Weeds of National Significance

Current management and control options for Chilean needle grass (*Nassella neesiana*) in Australia

National Best Practice Management Manual

Chilean Needle Grass

Supported by the State Government of Victoria

State Government Victoria Department of Primary Industries

National Chilean Needle Grass Taskforce

Australian Government

Defeating the Weed Menace

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Published by the Victorian Government Department of Primary Industries, November 2007

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Authorised by: Victorian Government, 1 Spring St, Melbourne, Victoria, 3000 Australia

ISBN 978-1-74199-720-0

For further information, visit the DPI Website at www.dpi.vic.gov.au or contact the DPI Customer Service Centre on 136 186

Editing:
Kirsten John/Trish Lothian

Design adapted from "Lantana Control Manual" by Web and Publishing Services, Department of Natural Resources, Mines and Energy 2004).

Front cover photography
Large picture: Chilean needle grass seed showing pollen (Charles Grech, DPI Victoria).
Smaller picture: Chilean needle grass invading Stromlo Forest, ACT (Jenny Conolly, Parks Conservation and Lands, ACT).

Printing:
Adams Print Pty Ltd, Breakwater, Geelong Vic 3220 Australia

This manual is part of the Chilean needle grass Weeds of National Significance (WoNS) Program, managed by Kelly Snell, National Chilean needle grass Coordinator, Department of Primary Industries, Victoria.

For further information on the WoNS Program visit the Weeds Australia website ***www.weeds.org.au/WoNS/Chileanneedlegrass/***
For copies of this manual contact the National Chilean needle grass Coordinator, contact details can be found on the **Weeds Australia website.**

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the Victorian Department of Primary Industries,

and the National Chilean Needle Grass Taskforce

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Foreword

Chilean needle grass is considered one of Australia's worst weeds of native grasslands and pasture. Since its introduction to Australia in the 1930s, Chilean needle grass has invaded grasslands, roadsides and farms in Victoria, NSW and the ACT. More recently, it has been found in South Australia, Queensland and Tasmania. The potential for Chilean needle grass to become permanently established in these regions and invade presently uninfested areas in Australia is of great concern. If allowed to spread unchecked, Chilean needle grass is likely to create huge environmental and economic costs.

Chilean needle grass places a huge burden on land managers. It reduces the carrying capacity of pasture, causes injury to stock and seriously degrades native grasslands. Its unique survival mechanisms and the difficulties of identification make Chilean needle grass a particularly challenging weed to control.

The Chilean Needle Grass Taskforce recognises the need to contain the spread of Chilean needle grass and to control existing infestations, as well as the need to provide best practice information to those attempting to carry out these often daunting tasks. The *Chilean needle grass best practice manual* is an important link in that chain.

Designed to help provide effective management solutions for Chilean needle grass, the *Chilean needle grass best practice manual* brings together detailed information about the plant itself, as well as best practice information about existing control and management options.

I recommend this manual to weed control authorities, land managers and all who are responsible for land that is affected, or at risk of invasion, by Chilean needle grass.

Finally, I would like to thank all those responsible for its production.

Keith Hamilton
Chair
Chilean Needle Grass Taskforce

National Chilean Needle Grass Taskforce

Using this manual

Where does the information come from?

The advice in this manual is based on published information, existing research and the experiences of individuals and organisations currently managing Chilean needle grass in Australia.

Our current understanding of best practice, however, is by no means the final word and, as further research unfolds and the experiences of trial and error by land managers grows, strategies for Chilean needle grass control can be expected to evolve into the future.

This manual contains six sections:

Section 1 Biology and threat

A description of the biology and ecology of Chilean needle grass, its impact and national distribution, including photographs and diagrams to help identify Chilean needle grass and to monitor flower/panicle seed development.

Section 2 Integrated weed management

How to plan integrated Chilean needle grass management, including prioritising infestations for control and what to consider at each of four planning steps. Considers which land management practices to follow in different circumstances, to minimise the risk of Chilean needle grass spreading.

Section 3 Selecting a control program

Describes different control programs to consider in a range of different circumstances.

Section 4 Control methods

Detailed descriptions of control methods – from cultural to chemical – the circumstances and implications of their use and examples of their integration by land managers.

Section 5 Case studies

Case studies of approaches taken by land managers, including different control methods and strategies for managing Chilean needle grass in different situations.

Section 6 Further information

The declaration status of Chilean needle grass in Australia, references and further reading, weed contacts across Australia, a glossary of terms and a list of acronyms used in this manual.

Note on referencing:
Specific studies or important points are referenced in the text and listed alphabetically in a comprehensive references and further reading section beginning on page 75. Key references for some sections (for example, grass identification) are listed under “further information” at the end of that section.

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Chilean needle grass dominating pasture in NSW (Jenny Schabel, Hawkesbury Nepean CMA).

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Section 1 Biology and threat

1.1 Impact of Chilean needle grass in Australia

Chilean needle grass is a highly invasive weed and has a serious impact on agricultural and native ecosystems.

Chilean needle grass is one of Australia's worst weeds. It invades native grasslands, agricultural land, roadsides and urban parks, gardens and recreational reserves.

Growing concerns about the seriousness of the problem, the potential for spread and the likely economic and environmental impacts have led to the declaration of Chilean needle grass as a Weed of National Significance (Thorp and Lynch 2000).

A National Strategy for Chilean needle grass has been developed (ARMCANZ and ANZECCFM 2001): '*to stop the spread, and reduce the occurrence and impacts of Chilean needle grass in natural and agricultural ecosystems*'.

Agriculture

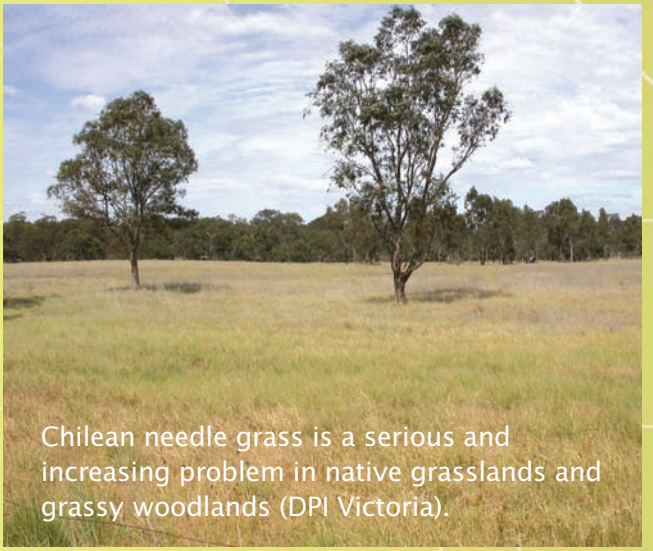
Chilean needle grass displaces palatable pasture species and can reduce productivity by up to 50 per cent over summer (Gardener 1998; CRC for Australian Weed Management 2003).

It is less palatable than pasture grasses and nearly impalatable once in the reproductive stage. It reduces crop yield and contaminates produce such as hay, grain and seed. It is also a major contaminant on vehicles, machinery and equipment, which all have the potential to spread Chilean needle grass across properties and over long distances.

The panicle seed readily attaches to stock, particularly sheep, and can cause injury by burrowing into the skin and sometimes muscle. Its presence in wool reduces quality and can be a major cause of downgrading.

The average annual cost of controlling Chilean needle grass has been estimated at between $64 and $119 per hectare (McLaren et al 2002).

Chilean needle grass panicle seed can downgrade wool (left) and injure stock (right) (DPI Victoria).



Chilean needle grass is a serious and increasing problem in native grasslands and grassy woodlands (DPI Victoria).

Chilean needles grass is a weed of parks, gardens, neglected areas and roadsides (DPI Victoria).

Native Grasslands

Chilean needle grass is the worst environmental weed threatening native grasslands.

Native grasslands are one of Australia's most threatened ecosystems. Less than 1 per cent of their original extent remain (Ross 1999) in various stages of degradation throughout south-east Australia and are under threat from the capacity of Chilean needle grass to rapidly invade disturbed soils and degraded ecosystems. Chilean needle grass will out-compete and displace native grass species, interfere with re-vegetation programs and, once established, the seed banks are difficult to manage.

Chilean needle grass is a particular problem in native grasslands and grassy woodlands in south-east Australia, which include species such as kangaroo grass (*Themeda triandra*) wallaby grasses (*Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), native tussock grasses (for example, *Poa* spp.), weeping grass (*Microlaena stipoides*) and wiregrass (*Aristida* spp.).

Linear reserves

Roadsides contain some of the heaviest infestations of Chilean needle grass in Australia and provide vectors for its invasion and spread through adjacent agricultural land, native grasslands and urban areas.

The movement of vehicles and machinery contaminated with panicle seed along roadsides and linear reserves, such as rail corridors and powerline easements, is the greatest source of the spread of Chilean needle grass. Routine maintenance activities such as mowing along linear areas during the Chilean needle grass seeding period further enhance spread.

Urban situations

In urban areas, Chilean needle grass can be a weed of neglected land, parks, gardens, reserves and sporting grounds. Some of these areas either contain or are adjacent to remnant native grasslands already under threat from increasing urbanisation. The panicle seed of Chilean needle grass can cause injury to pets and is easily spread on their coats or on the socks and shoes of humans.

1.2 Preferred habitat and distribution in Australia

Current distribution

Chilean needle grass is native to South America, including Argentina, Bolivia, Chile, Ecuador, southern Brazil and Uruguay.

The first record of Chilean needle grass in Australia was in Northcote (a suburb of Melbourne), Victoria, in 1934 (McLaren et al 1998). It was first recorded in New South Wales in 1944 (McLaren et al 1998). Chilean needle grass is now widespread and well established in parts of Victoria, NSW and the ACT and has naturalised in localised areas of South Australia, Queensland and Tasmania (Figure 1). Chilean needle grass has not yet been reported in Western Australia or the Northern Territory.

Roadsides are a major source from which agricultural and natural ecosystems are invaded (Tony Cook, NSW DPI).

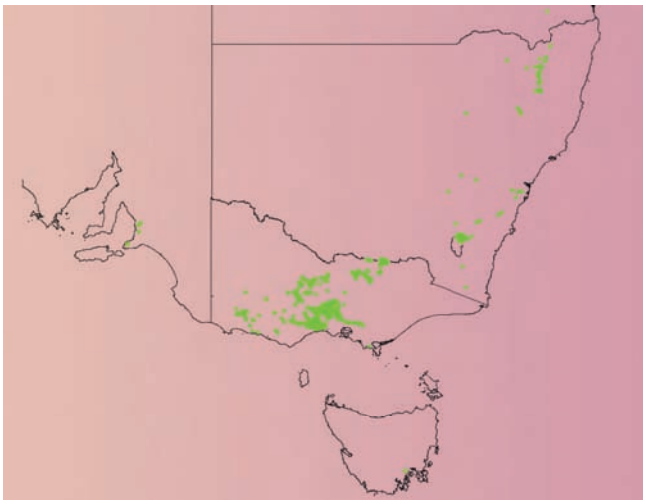


Figure 1. Current distribution of Chilean needle grass in Australia (DPI Victoria)

The Potential Distribution of N. neesiana Predicted from Australian Distributions in 2004.

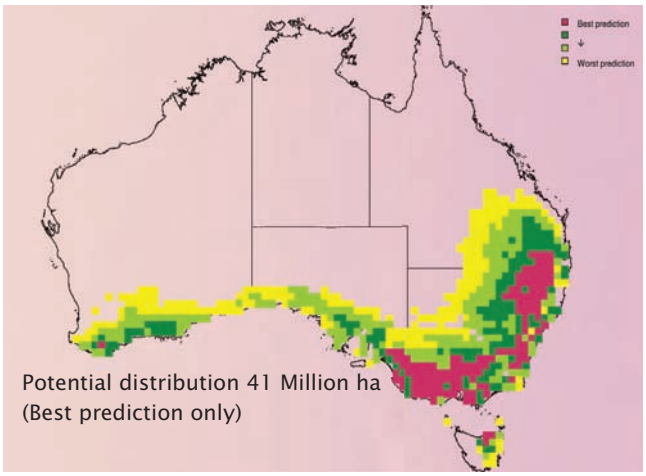


Figure 2. Potential distribution of Chilean needle grass in Australia (McLaren et al 1998)

Potential distribution in Australia

Climatic modelling using CLIMATE® predicts that Chilean needle grass has the potential to invade approximately 40 million hectares in Australia (McLaren et al 1998). Much of that figure includes prime agricultural production areas, areas of high conservation value and includes a large proportion of the temperate grasslands or grassy woodlands from south-east Queensland to Western Australia (Figure 2).

Climate

Chilean needle grass has a wide climatic tolerance (Gardener 1998) and is capable of competing vigorously under annual rainfall that ranging from 450–1000 mm. It grows in climates ranging from warm, wet summers and cold, dry winters, such as the Northern Tablelands of NSW, to the Mediterranean-type climates of Victoria and South Australia that experience hot, dry summers and cool, wet winters. Chilean needle grass is tolerant of heavy grazing and, to a lesser extent, drought.

Soils

In Australia, Chilean needle grass has established on fertile soils, including the basaltic soils of the New England Tablelands, the volcanic plains of Victoria, on rich clay soils near Lucindale in South Australia and is found on black alluvium, red volcanic and sediment-derived soils in Queensland. Chilean needle grass is also found on poorer sedimentary soils near Bendigo, Victoria, and grows in low-fertility habitats in New Zealand.

1.3 Description and life cycle

Taxonomy

Chilean needle grass (*Nassella neesiana*) is in the tribe* Stipeae (commonly referred to as stipoid grasses) within the grass family* of Poaceae.

There are six genera of stipoid grasses in Australia, with *Austrostipa* the only indigenous genus.

Nassella, one of the introduced genera, includes Chilean needle grass and species such as serrrated tussock (*N. trichotoma*), Mexican feather grass *(N. tenuissima)*, cane needle grass *(N. hyalina)*, Texas needle grass *(N. leucotricha)*, lobed needle grass *(N. charruana)* and short-spined needle grass (*N. megapotamia*).

Life cycle

KEY FEATURES OF THE CHILEAN NEEDLE GRASS LIFE CYCLE

- Chilean needle grass is a perennial tussock-forming grass that grows in clumps over 1 m tall, and up to 1.5 m when in seed.
- Vegetative growth usually occurs throughout the year, except summer.
- Three types of seed can be produced – panicle seed on distinctive seed heads in spring/summer, and stems and basal seed throughout the year.
- Seed can remain viable in the soil in excess of three years.
- Seed germination is usually in spring or autumn, but can occur at almost any time of the year if conditions are suitable.
- Panicle seed is dispersed via machinery activities, animal and water movement but not by wind.

Germination occurs mainly through spring and autumn (Sep–Nov and Mar–Apr) as rainfall and light are adequate. Although where moisture and temperature conditions are adequate, Chilean needle grass can germinate and establish at other times of year. Stem and basal seed often germinate first during autumn as panicle seed requires time to soften before germinating. Seedlings generally establish better on disturbed sites.

Vegetative growth of seedlings and established plants occurs mainly in autumn, winter and spring (Apr–Oct).

Flowering mainly occurs during spring and summer (Sep–Dec), and is likely to occur later in summer if disturbed by management such as grazing. Flowering can occur at other times of the year if temperature and moisture conditions are suitable (for example a second flowering period occurs during autumn in northern New South Wales and Queensland).

Panicle, stem and basal seed: see "seed production" opposite.

* These terms are defined in the glossary on page 81.

Table 1. General growth pattern of Chilean needle grass

Chilean needle grass lifecycle	SPRING			SUMMER			AUTUMN			WINTER		
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Germination												
Vegetative growth												
Flowering						N	N	N				
Panicle seed production							N	N				
Panicle seed maturation								N	N			
Stem and basal seed maturation	B	B	B	B	B, S	S	S	S	S	S	S	S

= general pattern of growth; N = additional seeding period in northern New South Wales and Queensland; S = stem seed; B = basal seed.

