarzer

Regional Engineering Manager

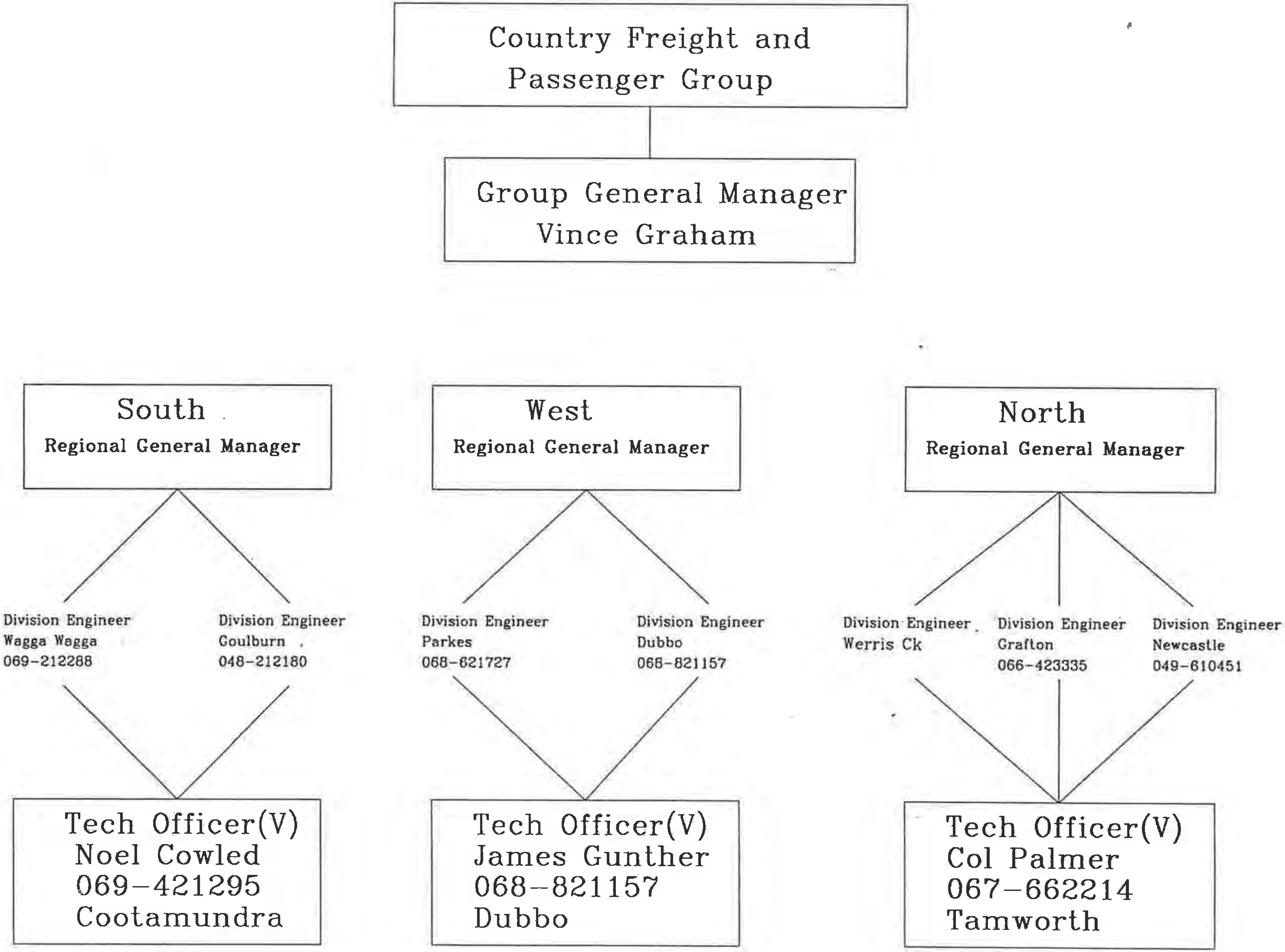
* Northern
* Southern
* Illawarra
* Western

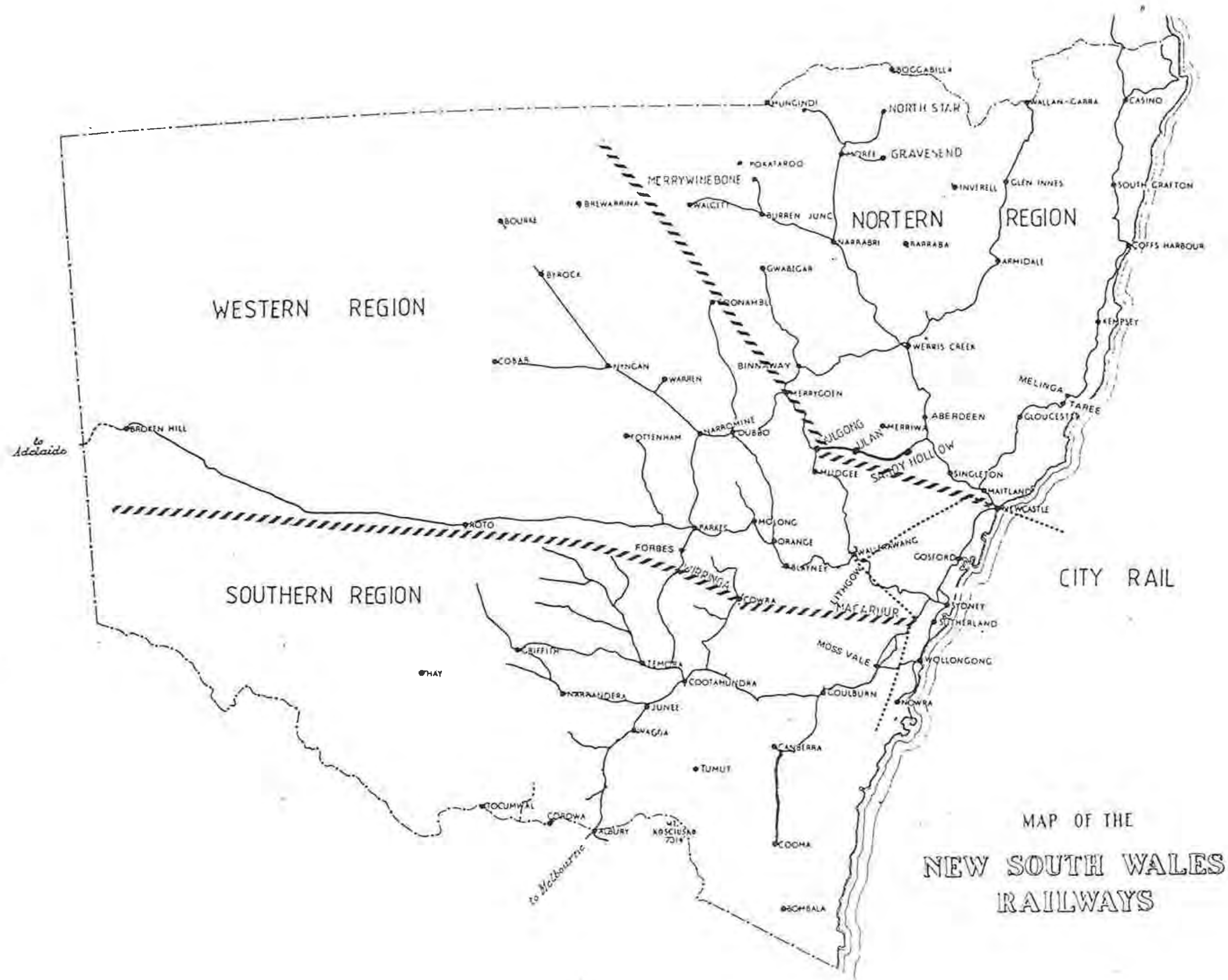
Technical Officer
Vegetation

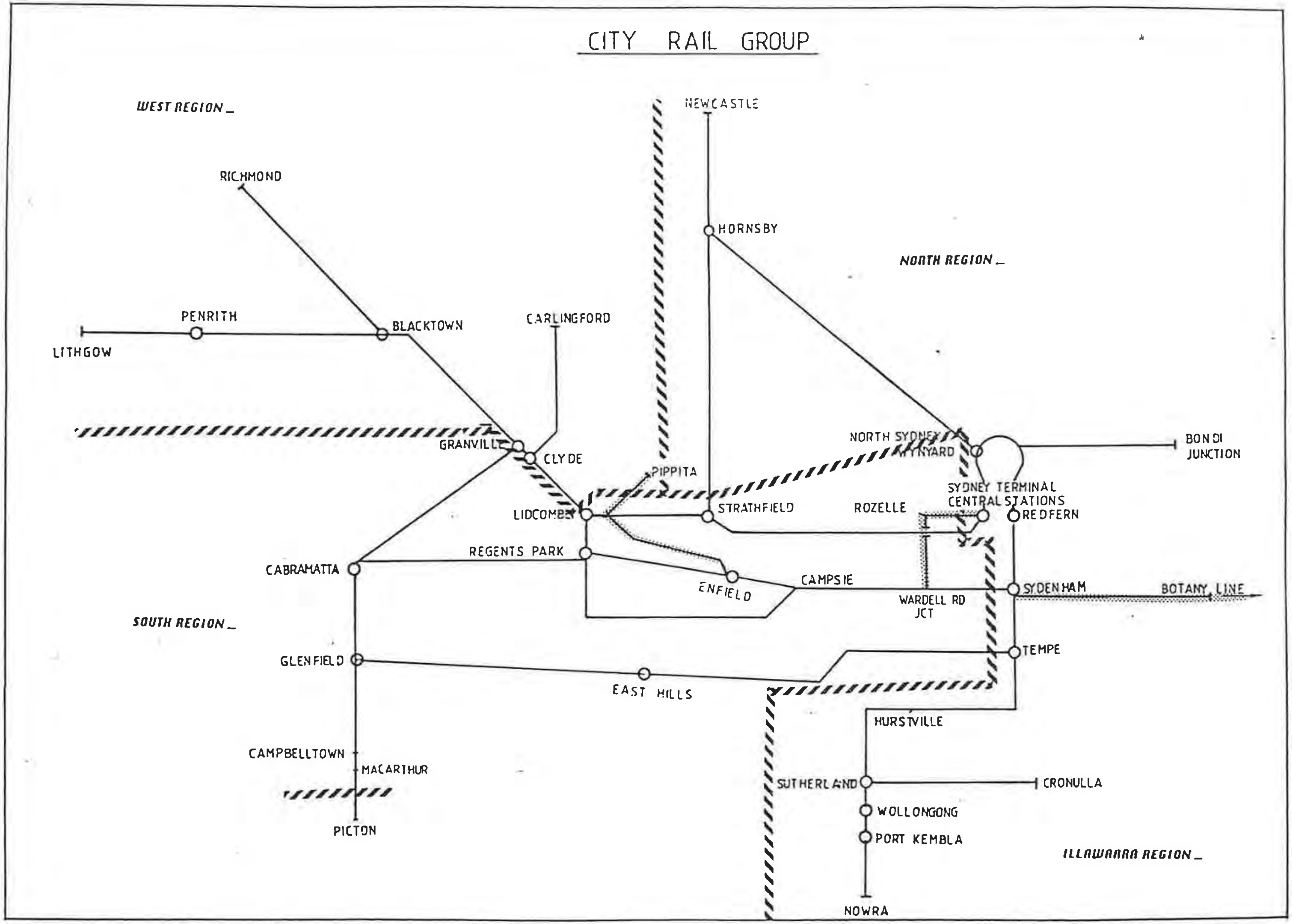
Ulf Lorenz

02–516–0491

02–603–6676


Country Freight and Passenger Group
Group General Manager
Vince Graham
South
Regional General Manager
West
Regional General Manager
North
Regional General Manager
Division Engineer
Wagga Wagga
069-212288
Division Engineer
Goulburn
048-212180
Division Engineer
Parkes
068-621727
Division Engineer
Dubbo
068-821157
Division Engineer
Werris Ck
Division Engineer
Grafton
066-423335
Division Engineer
Newcastle
049-610451
Tech Officer(V)
Noel Cowled
069-421295
Cootamundra
Tech Officer(V)
James Gunther
068-821157
Dubbo
Tech Officer(V)
Col Palmer
067-662214
Tamworth


MAP OF THE
NEW SOUTH WALES
RAILWAYS
WESTERN REGION
SOUTHERN REGION
NORTERN REGION
CITY RAIL
to Adelaide
to Melbourne
BROKEN HILL
ROTO
COBAR
BOURKE
BYROCK
BREWARRINA
NYNGAN
WARREN
TOTTENHAM
NARROMINE
DUBBO
PARKES
FORBES
MOLONG
ORANGE
BLAYNEY
COWRA
WIRRINGA
MACARTHUR
LITHGOW
WALLERAWANG
MUDGEE
GULGONG
ULAN
SANDY HOLLOW
MERRIWA
BINNAWAY
MERRYGOEN
COONAMBLE
GWABEGAR
WALGETT
MERRYWINEBONE
POKATAROO
BURREN JUNC
NARRABRI
BARRABA
MOREE
GRAVESEND
NORTH STAR
MUNGINDI
BOGGABILLA
INVERELL
GLEN INNES
WALLANGARRA
ARMIDALE
WERRIS CREEK
ABERDEEN
SINGLETON
MAITLAND
NEWCASTLE
GOSFORD
SYDNEY
SUTHERLAND
WOLLONGONG
NOWRA
MOSS VALE
GOULBURN
CANBERRA
COOMA
BOMBALA
TUMUT
COOTAMUNDRA
TEMORA
JUNEE
WAGGA
NARRANDERA
GRIFFITH
HAY
TOCUMWAL
COROWA
ALBURY
MT. KOSCIUSKO 7314
CASINO
SOUTH GRAFTON
COFFS HARBOUR
KEMPSEY
MELINGA
TAREE
GLOUCESTER