Seed production

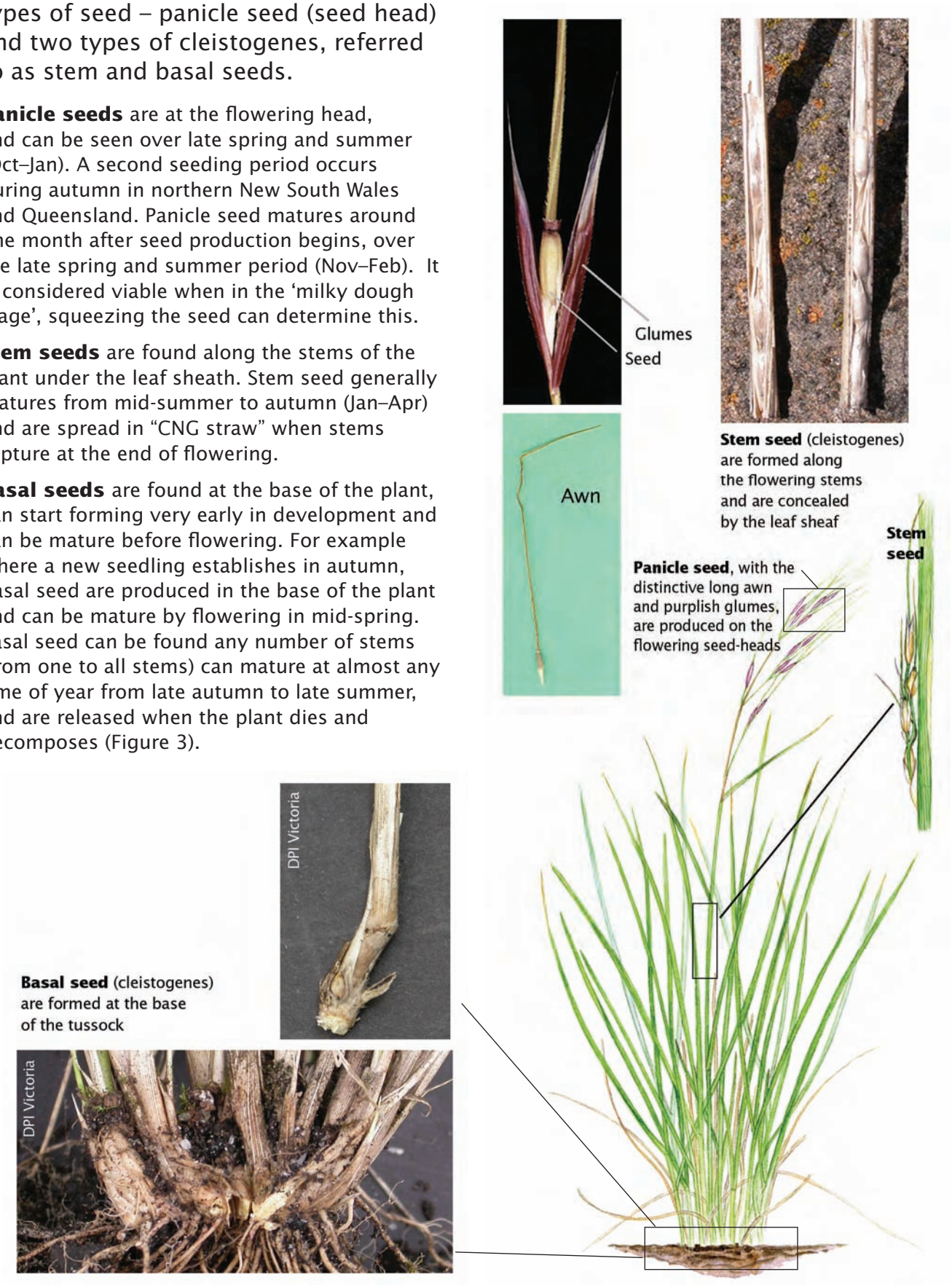
Chilean needle grass is unique in its biology as it produces three different types of seed – panicle seed (seed head) and two types of cleistogenes, referred to as stem and basal seeds.

Panicle seeds are at the flowering head, and can be seen over late spring and summer (Oct–Jan). A second seeding period occurs during autumn in northern New South Wales and Queensland. Panicle seed matures around one month after seed production begins, over the late spring and summer period (Nov–Feb). It is considered viable when in the 'milky dough stage', squeezing the seed can determine this.

Stem seeds are found along the stems of the plant under the leaf sheath. Stem seed generally matures from mid-summer to autumn (Jan–Apr) and are spread in "CNG straw" when stems rupture at the end of flowering.

Basal seeds are found at the base of the plant, can start forming very early in development and can be mature before flowering. For example where a new seedling establishes in autumn, basal seed are produced in the base of the plant and can be mature by flowering in mid-spring. Basal seed can be found any number of stems (from one to all stems) can mature at almost any time of year from late autumn to late summer, and are released when the plant dies and decomposes (Figure 3).

Figure 3. The Chilean needle grass plant showing the sites of seed production.



Chilean needle grass can be moved from infested areas where there is heavy traffic, particularly when it is wet (DPI&F Queensland).

Chilean needle grass panicle seed in the fleece of sheep (Charles Grech, DPI VIctoria).

Seed bank

Input of all three seed types, including large amounts of panicle seed, can eventually build up into a large seed bank. Up to 20 000 panicle seeds/m^2 and over 6 000 basal and stem seeds/m^2 have been recorded in good conditions New South Wales (Gardener 1998).

In one study (Gardener *et al* 1996a), seed banks were shown to decline by 57 per cent per annum. To reduce this seedbank by 99 per cent, seeding would need to be prevented for approximately eight years.

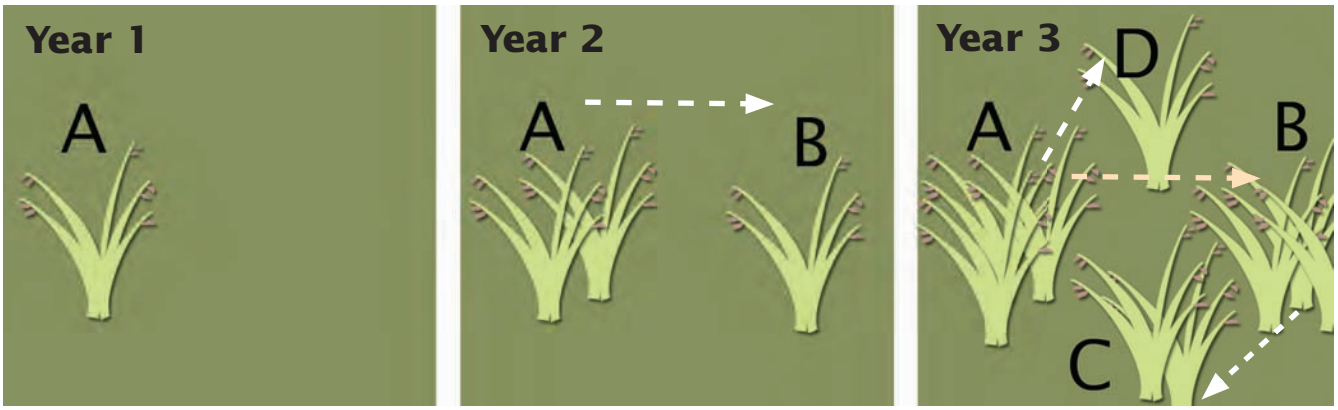
Seed can survive in the soil in excess of three years and declines through germination or seed decay (Gardener et al 2003b). Therefore the seedbank can be maintained over this period with very little input, and means Chilean needle grass can spring back after drought.

Seed spread

Chilean needle grass panicle seed is large and heavy and will travel no more than a few metres in wind (Gardener 1998). This causes distinct clumpy patches to form and means dispersal relies on vectors such as machinery, animals and water.

Masses of Chilean needle grass panicle seed can be carried on machinery (Charles Grech, DPI Victoria)

Figure 4. Spread of Chilean needle grass over time:



Year 1: Chilean needle grass plant is present.

Year 2: The initial infestation (A) increases in size due to localised panicle seed spread. Panicle seed is transported by stock to form a new infestation (B).

Year 3: Panical seed is transported by vehicle from A and B to form new infestations (C, D). Infestations A and B set panicle seed and once again increase in size.

Chilean needle grass was introduced to this site by the movement of infested soil (DPI&F Queensland).

Animals

Panicle seed is very well adapted to move on animals. Backwards facing hairs, a sharp callus, strong spines on the corona and a long, twisted awn ensures that they will readily attach to animal fur.

Panicle seed can easily contaminate and be moved about on the fleece or fur of stock or feral animals, with the fleece of sheep being a particular problem.

Kangaroos and feral animals, rabbits in particular, have been suspected to move Chilean needle grass panicle seed.

Vehicles and machinery

Vehicles and machinery are the number one vector for spreading panicle seed. Panicle seeds readily attach to cars, machinery, tractors, spray units, mowers and slashers, and new infestations can often establish at long distances from the original infestation. For example, slashing during the panicle seeding period is a major mechanism for contamination and seed spread.

A major problem in the spread of Chilean needle grass panicle seed is its unique biology that allows it to attach to just about anything.

Water

Rivers, creeks and drainage channels can transport Chilean needle grass panicle seed downstream from the original infestation. In particular, flood waters are known to move panicle seed downstream to new locations.

Flood waters are believed to have spread Chilean needle grass along the Condamine river in Queensland (DPI&F Queensland).

Stock feed and cropping

Chilean needle grass panicle seed can be a contaminant of hay, seed or grain. Movement and use of contaminated produce can lead to the development of new infestations, often long distances from the original source. This risk is increased during drought conditions when lower quality hay, seed and grain is sold, bought and transported extensively across the country.

Soil

As Chilean needle grass develops a semi-persistent seed bank, any movement of soil from an infested area is likely to transport panicle seed and create new infestations. Potential movement of panicle seed can occur via activities such as road works, landscaping, building or be transported on tractor tyres during cultivation operations.

Panicle seed heads are a distinct purplish colour and have a nodding habit (Charles Grech, DPI Victoria).

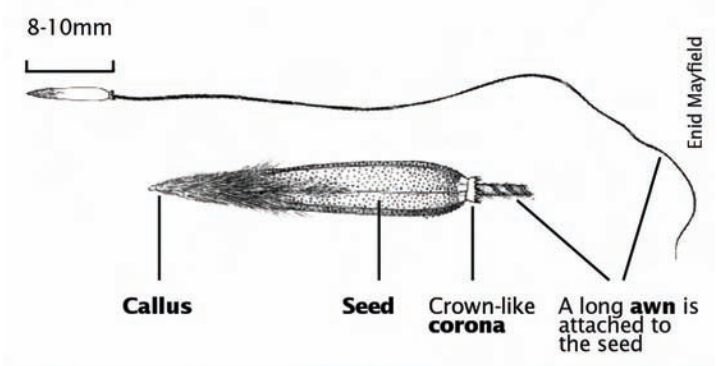
1.4 Identification

Grasses are amongst the more difficult groups of plants to identify. Additional references on identifying grasses are provided at the end of this section.

Chilean needle grass can be difficult to identify, especially when its distinctive panicle seed heads are not present. It can easily be confused with a number of other grass species.

Identifying Chilean needle grass in seed

The best time to identify Chilean needle grass is in spring, usually between October and March, when its distinctive purple flowers or panicle seeds are present. Although this timeframe may vary between localities and seasons, in northern NSW, for example, Chilean needle grass has a second panicle seeding period during autumn.



The panicle seed head is easily recognised by the following characteristics:

- Glumes are a distinctive purple/violet colour with long, light green awns (40–85 mm).
- When mature, glumes become a dark purplish colour and the awns dry out.
- Can be up to 30 cm long and nod characteristically by drooping to one side of the stalk.
- The panicle seed head is straw coloured when dry, and twists and kinks, often forming a tangled mass.
- The panicle seed itself can be identified by a distinctive ring of hairs that resembles a raised crown or ridge of small teeth.
- Panicle seed is the best feature to use to identify Chilean needle grass from other Nassella species (see figure 5).

Distinguishing characteristics of Chilean needle grass panicle seed

Photo: Geoff Robertson

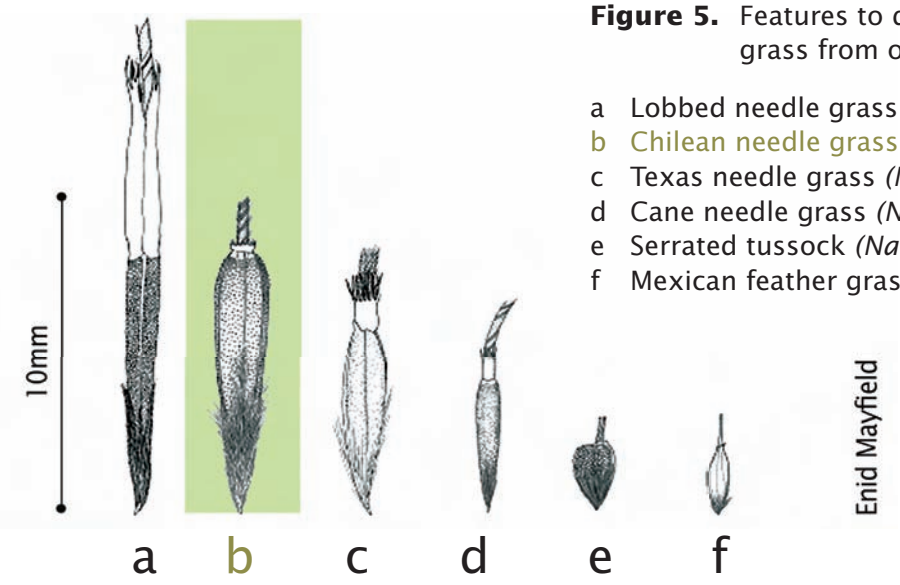


Figure 5. Features to distinguish Chilean needle grass from other *Nassella* species

a Lobbed needle grass *(Nassella charruana)*
b Chilean needle grass *(Nassella neesiana)*
c Texas needle grass *(Nassella leucotricha)*
d Cane needle grass *(Nassella hyalina)*
e Serrated tussock *(Nassella trichotoma)*
f Mexican feather grass *(Nassella tenuissima)*

Other *Nassella* species can be differentiated by seed size or the corona around the panicle seed. To distinguish the panicle seed of Chilean needle grass, compare the illustrations below:

a) Lobed needle grass (*N. charruana*) has a 4–6 mm-long whitish, papery corona rather than a crown-like corona.

b) Chilean needle grass (*N. neesiana*) has thick, tooth-like hairs (less than 1.5 mm), with panicle seed 6–10 mm and awns 40–85 mm long.

c) Texas needle grass *(N. leucotricha)* has longer thinner hairs (~3 mm) on the corona.

d) Cane needle grass (*N. hyalina*), has shorter awns (35–40 mm) and smaller seed (3.5–6 mm).

e) Serrated tussock (*N. trichotoma*) has shorter awns (up to 30 mm) and smaller seed (1–2 mm).

f) Short-spined needle grass (*N. megapotamia*) has smaller seed (2–4 mm).

Chilean needle grass after fire (DPI Victoria).