CITY RAIL GROUP
WEST REGION
NORTH REGION
SOUTH REGION
ILLAWARRA REGION
LITHGOW
PENRITH
BLACKTOWN
RICHMOND
CARLINGFORD
GRANVILLE
CLYDE
LIDCOMBE
PIPPITA
NEWCASTLE
HORNSBY
STRATHFIELD
NORTH SYDNEY
WYNYARD
BONDI JUNCTION
SYDNEY TERMINAL
CENTRAL STATIONS
REDFERN
ROZELLE
REGENTS PARK
CABRAMATTA
ENFIELD
CAMPSIE
WARDELL RD JCT
SYDENHAM
BOTANY LINE
TEMPE
GLENFIELD
EAST HILLS
HURSTVILLE
CAMPBELLTOWN
MACARTHUR
PICTON
SUTHERLAND
CRONULLA
WOLLONGONG
PORT KEMBLA
NOWRA

SILVER-LEAF NIGHTSHADE –

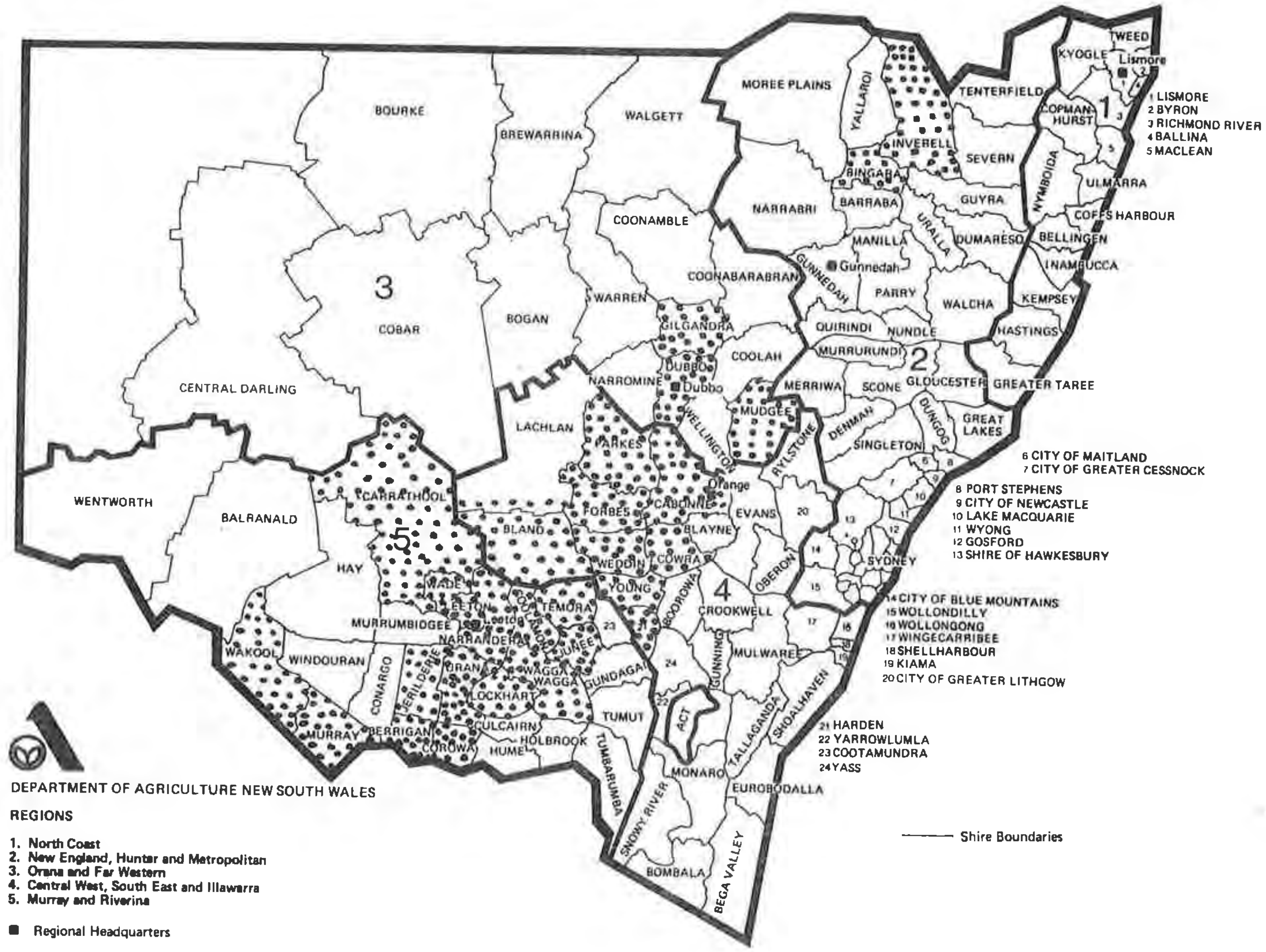
DEVELOPMENTS IN CHEMICAL CONTROL

Peter Gorham,
Noxious Plants Advisory Officer,
Cowra.

Silver-leaf nightshade, *Solanum elaeagnifolium*, a deep rooted summer growing perennial, reduces crop and pasture yields, has no feed value and may be toxic to stock.

A native of Southern United States and the Central Americas, silver-leaf nightshade was first reported in Australia at Bingara, N.S.W. in 1901. How the plant was introduced into Australia is not known. However, the wide spread of subsequent recordings – Tenterfield 1907, North Melbourne 1909, Singleton 1914, Hopetown Vic. 1918, and Cowra 1923, make it certain that there were several different sources. (Cuthbertson et.al.) The plant has since spread further into the southern and central wheat zones, the M.I.A. and North Western Slopes of N.S.W.

Figure 1



DISTRIBUTION OF SILVER-LEAF NIGHTSHADE IN N.S.W.