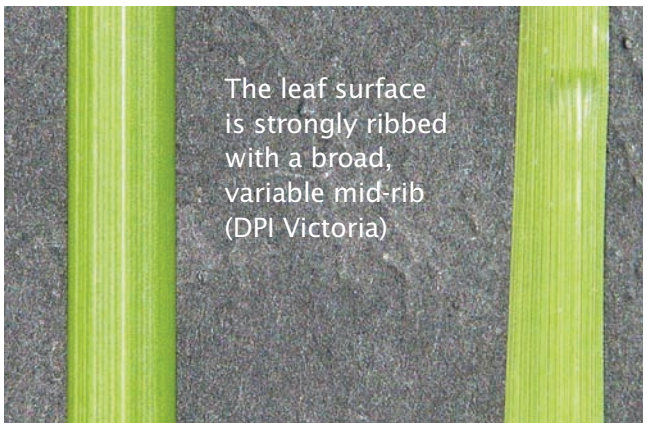
Chilean needle grass plants in agricultural situation (DPI Victoria).

Identifying Chilean needle grass when not in seed

Differentiating Chilean needle grass from other grass species is challenging, as characteristics such as leaf size and colour are not always consistent, often making it difficult to tell apart when not in seed.

The following features will help distinguish Chilean needle grass when not in flower.

Mature, straw-like Chilean needle grass (Charles Grech, DPI Victoria)



The leaf surface is strongly ribbed with a broad, variable mid-rib (DPI Victoria)

Growth habit

Chilean needle grass forms erect, robust tussocks that can be up to 1 m tall and variable in nature, depending on grazing pressure. As the plant matures, the leaves tend to droop. Under heavy grazing, plants can produce many shoots, resulting in wide, untidy tussocks.

Colour

Chilean needle grass is often described as having a distinctive colour, depending on the locality and conditions. During early growth stages it can be a darker green compared to most other pasture species and during winter in colder regions it becomes yellow or straw like, unlike native grass species.

Leaf Characteristics

Chilean needle grass leaves are between 1–5 mm wide, up to 300 mm long and are flat in appearance. The leaves can roll inwards when under stress, for example during drought. The upper leaf surface is strongly ribbed, with a broad, but variable, mid-rib.

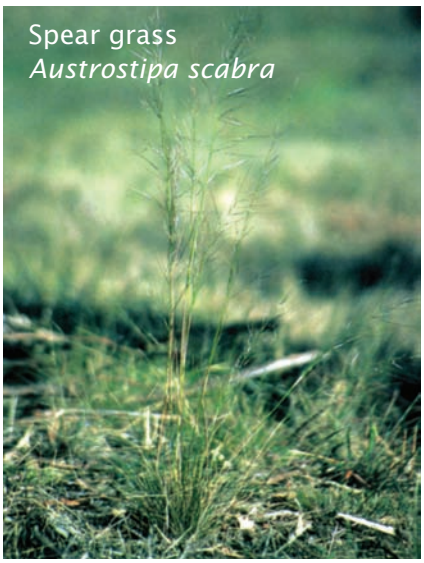
Hairs can be observed on the upper side of Chilean needle grass leaves and can be felt by sliding fingers up the leaf surface.

Chilean needle grass plant (DPI&F Queensland).

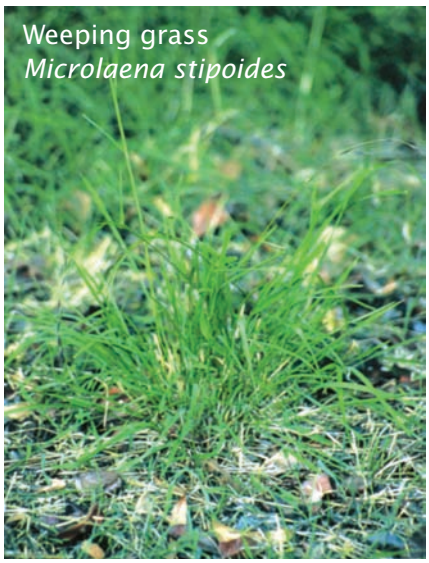
Chilean needle grass takes on a "yellowing" appearance towards the end of winter around the ACT (Jenny Conolly, Parks, Conservation and Lands, ACT).

Features to distinguish Chilean needle grass from native or other grasses

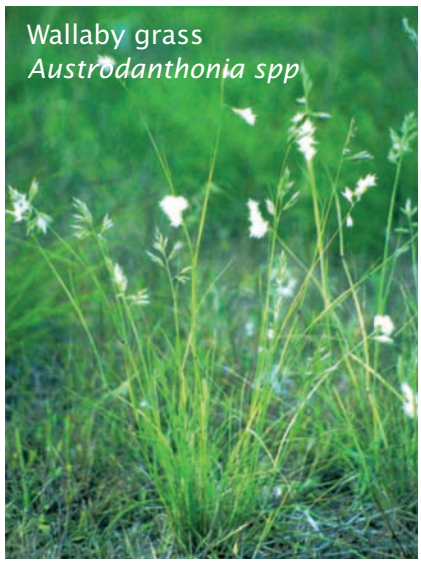
Without its distinctive panicle seed heads, Chilean needle grass can easily be mistaken for many other grass species, especially spear grasses (*Austrostipa* species), wheatgrass (*Elymus scaber*), wallaby grasses (*Austrodanthonia* species) and tall fescue (*Festuca arundinacea*).



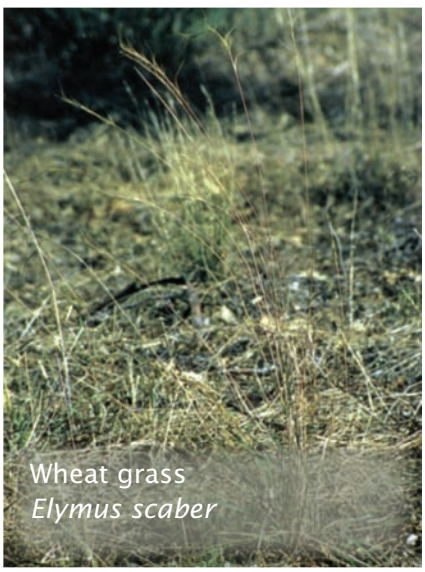
Spear grass
Austrostipa scabra



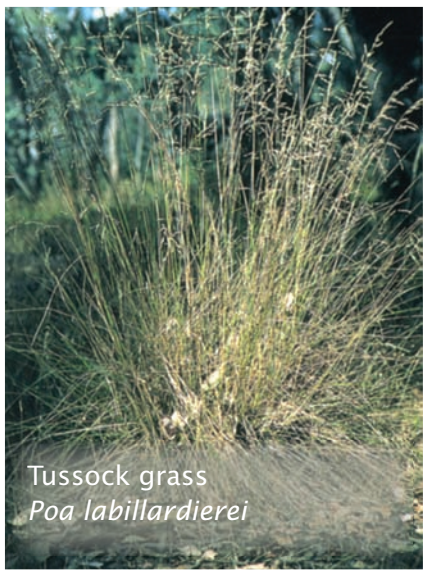
Weeping grass
Microlaena stipoides



Wallaby grass
Austrodanthonia spp



Wheat grass
Elymus scaber



Tussock grass
Poa labillardierei

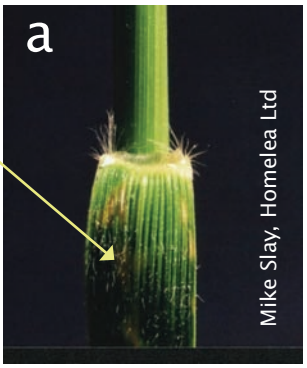
Kangaroo grass
Themeda triandra

These photos sourced from *Native Grasses: An identification handbook for Temperate Australia, 3rd Edition*, CSIRO 2002

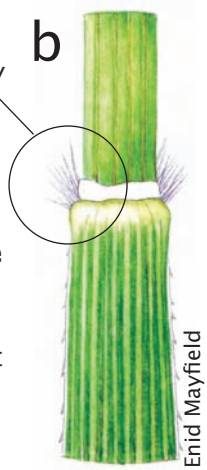
Tall fescue, *Festuca arundinacea* (Andy Raymond, formerly Bega Valley Shire).

Follow these steps to differentiate Chilean needle grass from other grass species:

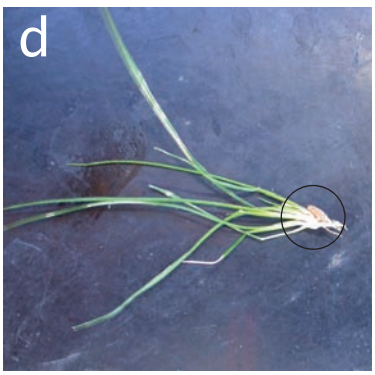
1. **Feel for short erect hairs on the upper side of leaf (a)**: (most native grasses are smooth or have much softer hairs).



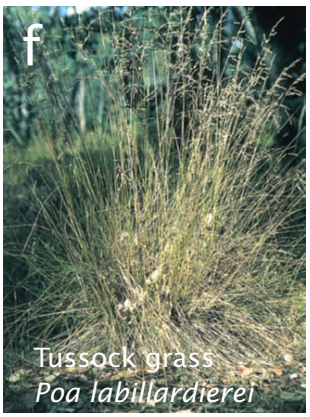
2. **Look for a small tuft of hair at the junction of the leaf blade and leaf sheath (b)**, you will probably need a hand lens (Note: wallaby grasses are quite similar, but Chilean needle grass can be differentiated by its much coarser and wider leaves).



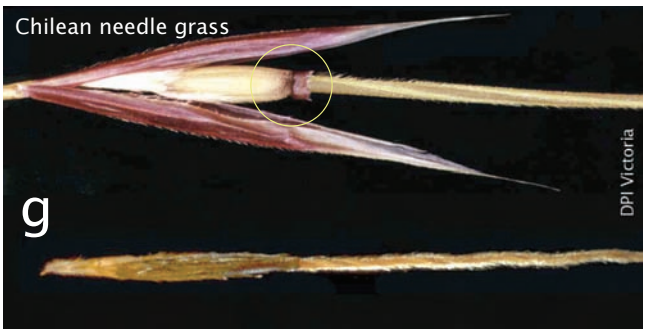
3. **Look for seeds at the base of the plant (c, d) and in the leaf sheaths (e)** (basal and stem cleistogenes are not present in native grasses. **Note:** Texas needle grass can produce stem seeds, but not basal seeds)



4. **Mature plants are not the pronounced 'clumpy' type tussocks** like those of serrated tussock (*N. trichotoma*) or native *Poa* species (f)



5. **The corona is absent in seeds of native spear grasses** (species of *Austrostipa*), which are otherwise similar in appearance. (g) (DPI Victoria)



For further information on identifying Chilean needle grass and other grasses:

DPI Victoria. (2007). *Weeds of National Significance Management Guide - Chilean needle grass.* Department of Primary Industries, Victoria.

Gardener, M. (1999). Landcare Notes: *Chilean needle grass identification*. Keith Turnbull Research Institute, Department of Natural Resources and Environment, Frankston, Victoria.

Lamp, C.A., Forbes, S.J. and Cade, J.W. (2001). *Grasses of Temperate Australia – a field guide*. Bloomings Books, Australia.

Mitchell, M. (2002). *Native grasses – Identification handbook for temperate Australia, 3rd edition*. CSIRO publishing, Collingwood, Victoria.

Sharp, D. & Simon, B.K. (2002), *AusGrass: Grasses of Australia*. CD-ROM, Version 1.0, Australian Biological Resources Study, Canberra, and Environmental Protection Agency, Queensland.

Slay, M. (2002). *Chilean needle grass: A guide to the identification and management in Hawke's Bay*. Hawke's Bay Regional Council, New Zealand.

Walsh, N. (1998) Identification of South American tussock weeds. *Plant Protection Quarterly* 13(2), pp. 59-62.

Section 2 Integrated weed management

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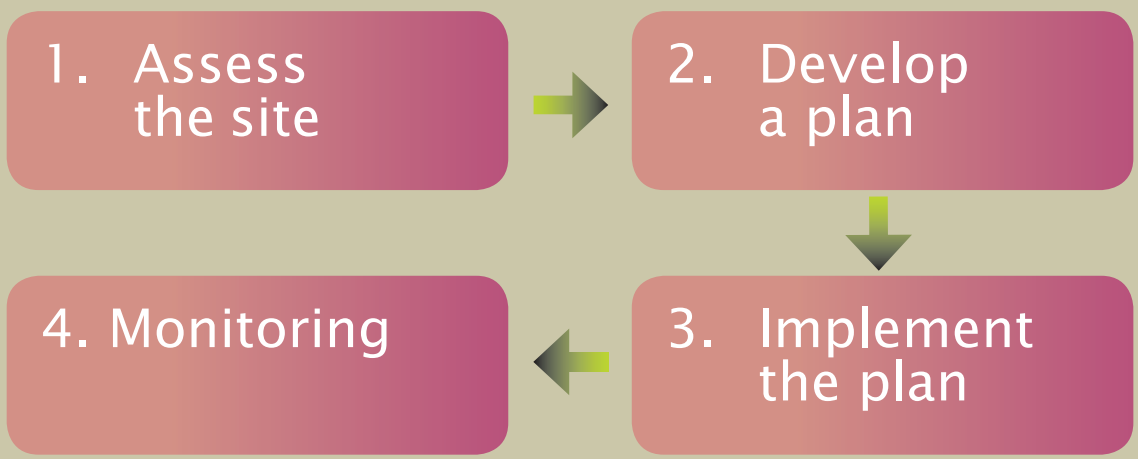
Section 2 Integrated weed management

2.1 Developing an integrated plan

An integrated Chilean needle grass management program has four steps: site assessment, developing a plan, implementing it and monitoring the outcome. This section outlines what to consider at each step.

Figure 6. Four steps to planning an integrated management plan



Step 1: Assess the site

A site assessment to identify problem areas is vital to help plan which sites should be treated first.

Map infestations

A large-scale topographic map, an aerial photograph or a hand-drawn map are all effective ways to record infestations. Consider and document risks or issues, such as accessibility and assets of agricultural, environmental and cultural value.

When looking for Chilean needle grass:

- Check for new infestations in high-risk areas such as:
  - fencelines bordering infested roadsides, riverbanks, stream flood limits, roadside drains, vehicle tracks, vehicle clean-down areas, areas where stock congregate and holding paddocks
  - areas where hay, grain or soil has been used that was originally purchased from an area known to have Chilean needle grass.

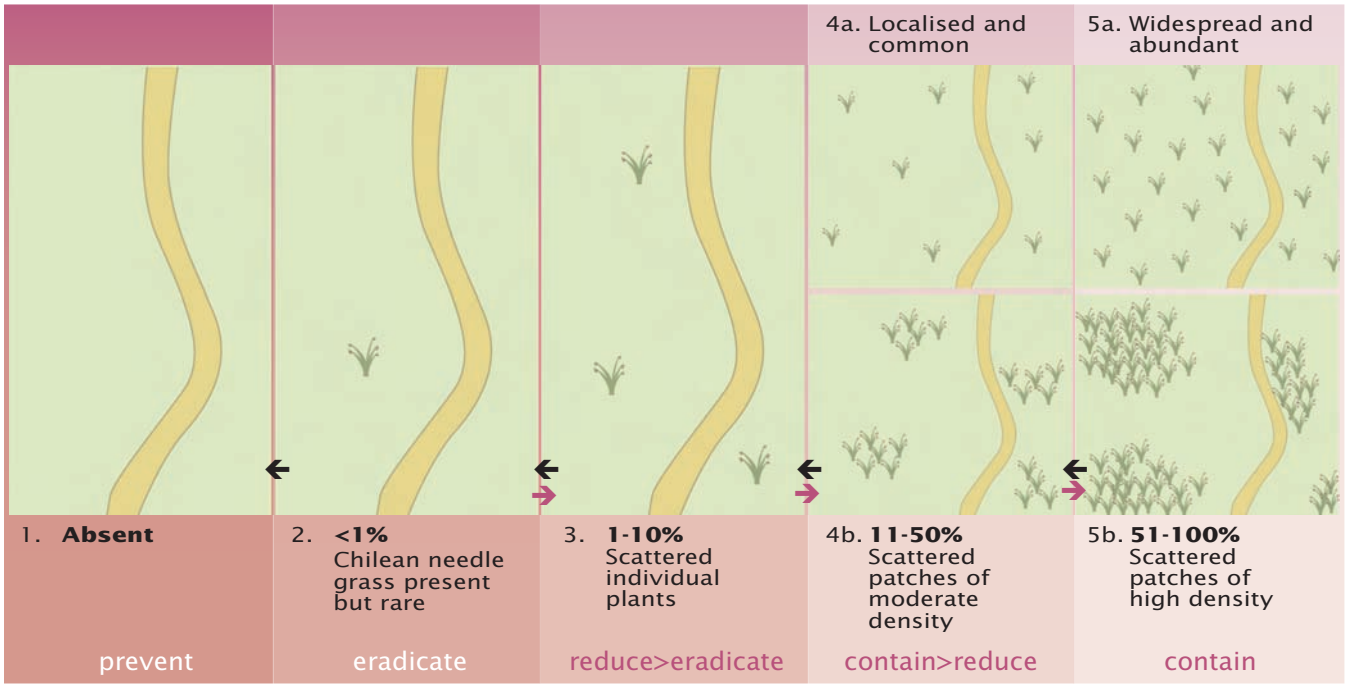
- Survey in spring when the distinctive flower heads are present.
- Learn to identify Chilean needle grass when not in flower (see page 10).
- Take notice when flowering and panicle seed development occurs to effectively time control methods.
- Be consistent and conduct monitoring at a similar time each year, using comparable methods and recording the same information each time.

Estimate density

Use figure 7 below to determine the percentage cover of Chilean needle grass; this will help prioritise which sites need to be treated first.

Figure 7: WoNS Density classes (McNaught et al 2006)

Changes in an infestation over time: ← with integrated management; → without management



DO YOU NEED TO MAP CNG OR IMPROVE EXISTING CNG MAPS?

Consider using the National core attributes for weed mapping.

A Field Manual for Surveying and Mapping Nationally Significant Weeds was published by the Australian Government (McNaught et al 2006) to improve the consistency of data across a national scale. The manual is for land managers, land management agencies and research organisations and is based on collecting core attributes (as agreed by the Australian Weeds Committee - AWC) as minimum information for monitoring the distribution and spread of WoNS.

There are 13 core attributes, which form minimum data that should be collected, including information such as date, place, longitude, latitude and density. Using these core attributes will help ensure all CNG data collected is consistent and applicable from one local area or region to the next, and across the whole country. It will enable a clearer picture of the CNG problem across the Nation and enable more efficient resource direction.

The manual explains the data collection in detail and guidelines have also been prepared by the Cooperative Research Centre for Australian Weed Management to assist communities and landholders to map weeds and develop local weed management plans. For a copy of the manual visit the Weeds Australia website: www.weeds.org.au/mapping.htm.

Step 2: Develop the plan

Where large infestations have developed, Chilean needle grass management can become complex. Successful management relies on a good plan.

Where a land manager works alone or where infestations are small, a simple recording system is encouraged. A hand-drawn property plan is a useful tool to continuously add notes and plan treatments.

Where the situation is more complex, or a land manager needs to share the information with others, such as staff, family, contractors, neighbours or Noxious Weed Authorities, a more thorough recording and planning system may be required.

Set objectives

The following objectives can be applied at any scale, from one paddock within a property to a whole farm, region or state. Multiple objectives may be required if the situation is complex.

Prevention: Where no Chilean needle grass exists, prevent it from entering the land.

Eradication: Where early stage invasion or small isolated infestations exist, high priority should be given to eradication.

Reduction or containment: Where Chilean needle grass is established and/or widespread, it is unrealistic to expect to eradicate the weed. Use control to limit the impact of Chilean needle grass, to gradually decrease the infestation size and to keep it from spreading further.

Prioritise sites

As Chilean needle grass infestations are often widespread and patchy, it can be difficult to know where to start to control. Consider high priority areas as follows:

1. **New, small or outlying infestations** should be eradicated first to stop a seed bank from developing and reduce the likelihood of a large established infestation developing.
2. **Areas with high risk of spread**, such as roadsides, riverbanks and stock routes should be controlled as a high priority, to limit further spread and reduce the chance of new infestations developing.
3. **High value assets** where infestations are established, including the most productive pasture, the highest value native grasslands and sites of community or cultural importance.
4. **Sites where efficiencies are gained** from simultaneous control of other grassy weeds such as serrated tussock, African lovegrass or giant Parramatta grass.

Determine control methods

Identify the most appropriate methods to control Chilean needle grass for your situation (see Section 3 Selecting a control program, on page 23), taking into account available resources including finances.

(Left) High risk areas for spread such as roadsides should be high priority to limit Chilean needle grass.

(Above) Sites where benefits can be gained from control of other weeds included as part of a holistic management plan.

PLAN TO PREVENT SPREAD

Any management program must include prevention of spread through adequate hygiene practices. Include this in your plan to ensure that any activities carried out will not spread the problem further.

DO YOUR WEED MANAGEMENT PLAN ONLINE

The Queensland Department of Natural Resources and Water has developed a Property Pest Management Plan (PPMP) kit. This kit contains guidelines on how to prepare a PPMP and practical worksheets to help you develop one for your property. The kit is available online at http://www.nrw.qld.gov.au/oneplan/index.html

Step 3: Implement the plan

Consider the effectiveness of control methods at different times of the year (for example, herbicide control is best conducted in spring, before panicle seed set) and balance this with the time and resources available.

See Section 4 Control methods, on page 39, for further information.

Once your chosen objectives and plan of action has been decided:

- allocate responsibility for actions
- schedule activities on a calendar
- get started.

COORDINATE MANAGMENT PROGRAMS TO ACHIEVE GREATER EFFECTIVENESS

Coordinate management programs with neighbouring property managers, across the community or with other local, regional or state authority programs. This ensures greater cost effectiveness and reduces the likelihood of spread and invasion from adjoining lands.

Local or state authorities often coordinate weed control activities, especially if the weed is new to the area and is a major threat. These programs often assist landholders through activities such as training, spraying and re-vegetation. Examples of this type of government coordination can be found in the Queensland and Bega Shire case studies on page 60 and 68. Contact your local authority for more information (page 74).

Step 4: Monitoring

Have control works been successful? Is follow-up action required? What will be required next year?

Monitoring is an essential part of any good management program to ensure that control activities and methods have been successful.

Periodically check all sites where control activities have been carried out. Where control has been unsuccessful or Chilean needle grass is beginning to re-emerge, follow up with further control activities.

Record the success of control activities and use this to review your plan. Take notes on what works and what doesn't, record progress in a site diary, on maps, information sheets, or with photo

Landholders attending a field day near Clunes, Victoria to get advice and support in management techniques. (DPI Victoria).

points. Consider recording changes in Chilean needle grass density or percentage cover.

Doing this will allow you to build up a picture of what is happening on the site over time, identify new issues to plan for next year and, if necessary, demonstrate progress to your group or funding body or authority.

BE AWARE OF CHILEAN NEEDLE GRASS IN DROUGHT CONDITIONS

The drought tolerance of Chilean needle grass means it will remain healthy while many competing plants that are not drought tolerant suffer. Chilean needle grass almost always produces panicle seeds, is often the last species to dry out before summer and the first species to green up the following season, especially after summer rain.

This is a particular problem in agricultural pasture and drought conditions have the potential to magnify the Chilean needle grass problem across the country. Chilean needle grass will be the first to flourish after rains, dominating landscapes and causing large areas of paddocks to become unpalatable as it goes into seed.

Transport of stock feed across the country during the drought conditions is another concern that can lead to occurance of new infestations in areas not previously known to contain Chilean needle grass. During drought periods, take care to monitor infestations and keep control plans flexible to ensure you can keep on top of the infestation.

Further information

Surveying and mapping:

McNaught, I, Thackway, R, Brown, L and Parsons, M (2006). *A Field Manual for Surveying and Mapping Nationally Significant Weeds*. Bureau of Rural Sciences, Canberra (available on **www.weeds.org.au/mapping**.htm).

Integrated Weed Management:

CRC for Australian Weed Management (2007). *Integrated Weed Management Manual.* CRC for Australian Weed Management, Adelaide, South Australia. (Order on: ***www.weeds.crc.org.au/publications/iwm_manual_flyer.html***).

Module 1: *Developing and implementing a weed management plan* in: CRC for Australian Weed Management (2004). *Introductory weed management manual.* Department of the Environment and Heritage, Canberra (available on www.weeds.crc.org.au/publications/education_training_resources.html).

(Simon Kneebone, DPI Victoria).

Remove Chilean needle grass from clothing before leaving infested areas (DPI Victoria).

2.2 Prevention of spread

Land management practices are the greatest influence on the spread of Chilean needle grass panicle seed and adequate hygiene measures are essential.

Chilean needle grass panicle seed readily attaches to just about anywhere on vehicles, equipment and machinery, it is a major contaminant of stock, particularly sheep, and is also a contaminant of fodder, stock feed, grain, seed, soil and mulch. Movement of these vectors across the country without adequate hygiene measures means infestations are easily spread.

The practices outlined in this section are recommended for all control programs to prevent or limit the spread of Chilean needle grass.

General

In all situations, minimise movement in and out of infested areas when Chilean needle grass is in seed:

- if possible avoid working in infested areas all together until Chilean needle grass is controlled
- especially directly after wet weather, when mud and panicle seed will stick to wet machinery and vehicles.
- take care to stick to formed tracks and roads
- plan work to occur in clean areas first.

Monitor regularly and control emerging Chilean needle grass:

- in holding paddocks, clean-down sites and machinery storage areas
- after movement of materials, such as hay, roadside gravel and soil, onto clean sites.

When employing contractors:

- do not allow them on site unless they are clean and free from panicle seed
- ensure they clean down before leaving the site (consider the use of a 'cleandown' clause in new contracts to ensure this happens)
- consider using Weed Hygiene-accredited contractors.

Ask people working in or visiting infestations to check and brush off panicle seed before leaving the site.

Vehicles, machinery, equipment

Undertake an accredited vehicle and machinery hygiene training course.

Plan works. For example:

- slash before the main flowering period;
- time harvest to avoid Chilean needle grass panicle seeding; hay or grain should not be harvested from areas during this period;
- work in clean areas first.

Chilean needle grass panicle seed can accumulate on slasher decks (Charles Grech, DPI Victoria).

Inspect vehicles, machinery and equipment for contamination and clean down before removing from an infested site, including:

- on and around wheels, slasher decks and above bash plates;
- air filters, radiators and engine components;
- cabin interiors, as they carry a large amount of mud and gravel.

Where necessary, clean down any contaminated machinery or equipment. Dustpan and broom, air compressor, high pressure units are all practical options.

Be sure to:

- appropriately dispose of any panicle seed collected
- always use the same place to clean down
- monitor the clean-down site for emerging Chilean needle grass, and control where needed.

Some Local Councils in Australia have established special clean-down areas along roadsides, specifically for this purpose.

Clean down of contaminated machinery is a must (DPI Victoria).

A slasher mounted with blowers reduces contamination to limit spread in Queensland (DPI Victoria).

A cover on a slasher can significantly reduce contamination (DPI Victoria).

Chilean needle grass panicle seed can adhere more easily in muddy conditions (DPI&F Queensland).

Sheep are easily contaminated with Chilean needle grass panicle seed.

Clean down areas can reduce the rate of spread along roadsides (DPI Victoria).

Stock

Exclude stock from infested pasture when panicle seed is present (usually November–March).

Limit movement of stock (especially sheep) from infested to clean areas.

Place stock in quarantine/holding paddocks if:

- new stock are coming onto a clean site
- moving stock from a contaminated paddock to a clean paddock
- stock are suspected to be contaminated with panicle seed.

Always use the same holding paddock, monitor for germinating Chilean needle grass and control where needed.

Be careful when buying or selling stock feed that may be contaminated with Chilean needle grass panicle seed.

Cropping, fodder, grain, soil, mulch

Do not harvest while Chilean needle grass is in seed.

Do not buy or sell fodder, grain, seed, soil or mulch likely to be contaminated with Chilean needle grass panicle seed.

Avoid moving or dispose of spill material, such as soil, suspected to be contaminated with Chilean needle grass seed.

Consider the use of Vendor Declarations for both buying and selling.

VEHICLES CARRY MANY WEEDY HITCHHIKERS

Michael Moerkerk of DPI Victoria conducts vehicle and machinery hygiene workshops in Victoria. During the workshops, participants manually clean down and collect samples from vehicles and equipment used in land management activities. Germination tests and visual examinations are then conducted on the samples to assess the presence of weed seed.

On 70 vehicles and 36 items of machinery, Michael has found over 230 contaminant species, including 23 Victorian noxious weeds, one of which is Chilean needle grass (Moerkerk, 2005 and 2006). The most common location for contaminants on vehicles was the cabin and engine bay, but weed seed was also found in many other locations.

Vehicles and equipment used for land management activities are a significant risk for their capacity to spread weeds. Chilean needle grass panicle seed is well known for its ability to stick to vehicles and equipment. This study highlights the importance of practising good vehicle hygiene and regular cleaning during the seeding period to reduce the risk of spreading Chilean needle grass and other weeds.

For further information on preventing spread of Chilean needle grass on vehicles and machinery:

Baldyga, N. and Grech, C. (2005). *Machinery hygiene guidelines for roadside managers – minimising the spread of Chilean needle grass*. Department of Primary Industries, Bacchus Marsh, Victoria. (available on: ***www.weeds.org.au/WoNS/Chileanneedlegrass/***).

Section 3 Selecting a control program

Section 3 Selecting a control program

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The unusual seed biology and persistence of Chilean needle grass coupled with the necessity to vary control methods depending on circumstances, makes Chilean needle grass a challenging weed to manage.

For a successful integrated management program in all situations:

- limit spread by using good vehicle, machinery and stock hygiene practices
- always integrate a number of different control methods
- limit panicle seed production and provide or encourage competition of desirable grasses
- quickly eradicate new, small or outlying infestations before they establish
- incorporate Chilean needle grass management into the production or biodiversity system
- regularly monitor and review.

No single technique will successfully control or reduce Chilean needle grass. All situations will require a different combination of the available control methods to achieve success. Use Table 2 on pages 26-27, to select an integrated control program to suit your situation by following the instructions on page 25.

Integrate control methods for best results
Hume City Council,

Charles Grech, DPI Victoria

Charles Grech, DPI Victoria

Charles Crech, DPI Victoria

DPI Victoria

Choosing your control program

Step One: Follow the coloured boxes to select your situation

Start at the top boxes and select a category which describes the land to be managed – either agricultural land, native grassland or a linear reserve. Sticking to this category, continue to follow the arrows down to select the best match for your specific situation.

For example:

- If you are a roadside manager, the category of land to be managed will be 'linear reserves', followed by 'introduced' or 'native', depending on the desirable species present.
- Native grassland for conservation will fall under the 'native grass' category, then ungrazed'.
- For agricultural activities on arable land, you can specify the rainfall type and current land use (crop or pasture). Grazed native pastures and steep or rocky areas will fall under the 'native grass' category.

Step Two: Select from recommended control methods

Once you have selected the circumstances which best match your situation, the ticks within the table will indicate suitable control methods. These form an integrated management program tailored to your situation. Detailed information on these integrated control programs can be found on pages 23-37 and Section 4 Control methods, pages 39 to 56.