Biology

Each plant is capable of producing up to 60 berries containing about 75 seeds. Seed is most viable between 3 and 10 years old, which allows the plant to keep re-appearing for several seasons even if the plant is completely controlled. (Lemerle, 1983). Stems die off following the first autumn frosts, only the rootstock-bearing dormant buds beneath the ground survive the winter period until the following spring. The most important method of multiplication in Australia is by multiple regeneration from dormant buds on established roots. (Wapshere 1988) Because of infrequent germination and subsequent poor survival of seedlings, seed plays only a minor role in replacement from year to year and multiplication in established stands of the plant.

Control

Because of the immense root system, sometimes penetrating to a depth of more than 2 m, results with herbicides have been mixed. At present there are no satisfactory chemical control options available for broadacre infestations, mainly because of cost and non-selectivity. To date only three herbicides have been recommended for spot spray situations:-

Tordon 50-D, kills legumes and remains in the soil for considerable periods.
Roundup, non selective and
2,4-D which only kills top growth.

In February 1986, trials were set up at Cowra by Barney Milne of the Weed Research & Demonstration Unit at Orange to evaluate rates of application of a selection of new herbicides with the addition of additives.

TABLE 1

Treatment	Rate of Product Ha - 1
Arsenal	2L
Arsenal	4L
Starane	2L
Ally + Agral 600	15g + 200ml
Roundup + Agral 600	2L + 200ml
Roundup + Agral 600	4L + 200ml
Roundup + Agral 600	6L + 200ml
Roundup + Ally	4L + 15g
Roundup + Ally	6L + 15g
Tordon 50-D	22L
Velpar L + D.C. Tron	2L + 1L
Velpar L + D.C. Tron	4L + 1L

Plants varied from 10 cm to 65 cm high and from early flowering to bearing green fruit. Plants were in good spraying condition.

From the results obtained, Roundup at 4L/ha + 200 ML of Agral 600 was the most promising, giving a mean reduction of 88% in plant numbers.

Arsenal and Tordon 50-D also gave good results and may have some application in a spot spray situation or a long fence lines. With the promising results from the Roundup treatments a further trial was set up at Parkes in January 1988 to evaluate Roundup C.T. at several rates with Agral 600, Pulse, and D.C. Tron.

TABLE 2

Treatment	Rate/Ha
Roundup C.T. + D.C. Tron	2L + 1L
Roundup C.T. + D.C. Tron	3L + 1L
Roundup C.T. + D.C. Tron	4L + 1L
Roundup C.T. + Agral	2L + 300ml
Roundup C.T. + Agral	3L + 300ml
Roundup C.T. + Agral	4L + 300ml
Roundup C.T. + Pulse	2L + 200ml
Roundup C.T. + Pulse	3L + 200ml
Roundup C.T. + Pulse	4L + 200ml
Tillmaster (Roundup 180g/c + 2,4-D 90 g/c)	6L
Tordon 50-D (50 g/c PIC + 200 g/c 2,4-D)	11L

Plants varied from 5cm to 45 cm high and were in calry to mid flowering. Plants were in good spraying condition.

There were good to excellent reductions in flowering 1 year after spraying in all treatments. Roundup C.T. and D.C. Tron gave better control than the addition of Agral 600 or Pulse.

In January 1989 trials were continued to test Roundup C.T. in mixture with Shirwet 600, D.C. Trate and Goal C.T.

TABLE 3

Treatment	Rate of Product Ha-1
Roundup C.T. + Goal C.T. + D.C. Trate	4L + 75ml + 1L
Roundup C.T. + Shirwet 600	2L + 300ml
Roundup C.T. + Goal C.T. + Shirwet 600	2L + 75ml + 300ml
Roundup C.T. + Goal C.T. + D.C. Trate	2L + 75ml + 1L
Roundup C.T. + D.C. Trate	2L + 1L
Roundup C.T. + Goal C.T. + Shirwet 600	4L + 75ml + 300ml
Roundup C.T. + Goal C.T. + D.C. Trate	1L + 75ml + 1L
Roundup C.T. + D.C. Trate	2L + 2L
Roundup C.T. + D.C. Trate	4L + 2L
Roundup C.T. + D.C. Trate	4L + 1L
Roundup C.T. + Shirwet 600	4L + 300 ml

Silverleaf Nightshade green and healthy, some plants finished flowering and setting fruit, others in 40 to 60% flower. A heavy density up to 60 cm high.

The most economic result was Roundup C.T. at 2L + D.C. Trate at 2 L giving a mean plant reduction of 80.9%. Although a better result was achieved with 4L of Roundup it was not significant enough to justify the added cost of the extra 2L of Roundup. Overall the addition of D.C. Trate at 2 L/ha gave improved results compared to Shirwet 600. The addition of Goal C.T. did not improve results based on this trial. A second trial was established in April 1989 again using Roundup C.T. at rates of 2, 4 and 6 L/ha as well as in mixtures with 2,4-D ester (800 g/L) with either Shirwet 600 or D.C. Trate.

TABLE 4.

Treatment	Rate of Product Ha-1
Roundup C.T. + D.C. Trate	4L + 2L
Roundup C.T. + 2,4-D ester + D.C. Trate	2L + 700ml + 2L
Roundup C.T. + D.C. Trate	2L + 2L
Roundup C.T. + 2,4-D ester + D.C. Trate	6L + 700ml + 2L
Roundup C.T. + 2,4-D ester + D.C. Trate	4L + 700ml + 2L
Roundup C.T. + Shirwet 600	6L + 300ml
Roundup C.T. + D.C. Trate	6L + 2L

Silverleaf nightshade green and healthy varying from small plants 5cm high to 80 cm high, mainly 40 to 50 cm high.

DU PONT TRAVEL AWARD

Bernie Horsfield
Consultant
Industrial Weed Control
Du Pont (Australia) Ltd

Du Pont (Australia) Ltd congratulate Ken Hayes, Senior Noxious Plants Inspector, Coffs Harbour City Council and Graham Matthews, Chief Noxious Plants Officer, Bellingen Shire Council as joint winners of the Du Pont Travel Award to New Zealand.

Although the number of applicants was not high, the standard of applications were of such a high degree that once again it was not an easy task for the judges to decide on a final winner.

In fact, after scrutinising the applications and rechecking the points allocated to each applicant on the points system devised to include the items of criteria as listed in the Weeders Digest, the judges found it impossible to separate two applicants.

Du Pont therefore decided to make an unprecedented decision by awarding joint winners of their Travel Award.

In addition to this Award it was also felt that recognition should be given to other applicants for the time and effort taken in their submissions.

Plaques were therefore presented to the following officers as Regional winners of the Du Pont Noxious Plants Officer Award 1989.

Congratulations to:

David Richards, Chief Weeds Officer, Gunnedah Shire Council.