STEP 1 Determine situation		Agriculture (introduced species)			
Current land use		Crop		Introduced pasture	
Dominance		Summer Rainfall	Winter Rainfall	Summer Rainfall	Winter Rainfall
STEP 2 Choose control methods					
Cultural control methods	Timing				
Manual removal/chipping	All year	✓✓	✓✓	✓✓	✓✓
Mow/slash	1-3	✓	✓	✓	✓
Cultivate	1-4	✓✓	✓	✓	✓
Mulch/weedmat*	All year	✗	✗	✓	✓
Rotational grazing*	1 (also 2-4)	✓✓	✓✓	✓✓	✓✓
Set stock grazing*	1 (also 2-4)	✓ Use with wiper system	✓ Use with wiper system	✓ Use with wiper system	✓ Use with wiper system
Fire to reduce seeding*	4-6	✓	✓	✓	✓
Chemical control methods					
Spot spray flupropanate	1, 7	✗	✗	✓✓	✓✓
Spot spray glyphosate	1-3, 7 (also 4, 5)	✓✓	✓✓	✓✓	✓✓
Boom spray flupropanate**	1	✓	✓	✓	✓
Boom spray glyphosate*	1-3 (also 4, 5)	✓✓# During cropping sequence	✓ During cropping sequence	✓✓# During cropping sequence	✓✓ During pasture renovation
Wick wiper^ flupropanate	1, 7	✗	✗	✗	✗
Wick wiper^ glphyphosate	2, 5, 7	✗	✗	✓	✓
Competition					
Plant competition: cropping – plough/direct drill, specialised all terrain equipment, aerial sowing	N/A	✓✓	✓✓	✓✓	✓✓
Competition: spray and hay/ broadcast/direct seed	8	✓	✓	✗	✓

* Will not work alone, must be integrated with other methods for success.

** Flupropanate can be very damaging to many native grass species.

^ Wick wiping has the potential to cause lateral damage to non-target species.

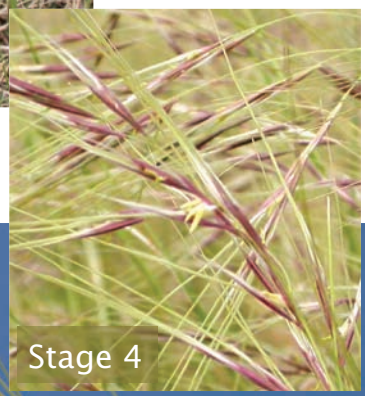
Better control in autumn.

✓✓ = recommended control methods (current best practice integrated control program)

✓ = control methods that may be useful, but can have variable results or require caution

✗ = not recommended

Native Grass		Linear Reserves	
Grazed (native pasture, in steep slopes, rocks)	Ungrazed (eg. parks, reserves)	Exotic	Native
✓✓	✓✓	✓✓	✓✓
✓	✓	✓✓	✓
✗	✗	✓	✗
✓	✓	✓	✓
✓✓	✗	✗	✗
✗	✗	✗	✗
✓✓	✓✓	✓✓	✓✓
✓**	✓**	✓✓	✓**
✓	✓✓	✓✓	✓✓
✗	✗	✓✓	✗
✗	✗	✓✓ During pasture renovation	✗
✓**	✗	✓	✗
✓	✗	✗	✗
✓✓	✓	✓	✓
✓✓	✓✓	✗	✓✓



Timing

CNG growth stages.

1. Vegetative: while seedlings or established plants are actively growing (before flowering)
2. Stem swelling: when stem swelling occurs just before flowering.
3. Early flowering: when plants first start to flower.
4. Flowering: during flowering.
5. Panicle seed emergence: once panicle seed emerges and is visible (caution needs to be taken not to spread seed during this stage).
6. Panicle seed fall: after panicle seed has matured and fallen from the plant.

Other

7. When native grass is dormant – Winter/June C4 grasses (*Themeda*), – Summer/December C3 grasses (*Austrostipa*)
8. April to July

Note: timings in brackets (eg "also 4, 5") can be used, but are a secondary preference.

Grazed Chilean needle grass is more palatable to stock (DPI Victoria).

3.1 Agriculture (introduced species)

Pasture – all situations

Established infestations in pasture should be managed by applying a combination of control activities that will decrease the abundance of Chilean needle grass, increase its palatability and limit the production of panicle seed.

The combination of grazing, cultivation, chipping, slashing, herbicide and fire selected will depend on Chilean needle grass growth patterns and the necessity to favour the growth of desirable species. Because these techniques are likely to result in bare ground, re-sowing desirable perennial pasture species that will compete with re-emerging Chilean needle grass or other weeds is essential.

Good planning and hygiene practices are vital to ensure the problem is not enhanced by panicle seed spreading on machinery, vehicles or livestock, see "Prevention of Spread", pages 20 to 22.

Small infestations should be manually chipped out immediately or spot sprayed before seeding. Manual removal is the most effective method and, where possible, preferred, as this will reduce the potential for Chilean needle grass to regenerate from basal seed maturation.

To prevent seed production and reduce the density of larger infestations, a combination of grazing and spraying is recommended (see summer or winter rainfall zones for further detail). If using flupropanate, caution should be taken that treated areas are not grazed or cut for stock food until the withholding period expiry, and that there is a permanent withholding period for lactating cattle and goats.

All control methods need to be followed up by encouraging perennial competition or re-sowing desirable pasture species, with direct drilling the best option.

Monitoring is essential to ensure re-emerging Chilean needle grass is followed up. Spot spraying with glyphosate is the best method to quickly reduce these plants.

"*Keeping Chilean needle grass short and green by grazing will reduce seed production and increase its feed value.*" (Landholder, near Guyra, NSW)

GOOD HYGIENE PRACTICES ARE ESSENTIAL

Avoid having stock in paddocks where Chilean needle grass is in seed and plan any activities to occur outside the Chilean needle grass panicle seeding period. Always inspect and clean down vehicles or machinery used within a Chilean needle grass infestation. Do not buy, sell or transport stock or stock feed that may be contaminated with Chilean needle grass seed. Vendor Declarations are a good way to ensure there is no Chilean needle grass contamination. For further information see "Prevention of Spread", pages 20 to 22.

Monitor and control Chilean needle grass in quarantine paddocks (DPI Victoria)

Pasture – summer rainfall zones

Management suited specifically to areas where summer rainfall is dominant, such as northern New South Wales and southern Queensland.

Chilean needle grass often produces panicle seed heads twice a year in this area, producing approximately two-thirds of seed heads in spring and about one-third in autumn, making it necessary to focus on limiting seed production in both seasons.

Strategic grazing with cattle is preferable to sheep, as cattle are better suited to grazing rougher Chilean needle grass herbage and pose less risk of becoming contaminated with panicle seed (Grech 2007a).

Spot spraying with glyphosate or flupropanate before panicle seed set is recommended to reduce off-target damage. Caution needs to be taken when spot spraying, as both glyphosate and flupropanate can damage other grass species.

Boom spraying with glyphosate can also be used and generally provides better control in autumn.

As infestations may need to be sprayed twice, in spring and again in autumn, it is extremely important to rotate herbicide choice to limit the chances of herbicide resistance.

Additional methods that can be used to limit panicle seed set with mixed success are set stock grazing with cattle and fire (where conditions allow). Caution needs to be taken with set stock grazing, as it can cause a shift in pasture composition, away from desirable perennial species and reduce the effectiveness of flupropanate (Grech 2007a).

BENEFITS OF STRATEGIC GRAZING IN SUMMER RAINFALL ZONES

Adopting management practices that encourage competitive plant species is an effective way to control weeds in grazing situations.

The results of a strategic grazing trial, conducted by the University of New England near Glen Innes on the New South Wales Northern Tablelands, show that strategic grazing management can encourage desirable perennial grasses in pasture heavily infested with Chilean needle grass.

Taking advantage of the relatively slow growth rate of Chilean needle grass, the researchers and the landholder used strategic grazing to heavily graze the pasture and give the faster-growing perennial grasses an advantage over Chilean needle grass during the subsequent rest periods.

The estimated contribution by dry weight of Chilean needle grass in the spring, fell from 55 per cent to about 30 per cent, with a corresponding increase in other perennial grasses such as cocksfoot, tall fescue and paspalum.

The Chilean needle grass changed from rank, unpalatable plants to a shorter, green and more palatable grass. The pasture was no longer completely dominated by Chilean needle grass but included a higher proportion of palatable introduced grasses, particularly cocksfoot and tall fescue.

Chilean needle grass re-emerging after fire should be spot sprayed (DPI Victoria).

Pasture – winter rainfall zones

Management suited specifically to areas where winter rainfall is dominant such as central and southern New South Wales, Victoria, South Australia and Tasmania.

Strategic grazing with sheep or cattle is effective and can encourage growth of desirable species. Cattle are the preferred grazers, where possible, as they are at less risk of contamination with Chilean needle grass panicle seed.

Follow up strategic grazing with spot spray applications of either glyphosate or flupropanate.

For widespread heavy infestations, glyphosate can be boom sprayed. Glyphosate will brown off Chilean needle grass plants but they will re-grow and require follow-up treatment in 6–12 months.

Spot spraying that follows strategic grazing is the preferred method for flupropanate. Note that flupropanate can be applied with a boom, although its effectiveness has been found to be short lived in winter rainfall areas, especially in situations where ground cover has been reduced during set stocking (Grech 2007a).

Fire over spring and summer can be a useful tool and is recommended in winter rainfall zones to prevent heavy or widespread infestations from seeding. Note that you can expect large germinations of Chilean needle grass following fire treatments and these will need to be managed. Set stock grazing is an option, although this can reduce the effectiveness of follow-up herbicide treatments, in particular flupropanate. For more information, refer to the text box, "Integration with strategic grazing is the key to effective use of flupropanate", opposite.

INTEGRATION WITH STRATEGIC GRAZING IS THE KEY TO EFFECTIVE USE OF FLUPROPANATE

Long-term grazing trials in Victoria and New South Wales have shown that set stock grazing in areas boom sprayed with flupropanate can increase Chilean needle grass, leading to poor survival of beneficial pasture species. Conversely, strategic grazing practices combined with boom spraying of flupropanate (Grech 2007a) improved Chilean needle grass control and enabled better survival of pasture species.

In one trial, initial results from set and strategic grazing showed a reduction in the infestation after both. However, after almost three years, Chilean needle grass began to increase cover towards original levels in the set stocking treatment, while in the strategic grazing treatment it remained at low levels.

A possible explanation is that pasture recovery in the set stocking treatment may have been reduced by the continual and selective nature of set stock grazing. Conversely, the strategic grazing approach helped to reduce panicle seed, thus reducing germination vigour and enabling greater competition from pasture species. This result highlights the importance of thinking strategically and combining compatible control methods as part of an integrated management plan.

Cropping – all situations

As with any situation where infestations can be manually chipped out, do this as a first preference. Crop rotation is a useful tool to increase competition to Chilean needle grass.

Sowing crops that will be actively growing in autumn/early winter can minimise germination and establishment of Chilean needle grass seedlings. Where seedlings establish, prevent flowering by integrating herbicide control or strategic grazing. Alternatively, harvest the crop before Chilean needle grass flowers.

Where strategic grazing is not possible, implement other control methods such as mowing, slashing, fire or cultivation.

Over-reliance on glyphosate may lead to herbicide resistance, so strategies to control Chilean needle grass should incorporate integrated weed management, for example, changing herbicide groups and applying cultural control activities. Note that flupropanate is not appropriate or registered in crops due to its residual properties.

Careful planning should be undertaken to ensure crops are not harvested whilst Chilean needle grass is in seed. Do not buy or sell grain or fodder that may be contaminated with Chilean needle grass panicle seed. Always inspect and clean down machinery used within a Chilean needle grass infestation.

Cropping – summer rainfall zones

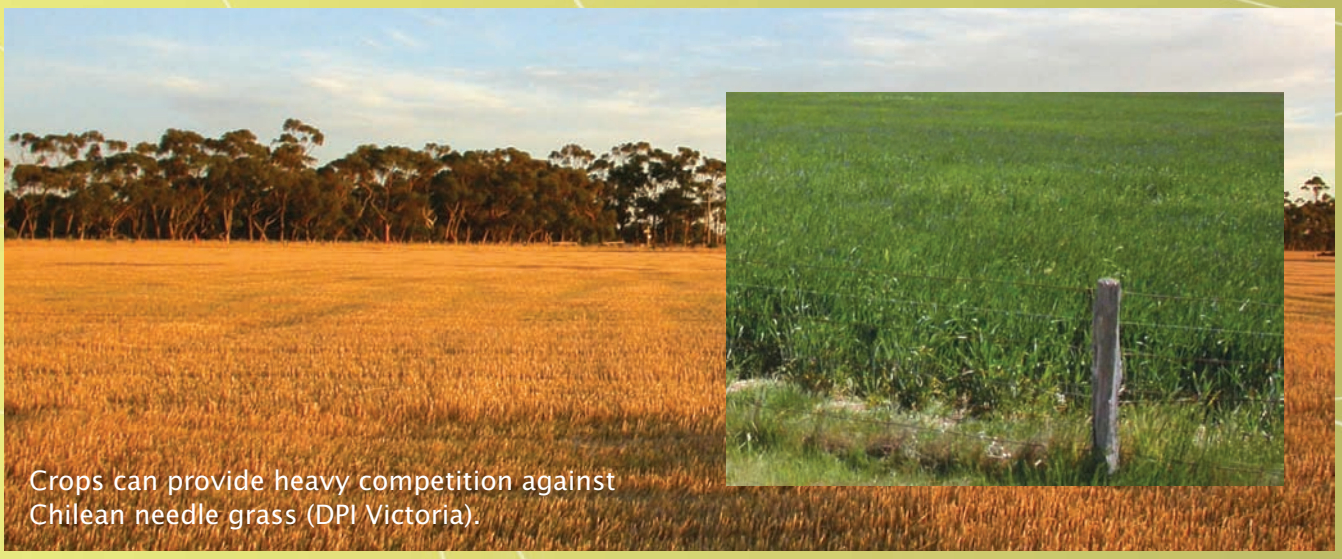
Management suited to areas where summer rainfall is dominant such as northern New South Wales and southern Queensland.

Crop rotation is an extremely useful management tool in these areas, as autumn/winter and summer growing crops will place high pressure on Chilean needle grass infestations. To reduce existing Chilean needle grass infestations, and for heavier infestations, control methods should coincide with the cropping sequence.

Cultivation as a part of a summer cropping sequence is very useful, as fast-growing summer crops can germinate and establish faster than the disturbed Chilean needle grass seed and provide excellent competition.

Boom spraying glyphosate before sowing the crop usually provides better control in autumn. Where Chilean needle grass seedlings re-establish, follow up by spot spraying.

Use strategic grazing to reduce existing plant cover in heavy infestations and, where this is not possible, use mowing or slashing.



Crops can provide heavy competition against Chilean needle grass (DPI Victoria).

INTEGRATE CROPPING AND SELECTIVE CHEMICAL CONTROL FOR IMPROVED MANAGEMENT OF CHILEAN NEEDLE GRASS

The heavy competition provided by a healthy crop, such as a legume forage, combined with selective herbicide control can provide excellent suppression of Chilean needle grass and reduce its proportion within a paddock. Keep in mind the following:

- Consider spraying with glyphosate in the year(s) before spring sowing to help reduce the panicle seed bank (spray topping can be used in New South Wales under Permit 7852).
- Cultivate paddock, allow weed seedlings to emerge, then apply a non-selective herbicide such as glyphosate.
- Sow a legume forage crop such as lucerne or red clover. Use options to control Chilean needle grass pre-emergence.
- Monitor Chilean needle grass development within the crop.
- Before panicle seed set and before Chilean needle grass has reached the late tillering stage, boom spray with fluazifop-P according to label directions, to control seed production. (Fluazifop-P is a selective herbicide that should only suppress most perennial grasses and is only available for use in certain States).
- Grazing can be carried out in the forage crop, but remember to comply with the withholding period on the herbicide label.
- Re-apply selective herbicide (fluazifop-P) if necessary.
- Once the forage crop is finished, cultivate the paddock, allow weed seedlings to emerge, then apply a non-selective herbicide such as glyphosate.
- Re-sow pasture or sow new crop.