John Kerrison, Chief Weeds Officer, Wingecarribee Shire Council.

Ian Kelly, Chief Weeds Officer, Castlereagh Macquarie County Council.

Our thanks to all those people who participated in this Travel Award and it is due to the effort taken by these applicants to submit such high standard submissions that Du Pont are pleased to advise that they will continue to sponsor similar awards at the next Biennial Conference.

Ken and Graham will attend the New Zealand Noxious Plant Officers Conference to be held in May next year.

Best wishes to them for an enjoyable and educational trip and we all look forward to reading their report and recommendations upon their return.

Environmental Planning and Assessment Act 1979
Rundle v. Far North Coast County Council
Spraying of groundsel bush with 2,4–D at Byrill Creek

DAMER WALSH – Senior Legal Officer (Environment)
NSW Agriculture & Fisheries, Sydney

His Honour Mr Justice Bignold delivered his judgement in this matter on 20 October 1989.

The application for an injunction was dismissed. His Honour held that the "spraying of 2,4–D on the infestation of the noxious plant groundsel is not the carrying out of a work on the subject land. He also held that the spraying was not a "use" of the land. Accordingly, the spraying was not an "activity" as defined in the Act.

It was necessary for Rundle to establish that the spraying was an "activity" and, in the opinion of His Honour, as this could not be established, Rundle's application failed "in limine", "on the threshold". Having failed on this threshold point, no other evidence submitted by Rundle could support her application and persuade the Court to grant an injunction.

In conclusion, His Honour held that even if a breach of the Act had been established and it became a question as to whether the injunction should, or should not, be granted, he would have exercised his discretion in favour of the Respondents and not granted an injunction.

The other issues on which His Honour commented do not affect his decision but serve as useful judicial opinions on these issues.

AFTER THE AMNESTY

Bruce Dowling

State Pollution Control Commission
157 Liverpool Street, Sydney, 2000

INTRODUCTION

In mid-1987 one of Australia's most important export industries was threatened when the United States detected unacceptable organochlorine pesticide residues in our beef. The response was swift and all State governments banned DDT from agricultural use. As a further measure, the Australian Government then encouraged the States to undertake collections of all organochlorine pesticides from rural areas. The rural collections were variously termed "amnesties", "recalls" or "surrenders" and the logistics adopted were different from State to State.

In New South Wales, a once only recall of organochlorines was carried out by the (then) Department of Agriculture. The statewide recall continued over several months and was extended to include other illegal and unwanted agricultural chemicals. Unfortunately, the government had little opportunity to fully plan the collection within the short time frame, for example, in regard to storage, segregation and final disposal of the chemicals.

DISPOSAL METHODS – LARGE QUANTITIES

The pesticide wastes collected during the New South Wales rural organochlorine recall were disposed of in several ways. Table 1 lists the principal means of disposal.

In April 1988 more than 165 tonnes of organochlorine and other pesticide wastes were shipped to the United Kingdom for high-temperature incineration. The cost of disposal was about A$1M.

Encapsulation in concrete has been found satisfactory for the disposal of small quantities of fungicides containing heavy metals such as mercury and cadmium. The concrete can then be placed in a landfill with the less persistent pesticides like carbamate and organophosphate insecticides and most herbicides. Many of these pesticide wastes have been buried in well-managed regional landfills where adequate environmental safeguards exist and community concerns are minimal. Some of these pesticides are still stored, pending resolution of some disposal options.

Special treatment has been employed with the more hazardous pesticides containing chlorpicrin, strychnine and yellow phosphorus.

Table 1. Disposal methods used for pesticide wastes collected during NSW rural organochlorine recall

Disposal method	Pesticide category
High temperature incineration	Persistent organochlorines *
Concrete encapsulation	Organometallics and metal-containing fungicides
Landfill	Carbamates, organochlorines and herbicides
Special treatment	Fumigants, strychnine, ignitables
Re-use	Cyanides
Storage pending treatment	Arsenicals

* Some non-organochlorines and containers were also disposed of by high temperature incineration

Re-use has been restricted to cyanides which are used by goldminers in the gold-extraction process.

Arsenicals present the biggest problem for disposal. More than 20 tonnes of arsenicals, mostly sheep dips, are currently stored, awaiting the development of an environmentally safe method of disposal. The SPCC has commenced an assessment of arsenical wastes and expects that it may be able to find some solutions to this problem by the end of 1989.

DISPOSAL METHODS – SMALL QUANTITIES

In the absence of statutory controls the SPCC has produced a "**Commercial User's Guide**" to the disposal of surplus pesticides, containers, sprays and spills. The disposal options outlined in this brochure are designed for the farmer orcommercialoperatorandcomplementthe "**AVCACODENo.1**" Wall Chart for the "on farm" disposal of pesticides. The guidelines are designed for small-scale disposal and as a general rule apply to quantities not exceeding 20 litres or 20 kilograms of concentrate.

Where quantities are in excess of these amounts or where highly toxic, carcinogenic or persisitent pesticides require disposal the SPCC should be contacted. The Commission provides advice on the disposal of chemicals and chemical wastes as part of its statutory responsibilities. In providing this advice a number of factors are considered including the nature and volume of the waste, the potential for minimisation, possible options for disposal and the environmental sensitivities found within the region.

While this approach may appear to be *ad hoc* it does allow for the best practicable means for disposal to be selected on a site-specific basis.

FORMAL ARRANGEMENTS

The need for formal arrangements to provide for the ongoing disposal of pesticide wastes is recognised at both the State and Commonwealth levels.

At the Commonwealth level, the Australian Environment Council has acknowledged the need for a uniform Code of Practice for the disposal of pesticide wastes. A working group was to be established to look at the problem but a lack of resources has meant that this work has had to be postponed.

A subcommittee of the Hazardous Chemicals Advisory Committee considered the possible establishment of regional pesticide waste facilities in New South Wales. Designs for biodegradation evaporation beds were considered but the unkown demand for such facilities made it difficult to assess the size of the beds that would be required.

The SPCC will shortly undertake a survey of regional landfill facilities to assess their suitability for the disposal of small volumes of selected types of pesticides and road-spill chemicals. The survey will commence with a simple questionnaire for councils, the New South Wales Health Department and SPCC inspectors to answer. Sites identified in returns as being potentially suitable will then be given a more detailed assessment. Factors to be considered in this assessment include soil type, leachate potential, disposal capacity, management requirements, environmental sensitivity and community concerns.

The possible establishment of a high temperature incinerator in New South Wales provides the opportunity for the disposal of a larger range of pesticides than just the organochlorines.