Cropping – winter rainfall zones

Management suited to areas where winter rainfall is dominant such as central and southern New South Wales, Victoria, South Australia and Tasmania.

The use of cultivation to encourage germination of Chilean needle grass panicle seed can be an ideal means to reduce large panicle seed banks where they have established.

Strategic grazing, slashing or mowing are good options to reduce reliance on herbicides.

Herbicide applications, such as boom spraying glyphosate, should be used as part of the cropping sequence or to control re-emerging plants.

Once the crop is actively growing, where possible, spot spray any emerging Chilean needle grass before panicle seed set with glyphosate.

Caution needs to be taken to ensure crops are not adversely affected by herbicide use.

Further information on managing Chilean needle grass in agricultural situations:

Gardener, M. and Sindel, B. (1998). The biology of *Nassella* and *Achnatherum* species naturalized in Australia and the implications for management on conservation lands. *Plant Protection Quarterly* 13(2), pp. 76-79.

Grech, C. (2007a). *Grazing management for the long term utilization and control of Chilean needle grass (*Nassella neesiana*)*, PhD thesis, University of New England, New South Wales.

Slay, M. (2002). *Chilean needle grass: A guide to the identification and management in Hawke's Bay*. Hawke's Bay Regional Council, New Zealand.

Storrie, A.M. and Lowien, J.C. (2003). *Chilean Needle Grass – Agnote DPI 194*, NSW Agriculture.

Selective stock grazing can help to reduce the height of desirable pasture species before wick wiping (DPI Victoria).

Providing competition to Chilean needle grass is a must.

3.2 Native grass

Grazed native grasses

Management programs suited to native pastures, including areas with steep slopes or rocky terrain.

Long-term management strategies are required that can prevent spread, reduce panicle seed production and seed banks, and encourage competing native species. The challenges posed by steep slopes or rocky terrain and the need to ensure that management programs don't negatively interfere with native grass species, impose some limitations when compared to managing introduced pastures.

The most successful way to manage native pastures is to integrate strategic grazing with sheep and spot spraying (while native grasses are dormant) with glyphosate. Boom spraying is not generally appropriate because of its potential for damage to native grasses and terrain limitations.

Flupropanate can be used although even as a selective herbicide it can be damaging to some native species and is not recommended at high rates on steep slopes. Caution should also be taken that treated areas are not grazed or cut for stock food until the withholding period expiry and that there is a permanent withholding period for lactating cattle and goats.

If using herbicide control, apply the herbicide when the native grass you wish to protect is dormant (winter for C4 grasses, such as *Themeda*, and mid-summer for C3 grasses, such as *Danthonia*).

Competition needs to be provided where Chilean needle grass plants are killed or removed. Strategic grazing to promote self seeding of desirable species (where appropriate) or direct drilling are the best method to replace Chilean needle grass with native pastures. Other successful replacement methods include spray and hay, direct and broadcast seeding. Specialised all-terrain sowing equipment may be required in rocky areas, or aerial sowing can be used.

For large infestations, where methods such as grazing or herbicides are not suitable (for example, on extremely steep slopes), fire may be a good alternative to reduce seeding and to prevent further input into the seed bank. Follow this up by providing competition with desirable pasture or native grass species or, in some instances, trees.

Wick wiping may have potential on some sites where terrain allows, where a height differential is achievable (strategic grazing may be useful to achieve this), where enough native grass seed is present to produce a monoculture, and where the site has been previously cultivated. Combine wick wiping with slashing or strategic grazing to ensure Chilean needle grass is taller than other grasses.

Un-grazed native grasses

Un-grazed native grasses incorporate native grasslands for conservation purposes and other parks and recreation reserves that may contain native grass species.

As native grasslands are one of the most threatened ecosystems in Australia, it is vital that control of Chilean needle grass does not disturb native species. A rule of thumb is to undertake only one

Restoration of native grasslands is essential to control Chilean needle grass (Sue Hadden, DSE Victoria).

Burning is an important component of managing native grasslands for Chilean needle grass (DPI Victoria).

major action per year as major sudden changes to the past management methods may have adverse consequences for the plants and animals currently ocurring on the site (Barlow 1998).

A high quality and biodiverse native grassland can resist weed invasion (Hector *et al*. 2001), therefore the key to success is to restore biodiversity to these sites by actively managing the native species and regularly monitoring and spot treating Chilean needle grass before panicle seed set.

Time control activities to coincide with the best time to re-vegetate. For:

Small scattered infestations: manual removal by chipping out plants is the most successful and safest option, as it can be used year round with limited off-target effects. Careful spot spraying with glyphosate can also be used. The use of mulch or weed mats can be effective on very small infestations, to act as a barrier to prevent invasion while smothering existing Chilean needle grass.

Widespread scattered infestations of low density: spot spraying with glyphosate is most appropriate, as it helps ensure native grass species remain unaffected. Flupropanate is not generally recommended because of its residual properties and the possibility of it damaging some native species.

Heavy infestations and low quality grasslands: carefully spot spray as much as possible with glyphosate and combine this with fire to prevent panicle seed set or burn standing seed. Note that the effects of fire can be unpredictable, both on kill of mature plants (this is not always adequate) and in germination from the seedbank.

Monitor the site post-fire and spot spray re-emerging Chilean needle grass. Slashing may also be an option to prevent panicle seed set or to enhance effectiveness of other control methods.

Restoring native species to provide competition to re-emerging plants is essential once Chilean needle grass has been treated. Natural restoration is the preferable method where this is possible. Otherwise, re-establishment with direct drilling, direct or broadcast seeding are appropriate methods. Spray and hay (page 56) is a good integrated method that can reduce Chilean needle grass density, restore native species and act as a barrier to limit further spread.

FUEL REDUCTION BURNING REDUCES THE DENSITY OF CHILEAN NEEDLE GRASS

Chilean needle grass is common in introduced grasslands in the Plenty Gorge Parklands, north-east of Melbourne, Victoria. As part of Country Fire Association training, fuel reduction burns were carried out for five consecutive years every November in a 1.5 ha area heavily infested with Chilean needle grass. A senior Parks Victoria Officer, Brendan Sullivan, observed that the frequent burning regime modified species dominance and has reduced the density of Chilean needle grass by approximately 90 per cent. The main grass species that replaced Chilean needle grass is phalaris (*Phalaris aquatica*).

Although the effects of fire on grassland communities can be unpredictable, and often burning does not provide adequate kill of mature Chilean needle grass, this observation shows that fire could be an important tool in the management of Chilean needle grass.

Research by Victoria University and VicRoads has demonstrated the potential of wickwiping on roadsides. A roadside infestation of Chilean needle grass was wick wiped in late spring approximately 6 months prior to these photos (left) compared to an untreated control (right); Chilean needle grass dominated the untreated plot, whereas a mix of species was re-emerging in the wick-wiped plot, conspicuous amongst these was native windmill grass *(Chloris truncata)* (DPI Victoria).

Further information on managing native grasslands:

Barlow, T. (1998). *Grassy Guidelines: How to manage native grasslands and grassy woodlands oil your property.* Trust for Nature, Melbourne, Victoria.

Beames, L., Hocking, C. and Wlodarczyk, P. (2005). Best practice management of Chilean needle grass (*Nassella neesiana*) in conservation reserves – the seedbank story. *Plant Protection Quarterly* 20(1), pp. 2-8.

Eddy, D. (2002). *Managing native grasslands – A guide to management for conservation, production and landscape protection*. WWF Australia (available on: www.wwf.org.au/publications/managing_grasslands.pdf)

Hocking, C. (2005). Chilean needle grass (*Nassella neesiana*) – potential impacts and control. *Proceedings of the Tussock Terminators Research Forum*, Albury, NSW, Australia, pp. 27-31.

Mason, B. (1998). *Replacement of Chilean needle grass (*Nassella neesiana*) by the native kangaroo grass (*Themeda triandra*): managing native grasslands in Central Victoria using the 'spray and hay' method*. MSc Thesis, Victoria University, Victoria.

Mason, B. (2004). *Directions for best management of kangaroo grass* (Themeda triandra) *re-establishment in south eastern Australian native grassland remnants*. PhD thesis, Victoria University, Victoria.

Williams, L. (2005). *An investigation into best practice management of Chilean needle grass (Nassella neesiana) in conservation reserves*. Honours Thesis, Victoria University, Victoria.

3.3 Linear reserves

For example roadsides, rail corridors, powerline easements.

Transportation of panicle seeds by vehicles and machinery is one of the main reasons roadsides are so vulnerable to infestation. Management programs need to focus on hygiene, limiting the spread of Chilean needle grass into neighbouring land or watercourses and reducing existing infestations.

Spill material, such as soil, that is suspected to contain Chilean needle grass panicle seed should be disposed of appropriately and not transported to a new site.

Introduced species present

Slashing is the most common method used to maintain linear reserves such as roadsides and is appropriate if conducted routinely and hygienically. It is essential to plan slashing to occur outside the Chilean needle grass panicle seeding period to avoid slashers and other equipment becoming contaminated with thousands of Chilean needle grass panicle seeds.

Machinery hygiene practices, including inspection and clean down of machinery and equipment are required. Use of a slasher cover or blower to limit contamination is highly recommended.

Reducing infestation density with is a must and will help reduce the effort required to control Chilean needle grass down the track. Successful methods include manual removal, spot or boom spraying with glyphosate or flupropanate and wick wiping is also a promising new technique.

The slasher cover designed by RMIT reduces the accumulation of weed seed (DPI Victoria).

Photo: John Laing

Where control methods kill Chilean needle grass plants, competition needs to be incorporated to reduce re-emergence and germination of Chilean needle grass; direct drilling is useful method to sow desirable species.

Applying mulch or a weed mat can be a good option in small infestations, as it smothers existing Chilean needle grass and acts as a barrier to prevent invasion into adjacent land.

Monitoring and follow-up action is essential.

Native species present

Many roadsides are also are important refuges for native vegetation, which, when managed appropriately, can at least hold back invasion, if not assist in control. Control of Chilean needle grass in linear reserves with native grasses requires a greater sensitivity when undertaking control activities.

Where native species are to be restored management should model the programs outlined in “Un-grazed native grasses”, page 33.

Fire is suitable for linear reserves that contain native species, to prevent seeding and help native grasses re-establish and compete.

Where only a few Chilean needle grass plants exist, manual removal is the best option.

Providing competition is a must and spray and hay may also be useful (see details page 56).

”Chilean needle grass got onto my property from the roadside, I didn’t realise early enough and it got away pretty quickly.” (Landholder, near Greenvale, Victoria)

IMPROVED SLASHER DESIGN COMBATS SPREAD OF CHILEAN NEEDLE GRASS

Slashing during the panicle seeding period is a major mechanism for Chilean needle grass spread. Panicle seed accumulates on the slasher deck and is dispersed during slashing operations. The Royal Melbourne Institute of Technology (RMIT) is developing modifications to existing slasher designs in order to minimise panicle seed collection and reduce dispersal into ‘clean’ areas.

In RMIT tests, front shields attached to the slasher deck have reduced panicle seed accumulation by about half. A new slasher cover design reduced panicle seed accumulation by almost 99%. Widespread use of such a cover could reduce the spread of many weeds, including Chilean needle grass, during slashing operations. Ways of delivering the slasher modifications to the community continue to be investigated.

AWARENESS HELPS PREVENT SPREAD OF CHILEAN NEEDLE GRASS

An energy company operating in the Darling Downs region in Queensland has erected signs in powerline easements to inform their maintenance staff of the presence of Chilean needle grass infestations and the need to clean down vehicles used during maintenance activities to reduce the risk of spread. Both management staff and contractors have undertaken Chilean needle grass identification training to raise awareness of the problem and ensure new infestations are identified and reported.

Further information on managing Chilean needle grass in linear reserves and urban areas:

Baldyga, N. and Grech, C. (2005). *Machinery hygiene guidelines for roadside managers – minimising the spread of Chilean needle grass*. Department of Primary Industries, Bacchus Marsh, Victoria. (available on: ***www.weeds.org.au/WoNS/Chileanneedlegrass/***).

Williams, N. (2005). Management strategies for preventing weed invasion in urban grasslands. *Plant Protection Quarterly* 20(1), pp. 12-15.

Managing Chilean needle grass on roadsides can reduce its spread into farms and native grasslands (DPI&F Queensland).

Chilean needle grass being slashed during trials (Charles Grech, DPI Victoria).

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Section 4
Control Methods

4.1 Cultural control methods

Cultural control methods are always favoured over use of herbicides where possible, and in most control programs at least one of these methods will be required before resorting to herbicides.

Manual removal

Manual removal of Chilean needle grass is the most effective removal method and is best for new or small infestations. It is a good opportunity to eradicate early infestations.

When chipping/removing Chilean needle grass plants, take care to remove any basal or stem seeds that may be present. Smaller plants, roots and all, are readily pulled out by hand, while larger plants will require digging. The plant and soil should be placed in a hole-proof sack and incinerated or buried before the plants dry out. Care should be taken not to drop any panicle seeds when handling Chilean needle grass stems with mature seeds.

Mowing or slashing

Mowing or slashing at the right time can prevent or reduce panicle seed head production and encourage re-growth that is more palatable to stock. Mowing has also been known to encourage the formation of prostrate Chilean needle grass swards and may also reduce the production of stem seed. Mowing is a good alternative option for areas where grazing is not a feasible option due to the scale or location of the infestation.

Slashing Chilean needle grass after the point of flowering is not recommended as the tractor and slasher are highly likely to become contaminated with viable panicle seed. This is a known vector for the spread of Chilean needle grass. Any slashing works should be coordinated to ensure that:

- operators are trained in weed identification and machinery hygiene
- weed infestations are mapped and monitored
- work plans protect 'clean/non-infested' areas and avoid working in weather when panicle seeds will stick to machinery
- clean down zones are established and monitored appropriately.

NARROW WINDOW OF TIME FOR SLASHING TO BE EFFECTIVE

Research trials undertaken by the Department of Primary Industries Victoria (Weed Sciences) showed that, to minimise panicle seed re-growth and the risk of transporting viable seed, Chilean needle grass needs to be slashed around the flowering stage. Chilean needle grass flowers for approximately two weeks, so there is a very limited window of opportunity within which slashing will be an effective control measure. The timing of flowering varies from year to year and needs to be closely checked once the panicle seeds emerge.

Further information: AgNote "Chilean needle grass: Managing seed production by slashing" (Grech 2007b), available at ***www.dpi.vic.gov.au/notes/***

Tractor-mounted slasher (DPI Victoria).

Unslashed Chilean needle grass (left) will produce more panicle seed than slashed Chilean needle grass (right) (DPI Victoria).

Cultivation can be an effective tool to reduce the seedbank if combined with other methods (DPI Victoria).

Cultivation

Cultivation can only be an effective tool when integrated with other control methods.

Cultivation alone can increase the proportion of Chilean needle grass as it stimulates panicle seed from the soil seed bank to germinate. This can be useful technique to reduce the soil seed bank if cultivation is followed up with another cultivation or a herbicide application to kill the new seedlings.

Before cultivating Chilean needle grass infestations, consider the following:

1. Shallow cultivations will encourage more Chilean needle grass seedlings, as most of the panicle seed bank is in the top 25 mm of the soil surface.
2. Stems and clumps of Chilean needle grass will attach to ploughs and spread viable panicle seeds. To avoid this ensure that plant material build-up does not occur.
3. Anywhere that is cultivated needs to have a replacement species sown to compete with any Chilean needle grass that may try and re-infest the area.
4. One year of cultivation may not run down the Chilean needle grass panicle seed bank enough to allow a perennial pasture to be re-sown – it may need several years of annual crops.
5. Cultivation is **not recommended in native grasslands**, as soil disturbance can cause rapid Chilean needle grass invasion.