SPEAKERS – 5TH BIENNIAL NOXIOUS PLANTS CONFERENCE

MR. GUY ROBINSON	Research Agronomist, Agricultural Research and Advisory Station, P.M.B., Glen Innes, 2370. 067.321633 "Use of grazing stock for weed control".
MR. JOHN BETTS	District Agronomist, Agricultural Research and Advisory Station, P.M.B., Grafton, 2460. 066.420420 "Pasture manipulation/management for the control of noxious weeds with particular emphasis on Parramatta grass".
MR. MAX McMILLAN	Special Agronomist (Weeds), Agricultural Research and Advisory Station, P.M.B., Glen Innes, 2370. 067.321633 1. "Progress in Lantana and blackberry chemical control". 2. "Progress in bitou bush chemical control" (jointly with Roger Stanley, John Toth and Tom Anderson). 3. Field day session: Two trials and time trial/operator comparison.
MR. LESTER McCORMICK	District Agronomist, NSW Agriculture & Fisheries, P.O. Box 71, Manilla, 2346. 067.851790 "The Wiregrass Action Group".
MR. PETER GRAY	Noxious Plants Advisory Officer, NSW Agriculture & Fisheries, P.O. Box 865, Dubbo, 2830. 068.811338 "Scrub Encroachment in the Western Division".

MS. DIEDRE LEMERLE Paper presented by Dr. Leon Smith	Research Agronomist (Weed Agronomy), Agricultural Research Institute, P.M.B., Wagga Wagga, 2650. O69.230999 "Effect of environmental factors on herbicide efficacy".
MR. PETER GORHAM	Noxious Plants Advisory Officer, NSW Agriculture & Fisheries, P.O. Box 129, Cowra, 2794. O63.422122 "Silverleaf night shade - chemical/biological control".
MR. NEIL NELSON	District Agronomist, NSW Agriculture & Fisheries, P.O. Box 177, Singleton, 233O. O65.722197 "Developments with dodder control".
MS. MADELEINE SAY	Technical Officer, Biological Weed Control, Agricultural Research & Veterinary Centre, P.O. Box 53, Orange, 2800. O63.636700 "Mycoherbicides".
MR. GEOFF MacALPINE Paper presented by Mr. Col Byrnes	Principal Officer, Pesticides, Division of Animal Health, Pesticide Registration Section, McKell Building, Rawson Place, Haymarket, 2000. O2.2175472 "Permits for pesticide use".
MR. ROGER STANLEY	Soil Conservationist (Investigations), Soil Conservation Service of N.S.W., P.O. Box 177, KEMPSEY. 2440. O65.621391 "Bitou bush control: Biological control and the bitou bush working group".
DR. RICHARD GROVES	Senior Research Scientist, CSIRO Division of Plant Industries, P.O. Box 1600, Canberra, A.C.T., 2600. 062.464911 "Noxious weed invasions in Australia".

MR. CHRIS O'KEEFFE	County Clerk, Far North Coast County Council, 82 Johnston Street, Casino, 247O. 066.622396 "A council's experience in the Land & Environment Court".
MS. ANNE CURREY	Publications Officer, North Coast Agricultural Institute, NSW Agriculture & Fisheries, Bruxner Highway, Wollongbar, 2480. 066.240325 "Communication and Publicity 1: Press releases and newspaper articles".
MR. ALAN BATCHELOR	Regional Media Officer, North Coast Agricultural Institute, NSW Agriculture & Fisheries, Bruxner Highway, Wollongbar, 2480. 066.240200 "Communication and Publicity 2: Radio and television".
MR. JOHN TOTH	Senior Research Agronomist, Biological & Chemical Research Institute, NSW Agriculture & Fisheries, PMB 10, Rydalmere, 2116. 02.6839777 1. "Chemical control of Bitou bush" (jointly with Max McMillan, Roger Stanley and Tom Anderson). 2. "Chemical control of Sifton bush".
MR. GEORGE DIATLOFF	Director, Alan Fletcher Research Station, P.O. Box 36, Sherwood, 4075. "Formulation Work at the Alan Fletcher Research Station".
MR.TREVORARMSTRONG	Agronomist, Alen Fletcher Research Station, P.O. Box 36, Sherwood, 4075. "The Tropical Weed Research Centre and the Queensland Weed Society".

MR. ALAN TOMLEY	Agronomist, Alan Fletcher Research Station, P.O. Box 36, Sherwood, 4075. "Biological Control of Groundsel bush: evaluation of progress and new prospects".
DR. RACHEL McFADYEN	Entomologist, Alan Fletcher Research Station, P.O. Box 36, Sherwood, 4075. "Ragweed and Parthenium biological control: evaluation of progress and new prospects".
MR. TOM ANDERSON	Experimentalist, Alan Fletcher Research Station, P.O. Box 36, Sherwood, 4075. "Experiences with bitou bush in Queensland".
MR. KEN HAYES	Senior Noxious Plants Inspector, Coffs Harbour City Council, P.O. Box 155, Coffs Harbour, 2450. "An evaluation of biological control of groundsel bush in northern coastal New South Wales".
MR. ALEX FLOYD	P.O. Box 432, Coffs Harbour, 2450. "The Vine Weeds of Coastal Rainforests".
MR. RICHARD BOLTON	P.O. Box 163, Lidcombe, 2141. "The Occupational Health & Safety Act – Requirements For Spray Operators and Their Employers, With a Brief Note on Standards For Storage of Pesticides".
MR. JIM CHERRY	Chief Weeds Officer, Central Northern County Council, P.O. Box 155, Quirindi, 2343. 067.461755 "New Zealand Trip Report".

MR. LES TANNER	Senior Inspector, Prickly Pear Surveillance Unit, P.O. Box 1, Bingara, 2404. 067.241616 "Prickly Pear into the 1990's". (Jointly with Dr. John Hosking)
DR. JOHN HOSKING	Entomologist, Tamworth Agricultural Research Centre, R.M.B. 944, Tamworth, 2340. 067.679300 "Prickly Pear into the 1990's". (Jointly with Mr. Les Tanner)
MS. ANNE CLOSE	Big Scrub Environment Centre, 88a Keen Street, Lismore, 2480. 066.213278 "The Big Scrub Environment Centre's Approach to Noxious Weed Control".
DETECTIVE SENIOR CONSTABLE JOHN DOLAN	State Drug Group, G.P.O. Box 45, Sydney, 2001. "Control and Identification of Drug Plants".
MR. BOB ATTWOOD	Soil Conservationist, Government Offices, Victoria Street, Grafton, 2460. 066.420666 "Weed Control in Catchment Areas and Protected Lands".
MR. BOB LEECH	Agriculture & Noxious Plants Controller, Snowy River Shire Council, Myock Street, Berridale, 2628. 064.563251 "Infra-red Photography for Weed Sensing".
MR. KEN BUNN	Noxious Plants Inspector, Port Stephens Shire Council, P.O. Box 42, B.H. 049.831333 Raymond Terrace, 2324. A.H. 049.374963 "Progress in Chemical Control of Alligator Weed". (Jointly with Dr. Kath Bowmer).

DR. KATH BOWMER Paper presented by Mr. Geoff McCorkell	C.S.I.R.O. Division of Water Resources, P.M.B. 3, Griffith, 2680. 069.620500 "Progress in Chemical Control of Alligator Weed". (Jointly with Ken Bunn).
MRS. JUDITH RAWLING	National Trust of Australia, Observatory Hill, Sydney. 2000. 02.2580123
DR. LEON W. SMITH	Principal Agronomist (Weeds), NSW Agriculture & Fisheries, P.O. Box K220, Haymarket, 2000. 02.2175050 "Recent Advances in Biological Control of Paterson's Curse".
MR. JEFF CUMMINGS	Rural Lands Protection Board, P.O. Box 168, North Quay, 4002. 07.2247307 "Administration and Practice of Noxious Plant Control in Queensland".
MR. MATT BOLTON	Agronomist, Tropical Weeds Research Centre, P.O. Box 187, Charters Towers, 4820. 077 873300 "Distribution and Control of Woody Weeds in North Queensland".
DR. BILL BLOWES	Australian Product Development Manager, Monsanto Australia Ltd., Agricultural Products Division, G.P.O. Box 4077, Melbourne, 3001. 03 6586666 "Adjuvant Technology".
MR. BRUCE DOWLING	Scientific Officer, State Pollution Control Commission, G.P.O. Box 4036, Sydney, 2001. 02 2658947 "Disposal of Unwanted Pesticides – What Happens after the Recall?"

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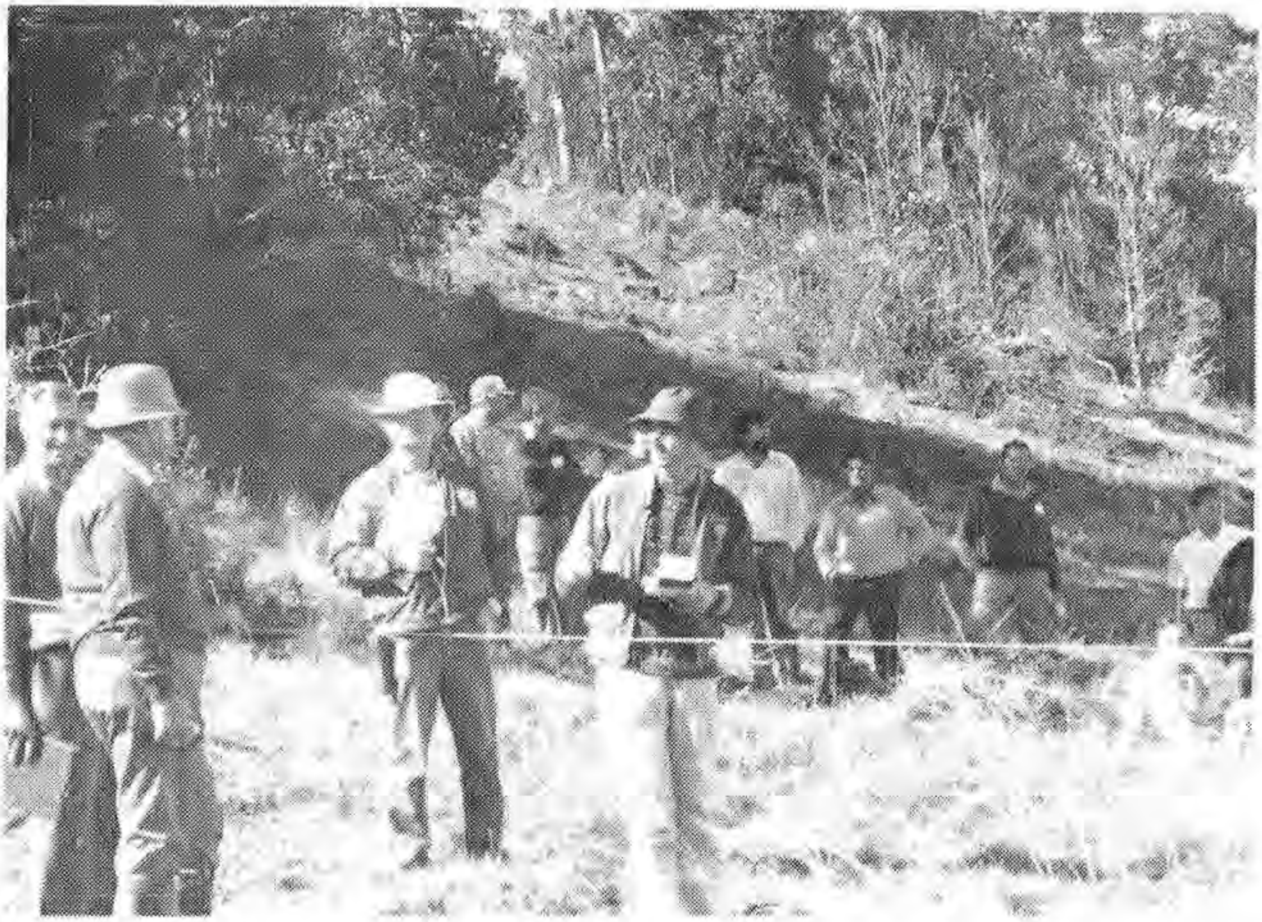
A "FEW" CONFERENCE HIGHLIGHTS.