REGIONAL TRIALS COMBINING HERBICIDE WITH CULTIVATION

Regional best practice management trials have been underway at Glen Innes since 2003. These trials are managed by the Victorian and New South Wales Departments of Primary Industries and look at different management strategies for different climatic zones. The Glen Innes site is considered a summer rainfall zone and had several successful cropping phases before being re-sown to pasture.

Areas intended for pasture re-sowing were sprayed out with glyphosate (1125 g a.i./ha) before Chilean needle grass panicle seed set, and cultivated before re-sowing. Soybeans were sown with trifluralin and fertiliser as a summer crop during December and harvested during the following May – yielding 2t/ha.

A fodder oat crop was direct drilled later that month with fertiliser, as a winter crop. These oats were grazed off during September and the plots cultivated, ready for another summer crop of soybeans that was sown at the end of spring. The second crop of soybeans was harvested in the following June (yield 3t/ha), in preparation for pasture re-sowing.

These methods, used as part of the cropping sequence, have provided intense competition and made establishment very difficult for Chilean needle grass.

Soybean crop sown at Glen Innes, New South Wales (Charles Grech, DPI Victoria).

A mulched barrier is used to protect remnant native grassland from Chilean needle grass invasion (Jenny Conolly, Parks, Conservation and Lands, ACT).

Mulching

For best results, integrate mulching with manual removal, herbicide application and plant competition.

The use of mulch for Chilean needle grass control is suitable for very small infestations, in particular those in urban parks or gardens. When combined with other control methods, it can suppress Chilean needle grass plants or act as a 'barrier' to slow the spread of Chilean needle grass into remnant vegetation and gardens.

Be aware that using mulch in large-scale areas, could lead to a nutrient flux that could be detrimental for re-establishment of native species over the long term. Weed mats may also be an alternative to mulch.

Mulching Tips

- Use another control method before mulching, such as herbicide application or manual removal.
- The mulch layer needs to be thick to effectively smother emerging weeds; a depth of 10 cm or greater is recommended.
- Regular top-ups are recommended, as mulches often settle and decompose.
- Regularly monitor and spot spray or manually remove weeds that will appear in the mulch.
- Establish desirable plants in the mulch to provide competition with weeds.

MULCHED BARRIERS PROTECT REMNANT NATIVE GRASSLANDS IN URBAN AREAS

Keeping Chilean needle grass out of native grasslands/conservation areas has been a constant battle for Jenny Conolly, Pests and Weeds Officer at Parks, Conservation and Lands in the ACT.

The Chilean needle grass is being spread by mowers, which slash the many urban roadsides, parks and gardens around the native grassland areas.

Treatment in the past at these sites has been by spot spraying Chilean needle grass in and around the perimeter of the grasslands. But now Jenny is investigating a new approach – the use of mulched barriers. Jenny believes that placing a 'barrier' around the perimeter of the grasslands will reduce the heavy urban invasion of Chilean needle grass into what are some of our last remaining fragments of native grasslands. The barrier is made by boom spraying a three metre band with glyphosate around native grass areas and then, when the grasses die, putting a thick physical mulch barrier (for example, recycled mulch from willow control programs) on the same 3m band.

Jenny hopes that by creating a barrier, mowers will be kept away from the native grasslands and the spread of panicle seed into the grasslands will be reduced. Regular monitoring and spot spraying of the barriers will prevent Chilean needle grass from creeping in, leaving only the Chilean needle grass plants already within the native grasslands to be controlled.

Burning can reduce panicle seed set or burn off standing seed (Charles Grech, DPI Victoria).

Fire is a potentially useful management tool that can be used as part of an integrated weed weed management strategy. Fire can be used to prevent seed set, burn off standing seed, or stimulate the growth of panicle seed in the soil seed bank. Fire will not usually provide a useful kill of mature Chilean needle grass, but can be particularly useful in native grasslands as a means of encouraging growth of native species.

A fire regime to control Chilean needle grass must be integrated with other techniques such as spot spraying and re-establishing desirable species post-fire. It must take into account the range of impacts on other species, particularly on natives.

Burning can provide a clearer indication of the level and pattern of infestation, and is most effective when followed by selective removal. Use fire only with advice from an agronomist or grasslands ecologist, or where the impact of fire on the environment is known and acceptable.

BURNING TO REDUCE PANICLE SEED PRODUCTION

Fire has been used to manage panicle seed production in trials completed by the Victorian Department of Primary Industries (Weed Sciences) at Greenvale over 2004 and 2005. Plots were burnt using a drip torch at different times of the year to destroy mature panicle seed and investigate pasture composition in the following seasons.

Trial results showed that burning at seedfall (when panicle seeds are mature and ready to fall) is a useful way of reducing the amount of viable panicle seed produced. Burning did stimulate many Chilean needle grass panicle seeds from the soil seed bank to germinate, early in the following season.

In the following season, burnt areas had less Chilean needle grass panicle seed than unburnt areas although the pasture was not as dense, with a lot of bare soil. Recovery of improved pasture species (eg *Phalaris aquatica*) was limited. Any areas that are burnt for Chilean needle grass control will need follow-up strategies to encourage pasture competition.

If considering burning, contact your local fire authority and check current fire restrictions and obtain permits if required:

New South Wales **Rural Fire Service** 02 8741 5555 www.rfs.nsw.gov.au	Queensland **Rural Fire Service** 07 3247 8130 www.ruralfire.qld.gov.au	South Australia **Your local council**
Tasmania **Tasmanian Fire Service** 03 6230 8600 www.fire.tas.gov.au	Victoria **Country Fire Authority** 03 9262 8444 www.cfa.vic.gov.au	ACT **Rural Fire Service** 02 6207 8609 www.rfs.act.gov.au

Fire is a useful management tool to aid recovery of native grasslands (DPI Victoria).

Further information: AgNote "Chilean needle grass: Management by fire" (Grech 2007e), available at ***www.dpi.vic.gov.au/notes/***

4.2 Grazing

Grazing considerations

Although it is not as nutritious as many other pasture species, Chilean needle grass can produce a large amount of reasonable quality feed, especially during winter. The main problem with pastures dominated by Chilean needle grass is that the stalks are unpalatable in late spring/summer and are avoided by stock.

Before grazing Chilean needle grass, consider the following:

1. Chilean needle grass feed value is generally less than that of other improved pasture grasses (for example, Cocksfoot – *Dactylus glomerata*).
2. Once the panicle seeds emerge from the stem, Chilean needle grass becomes unpalatable and stock are reluctant to graze it – this can lead to overgrazing of desirable species.
3. Mature panicle seeds will attach to fur and wool, especially sheep, and can spread Chilean needle grass across farms and into clean paddocks.
4. Grazing needs to occur before full panicle seed head emergence, but not too early to allow seed head re-growth (this occurs over a two-week period). The impact of grazing lessens with later growth stages.
5. Grazing needs to be part of an integrated weed management strategy for the whole farm, so that panicle seed is not allowed to mature in non-grazed areas.

NUTRITIVE CYCLE OF CHILEAN NEEDLE GRASS

The feed value and nutritional cycle of Chilean needle grass has been documented in an Agricultural Note (or 'Agnote') produced by the Department of Primary Industries Victoria (Grech 2007c) titled 'Chilean needle grass: Maintaining feed value by mowing and fertiliser application'.

This note details the effect of mowing and fertiliser application on the feed value over two growing seasons and compares the nutritional value of Chilean needle grass to cocksfoot, an improved pasture species with modest feed value.

Further information: AgNote "Chilean needle grass: Maintaining Feed Value by mowing and fertiliser application" (Grech 2007c), available at ***www.dpi.vic.gov.au/notes/***

Choosing the type of grazer – sheep or cattle?

Both sheep and cattle will graze Chilean needle grass when it is in its vegetative growth stages. These two species have different grazing habits and require different amounts of herbage to maintain condition and grow.

Work undertaken by the Department of Primary Industries Victoria (Weed Sciences) has shown that sheep should not be used to graze Chilean needle grass infestations once the plants are flowering. The fleece and skin of sheep are likely to become heavily contaminated by Chilean needle grass panicle seeds if the sheep are not removed from an infested paddock before Chilean needle grass flowering. To avoid spread, noxious weed legislation has been enacted (*state dependant*) that limits where the sheep can be transported.

Cattle are better suited to grazing rougher herbage such as Chilean needle grass and during trials generally ate more of the standing Chilean needle grass panicle seeds. The trial cattle only carried a few panicle seeds while grazing Chilean needle grass during flowering, although it has been known for mass infections in the brisket eyes and gums to occur in cattle grazing mature Chilean needle grass seed heads.

Further information: AgNote "Chilean needle grass: Grazing management and stock class" (Grech 2007d), available at ***www.dpi.vic.gov.au/notes/***

Choosing the grazing management method

When grazing Chilean needle grass, managers should ensure that the maximum number of seed heads are grazed before flowering and panicle seed set.

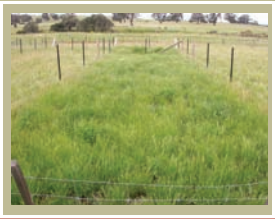
Rotational or strategic grazing is a method of grazing where a given number of stock are concentrated in one portion of the paddock to ensure that all the pasture plants are eaten evenly. Once that portion is grazed out, the stock are then moved. Slowly grazing the entire paddock in portions ensures that the less palatable Chilean needle grass plants can't be avoided and allowed to go ungrazed, eventually producing panicle seed.

This system of grazing has three main benefits:

- Grazing the developing Chilean needle grass seed heads reduces the production of panicle seed.
- Faster-growing perennial grasses are given an advantage, as they can compete quite effectively during the rest periods.
- Eating or trampling encourages more palatable vegetative growth and increases the palatability of Chilean needle grass over summer.

When considering a rotation or strategic grazing approach, remember that Chilean needle grass is likely to develop a panicle seed head which will emerge and flower over a two-week period.

Grazing is not recommended after flowering and grazing plans must take this into account. There may not be enough time to rotate stock around the whole Chilean needle grass infestation. Other management approaches may have to be used in areas where time runs out for grazing.

June 2004	September 2004	November 2004 (seed head comparison)	March 2005	July 2005
Strategic Grazing				
				
Set Stock Grazing				
				

A comparison of strategic grazing and set-stock grazing in best practice management trials conducted by the Victorian Department of Primary Industries at Greenvale, Victoria (Charles Grech, DPI Victoria).

STRATEGIC GRAZING WITH SHEEP

Sheep used in field trials conducted by the Victorian Department of Primary Industries (Weed Sciences) from 2003–2006 were reluctant to graze Chilean needle grass once the seed head emerged from the stem. These sheep were in two grazing groups. Some were strategically grazed at 300 DSE/ha for an average of 25 days over five strategic grazings per year. Other sheep were grazed continuously at 12 DSE/ha in a set stock system.

Set stock grazed sheep reduced the desirable grass cover in the plots, which lead to bare ground and further invasion of Chilean needle grass or broadleaf weeds. In contrast, strategic grazing plots had less Chilean needle grass panicle seed at the end of spring and an increased cover of improved pasture species. If unchecked, however, the strategically grazed sheep would overgraze the desirable species to ground level rather than eat the Chilean needle grass with emerged seed heads.

4.3 Chemical control methods

Registered chemicals

Use of herbicides is one of the best methods for control of Chilean needle grass and when used in combination with other management techniques it can be highly successful. It is especially useful for large infestations where other techniques can be labour intensive.

There is only one herbicide – flupropanate – fully registered for the control of Chilean needle grass. Glyphosate is also registered, but only under spot spraying for general weed control.

There are also a number of minor use permits available for further herbicide use on Chilean needle grass. The following tables provide current information on registered herbicides and minor use permits for Chilean needle grass control.

Table 3. Herbicides currently registered for use on Chilean needle grass (October 2007)

Active ingredient	State or Territory	Application method	Situation in which the herbicide is registered	Comments
Flupropanate	NSW, ACT, Victoria, Qld, SA, WA	Ground & aerial application and spot spraying. Refer to label for details and rates.	Urban open space, woodlands, roadsides, nature reserves and pasture.	Can be combined with glyphosate products as instructed on the label. Note: not currently registered in Tasmania.
Glyphosate	All states	Spot spraying	Domestic, commercial and agricultural areas.	Covered under a general weed control table eg. Roundup® Biactive label.

NOTE: herbicides are not to be used for any purpose or in any manner contrary to the label unless authorised under appropriate legislation. Before using a herbicide for the control of Chilean needle grass, or any other weed, read and adhere to the instructions and conditions for use on the label. Always follow the label and/or permit directions.

Table 4: APVMA minor use permits available for Chilean needle grass (October 2007)

Active ingredient	State or Territory	Application method	Situation in which the herbicide is registered	Comments
Glyphosate	SA	Boom spray and spot spray. Refer to permit for details and rates.	Urban open space, woodlands, roadsides, nature reserves and pastures.	APVMA permit number PER7807, expires 30 June 2009.
Glyphosate	NSW	Boom spray Refer to permit for details and rates.	Pastures For control of panicle seed production before hay cutting. Spot spray treatment to kill existing plants.	APVMA permit number PER7852, expires 30 September 2009.
Fluazifop-P	NSW	Refer to permit for details and rates.	Lucerne/Legume pasture For the selective panicle seed set suppression before hay cutting.	APVMA permit number PER7853, expires 31 March 2009.
Fluazifop-P or Glyphosate or Flupropanate	SA	Boom spray and spot spray. Refer to permit for details and rates.	Urban open space, grassland, nature reserves, amenity areas, woodlands and pastures.	APVMA permit number PER7823, expires 30 June 2009.
Fluazifop-P or Glyphosate or Flupropanate	Qld	Boom spray and spot spray. Refer to permit for details and rates.	Urban open space, woodlands, roadsides nature reserves and pastures.	APVMA permit number PER8421, expires 30 September 2009.

NOTE: herbicides are not to be used for any purpose or in any manner contrary to the label unless authorised under appropriate legislation. Before using a herbicide for the control of Chilean needle grass, or any other weed, read and adhere to the instructions and conditions for use on the label. Always follow the label and/or permit directions.

Be aware of legislation in your state regarding herbicide use. For example, some herbicides are restricted in certain states or in specific areas of the state. For up-to-date registration details and current permits visit the Australian Pesticides and Veterinary Medicines Authority (APVMA) website: ***www.apvma.gov.au***

Herbicide-use training is highly recommended for all herbicide users. Accredited training courses are run by organisations such as ChemCert, Smartrain and TAFE colleges. Other training courses may be available through state agencies, local councils or non-government organisations.

Keeping grazing pressure up during the flowering period increases the palatability of Chilean needle grass (DPI Victoria).

Chemical selection

Flupropanate

Flupropanate is a slow-acting herbicide. It can take between three and 12 months after application for plants to die, depending on weather conditions. In addition, flupropanate has the following characteristics:

- It has **residual properties** and kills seedlings that germinate while the herbicide is still active on the soil surface. The length of residual control depends on the rate applied, soil type and rainfall.
- Flupropanate **behaves differently in different textured soils**. Lower rates are recommended on sandy soils and low rainfall areas, higher rates are recommended on basalt soils and high rainfall areas (refer to label).
- It has a ***degree* of selectivity** and can affect off-target species in some situations (spot spraying is recommended in these situations, see cautions below).