A TYPICAL HIGHLANDER

CONFERENCES TAKE THEIR TOLL - ON SOME

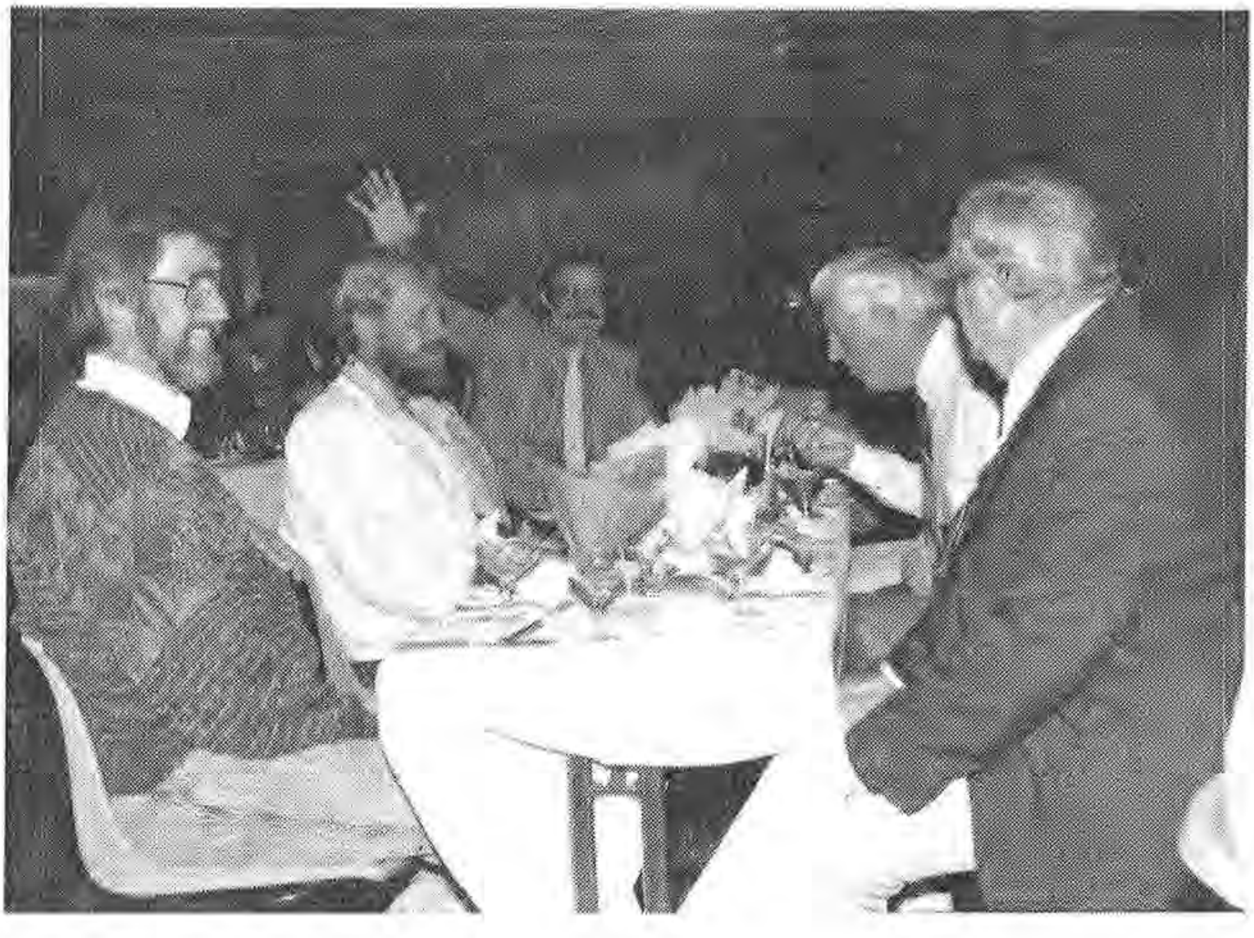


UTTER CONFUSION ???

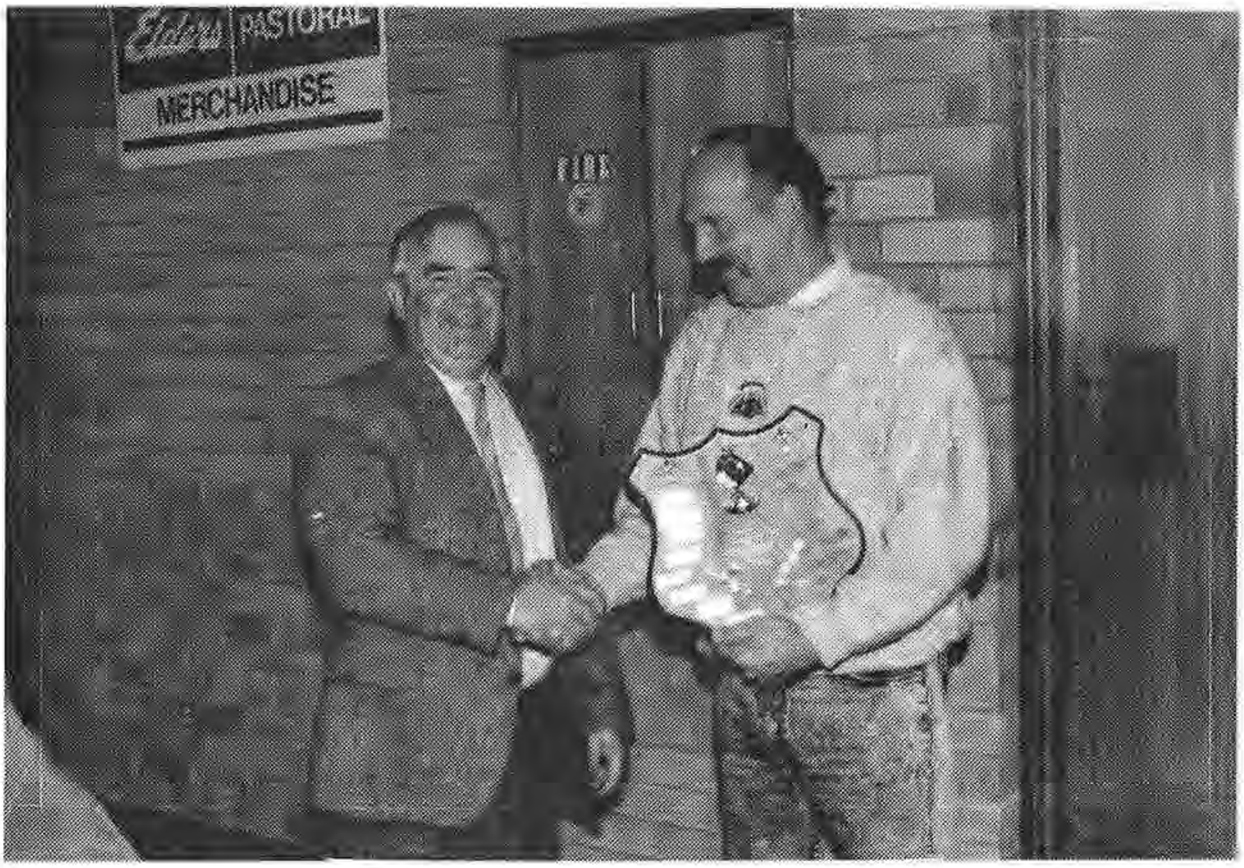
DON'T ARGUE DEREK I'M RUNNING THIS SHOW

A LITTLE BIT CLOSER NOW

CAPTIVE AUDIENCE



A HAPPY ENDING



LOCKHART SHIRE PRESIDENT, BRIAN CLANCY
CONGRATULATES INNOVATIVE IDEAS COMPETITION
WINNER ROGER PIGDON.