Cautions

- For best selective control, use the lowest rate possible needed to kill Chilean needle grass.
- Fescue, cocksfoot and phalaris are reasonably tolerant but phalaris can be sensitive to autumn applications..
- Desirable species can be affected if exposed to the spray or if seed is planted into treated soil (for example, native and perennial improved grasses, subterranean clover and annual legumes).
- Rates used to kill large Chilean needle grass plants will typically kill or severely damage some desirables, leaving areas bare and exposed for long periods.
- Follow-up management is important to encourage desirable species to grow and fill the gaps created by dead Chilean needle grass plants.
- As flupropanate has a long residual life, caution should be taken that treated areas are not grazed or cut for stock food until the withholding period expiry and that there is a permanent withholding period for lactating cattle and goats.
- Absorption is through the plant roots but leaf absorption has also been known to occur in laboratory conditions.

Flupropanate should not be used more than once a year.

Timing of applications

As flupropanate is slow acting, an application immediately before flowering will not always prevent the production of panicle seed. Flupropanate can be mixed with glyphosate to provide a quick knock down and residual control. To prevent Chilean needle grass from producing panicle seed, flupropanate should be applied no later than 8–10 weeks before flowering is anticipated (dependant on rainfall).

Spray native grass while dormant, winter for C4 grasses such as *Themeda*, mid-summer for C3 grasses such as *Danthonia*.

Visible pollen on Chilean needle grass indicates the last chance to spray glyphosate in time for optimum results (Charles Grech, DPI Victoria).

Glyphosate

Glyphosate is a quick-acting herbicide with no residual action, no selectivity and has the following characteristics:

- It is **absorbed through leaves and green stems**, is systemic (moves throughout the plant) and kills existing plants between one and four weeks after application.
- **It is non-selective**; it kills both grasses and broad-leafed plants when they are actively growing.
- **It is not residual**; it only kills existing plants and is inactivated on contact with the soil.
- There is currently no withholding period for stock grazing but, for perennial grass weeds, **it is not recommended** to graze stock or disturb the treated pasture for seven days.

Timing of applications

To prevent Chilean needle grass from producing panicle seed, glyphosate should be applied before flowering (or as flowering begins while pollen is visible). However, if this is not practical, applications between flowering and "milky dough stage" (where the seed becomes milky ripe) may reduce panicle seed set. Remember that mature basal cleistogenes may already be present.

Applications of glyphosate in northern NSW (summer rainfall zone) are more effective in autumn months, compared to spring applications (Storrie 2003), this finding has not been observed in southern winter rainfall zones such as Victoria.

Spray native grass while dormant, winter for C4 grasses such as *Themeda*, mid-summer for C3 grasses such as *Danthonia*.

Fluazifop-P

Fluazifop-P is registered through minor use permits in New South Wales, South Australia and Queensland. It is a relatively quick-acting selective herbicide with no residual action and has the following characteristics:

- It is **absorbed through leaves and green stems**, is systemic (moves throughout the plant) and usually kills existing plants between three and five weeks after.
- **It is selective**; it kills grasses when they are actively growing, broad-leafed plants are usually not affected.
- **It is not residual**; it only kills existing plants.
- There is currently a **withholding period of 21 days** for this herbicide (permits 7853, 7823). In addition, stock are not to be grazed in treated areas for at least 7 days before slaughter.

Timing of applications

For best results, spray young plants before late tillering (that is, before the stems extend and the first node on the stem becomes visible).

Charles Grech, DPI Victoria.

WEEDS OF NATIONAL SIGNIFICANCE CHEMICAL RESEARCH

Herbicide trials by the Victorian Department of Primary Industries (Weed Sciences) have looked at the use of both flupropanate and glyphosate. Trials have shown that if rain does not fall after a mid-spring flupropanate application, it is likely that plants will set seed and plant death will not be noticeable until the following autumn.

Work has also shown that flupropanate at 2L/ha (in permitted areas) can give a complete kill of Chilean needle grass and prevent re-growth of old plants. It also prevents establishment of new plants for at least two years after application.

The use of flupropanate above 2L/ha rates drastically reduces the selectivity of the herbicide, and sites receiving applications above 2L/ha are likely to need re-sowing of desirable species.

Research into glyphosate has shown that boom spray application will kill mature plants and provide a good quick initial knock down although this is not a long-term control method. Areas that were boom sprayed with glyphosate had re-growing Chilean needle grass plants 6–12 months after the application and, with no plant competition, often thicker than before spraying. Follow-up management, such as pasture renovation or a cropping sequence, is essential if areas are to be sprayed with glyphosate.

Chemical application

For best results, herbicides should be applied when Chilean needle grass is actively growing. Spraying stressed plants can lead to a reduced uptake of herbicide by the plant and may reduce the likelihood of a successful result. Integration of methods such as grazing, mowing, or cultivation can increase healthy plant growth and improve herbicide effectiveness.

For native grasses herbicides, are best applied when the native grass you wish to protect is dormant. This is during winter for grasses, such as *Themeda*, and mid-summer for C3 grasses, such as *Danthonia.*

Successful application relies on correct application technique, weather conditions, infestation size and density, plant health and size.

In all instances, rotate herbicide groups and other control methods to avoid herbicide resistance.

AVOID HERBICIDE RESISTANCE

Herbicide resistance is where a weed develops the ability to survive a herbicide application that it normally would not. Herbicide-resistant weed populations are becoming more common throughout Australia.

Herbicides are classified according to the way they kill plants, often called **the mode of action grouping**. All modern herbicides will have the mode of action grouping clearly displayed on the label. Repeated use of herbicides from one mode of action grouping increases the likelihood of herbicide resistance occurring.

Herbicide resistance has not yet been detected in Australian populations of Chilean needle grass, but could threaten the effectiveness of some of the commonly used herbicides. In New Zealand, resistance to the herbicide dalapon (2,2 DPA) has been detected (Hartley 1995). Dalapon is a herbicide in the group J mode of action grouping. It is not registered for use on Chilean needle grass in Australia, but it is in the same mode of action grouping as flupropanate. In addition, resistance to flupropanate has been detected in the related weed, serrated tussock (*Nassella trichotoma*) (McLaren et al 2006) and giant Parramatta grass (*Sporobolus fertilis*) (CRC for Australian Weed Management 2007) in Australia.

Strategies to maintain the effectiveness of herbicides and prevent resistance developing in Chilean needle grass populations include:

- use of other control methods as part of an integrated weed management strategy
- limiting the number of herbicide applications
- use of herbicides from different mode of action groupings (flupropanate is in group J, glyphosate is in group M, fluazifop-P is in group A)
- maximising the effectiveness of every application by ensuring that target weed, herbicide, climatic and site factors are adequately considered
- ensuring competitive use from the pasture species by adopting best agronomic practices (correct nutrition, species selection and grazing management).

Spot spraying with a backpack sprayer (Hume City Council).

Spot spraying – general

Spot spraying is an effective means of controlling small or isolated infestations – especially in high value or sensitive areas where off-target damage needs to be minimised.

The use of low pressure sprayers and adjustable spray heads allows more selective application and reduces the chance of off-target damage. A marker dye mixed with the spray solution is advisable to ensure that all Chilean needle grass plants are sprayed and to minimise overlap.

Spot spraying can be done using glyphosate, flupropanate, or in combination (refer to label for herbicide rates). Glyphosate will provide a quick knock down of Chilean needle grass plants, although it is not selective and can result in off-target damage. Flupropanate herbicides are selective in certain circumstances, yet can kill many native grass species.

When glyphosate and flupropanate are used in combination, the effect of flupropanate may not be seen until the following season, while the glyphosate will provide a rapid brown out of the plant. Flupropanate will stay present in the soil, limiting cleistogene germination.

Spot spraying – native grasslands

Spot spraying with glyphosate knocks down Chilean needle grass and enables competing native grasses to germinate. Spot spraying is most appropriate for:

- widespread scattered infestations of low density
- localised low to moderate density infestations.

Spot spray on a regular basis to place continual pressure on Chilean needle grass and ensure germinating native grasses have a chance to flourish.

Where heavy patches of Chilean needle grass border native grasslands, work from the edges of the infestation towards the middle. This pushes the invasion backwards and can allow adjacent native vegetation to disperse into the treated area and compete.

It is essential to ensure spray operators have sound skills to identify Chilean needle grass when not in flower, to prevent accidental off-target spraying.

It is not advisable that inexperienced operators use flupropanate in native grasslands.

For best results, spray when the native grass you wish to protect is dormant (winter for C4 grasses, mid-summer for C3 grasses) and integrate with other control techniques such as regeneration.

Boom spraying before sowing new pasture (DPI Victoria).

INTEGRATE SPOT SPRAYING WITH COMPETITION TO IMPROVE CONTROL OF SMALL INFESTATIONS

Following spot spraying, bare patches can be perfect sites for the re-establishment of Chilean needle grass from the seed bank. To crowd out any surviving Chilean needle grass, provide some competition by:

- scratching over the bare patches with a steel rake to provide a suitable seedbed
- sowing some suitable pasture or native grass seed in the prepared patches and applying fertiliser if necessary.

This is most effective when undertaken while soil is moist or, where possible, water the seed to give it a head start.

Boom spraying – ground and aerial application

Boom spraying is suitable for large infestations and in circumstances when time, aspect and accuracy constraints limit the use of spot spraying.

Boom spraying with selective herbicide is a good method to use in improved pasture situations where competitive species still exist within the infestation.

Boom spraying with knock-down herbicides (for example, glyphosate) should only be used if the area is to undergo renovation.

The use of boom spraying is not usually recommended in native grasslands, as the currently registered selective herbicides can damage some native species.

Considerations before boom spraying

Selectiveness of the herbicide relies on the correct rate of herbicide per hectare being applied in an even and consistent manner. To achieve this, the boom sprayer needs to be calibrated and driven accurately at consistent speed. It's important to:

1. Know the type of paddock you will be driving and consider what speed will be appropriate for the entire area – choose one speed and stay constant.
2. Choose appropriate spray nozzles to suit the ground speed and volume of water to be applied per hectare (refer to the herbicide label). Avoid spray drift by using lower pressures and nozzles that produce large droplets (coarse to very coarse classification, for example) such as air induction nozzles.
3. Clean the filters and check the spray pattern and output of all spray nozzles on the spray boom.
4. Use a method of guidance (for example, foam marker, GPS systems) when driving across the paddock to ensure that strips are not missed or double overlapped.
5. See also text box page 30, "Integration with strategic grazing is the key to effective use of flupropanate".

Wick wiping unit attached to the rear of a four wheel motorbike (DPI Victoria).

Selective stock grazing can help to reduce the height of desirable pasture species before wick wiping (Charles Grech, DPI Victoria).

Wick wiping

Wick wiping is a promising future control option to prevent rapid increase of infestations and panicle seed production, especially where selective control with herbicides is difficult.

In situations where Chilean needle grass is taller than other grass species wick wiping is ideal, as the application can be selectively adjusted to apply herbicide to the taller Chilean needle grass plants. The presence of species such as *Danthonia* or couch represent an ideal situation, as they are generally much shorter than Chilean needle grass.

Wick wiping has shown promising results in turf, pastures and along roadsides with research currently underway in all three areas.

Wiping has limitations in the following situations:

- in undulating or rocky ground where a constant wiper height cannot be maintained
- in native grasslands or pasture dominated by species that may be taller than Chilean needle grass, such as spear grasses (*Austrostipa* spp.), phalaris (*Phalaris aquatica*) and cocksfoot (*Dactylis glomerata*).

In situations where Chilean needle grass is less palatable than taller species, grazing at light stock rates can be used to selectively graze down the palatable species.

Several herbicides can be applied using a wick wiper. Glyphosate is used more commonly than flupropanate. Mixtures of these two herbicides have been known to have an antagonistic effect when applied as a tank mix at high concentrations through wick wipers.

When applying herbicides through wick wipers, take care to ensure that the wiper is not dripping herbicide onto non-target plants, although the carpet or rope wicks should be wet at all times.

WICK WIPING CAN SELECTIVELY CONTROL CHILEAN NEEDLE GRASS IN TURF

At Clifton Showgrounds on the Darling Downs in Queensland, the Chilean needle grass-infested polo playing fields and areas of the horse racing track have been re-planted with couch grass (*Cynodon dactylon*) and kikuyu (*Pennisetum clandestinum*).

Following mowing, Chilean needle grass out-competes desirable species, and grows taller than these grasses, providing an ideal window of opportunity to selectively control the Chilean needle grass with a wick wiper.

Indications to date suggest this method is very successful in areas of intensively managed turf (pers comms Phil Maher DPI&F 2007).

Tractor-mounted wick wiper (DPI Victoria).

Chilean needle grass that was spray topped during a research trial (right), compared to untreated Chilean needle grass (left) (DPI Victoria).

APPLYING WICK WIPING IN PASTURES

Research into the efficacy of wick wiping Chilean needle grass is currently being conducted by the Department of Primary Industries Victoria (Weed Sciences).

The trials in pastures infested with Chilean needle grass have been underway over several seasons at Mickleham, Victoria, using a carpet wick wiper mounted on the linkage of a tractor.

The trials have found that:

- Areas to be wick wiped need to be reasonably level to maintain a constant wiping height.
- Generally, the best time for applications is in spring, when panicle seed heads are actively growing, but preferably before flowering. Applications applied later can have good results but may not prevent as much panicle seed production.
- Vehicles need to have adequate ground clearance – with tall wheels and wide wheel bases essential to avoid squashing down Chilean needle grass stems and to reduce the effect of any ground undulation.
- Best results have been achieved with slow speeds (less than 8 km/h) and by 'double passing' – wick wiping the pasture twice in opposite directions to apply herbicide to both sides of the leaf.
- Wick wiping when panicle seed is flowering or being shed will lead to panicle seed lodging both in the wiper and the equipment pulling the wiper. All equipment and machinery must be cleaned down to avoid transporting viable panicle seed.

Further information: AgNote "Chilean needle grass: Integrating herbicide wipers" (Grech 2007f), available at ***www.dpi.vic.gov.au/notes/***

Spray topping

Spray topping is the application of herbicides to improve feed quality/ palatability.

It is not currently a registered method for control of Chilean needle grass. However, Permits 7852 and 7853 are available in NSW to prevent Chilean needle grass panicle seed production (see Table 4, page 46).

Research by the Department of Primary Industries Victoria to evaluate the effect of glyphosate spray topping on panicle seed production and the feed value of Chilean needle grass has shown to reduce panicle and stem seed set, although results are not yet conclusive.

Possibly a future technique spray topping requires further research to gain registration for control of Chilean needle grass.

4.4 Competition

General

Competition is vital to limit Chilean needle grass and will usually be one of the last control activities implemented before monitoring and follow-up action is required.

Maintaining a healthy cover of desirable competing plants can prevent establishment of new Chilean needle grass plants, slow growth of existing plants and help provide long-term management solutions.

Healthy crops can provide heavy competition against Chilean needle grass (DPI Victoria).

An all-terrain disc seeder (RockHoppa by AgReCon) is useful for direct drilling seed in rocky ground (DPI Victoria).

Competition is a useful management tool on all land types, although integrating sowing or restoration with other methods will provide the greatest effectiveness.

Broadcast seed, direct seed and direct drilling are all appropriate ways to provide competition. Strategic grazing is another method that can improve cover of existing desirable species.

To maximise the effect of competition:

- Apply with other treatments such as mowing, grazing and herbicide control.
- Grow plants well suited to your region (for example, use species suited to soil types, rainfall patterns, or local indigenous species in native grasslands).
- Ensure that a range of species are present to maintain cover throughout the year.
- Include species that are drought tolerant to compete with Chilean needle grass during drought.
- Encourage the growth of competing species by restoring native grasslands or applying strategic grazing on agricultural and native pastures.

Natural restoration of native grasslands

Allowing native grasslands to re-establish naturally is the preferable method for restoration for three main reasons:

- Native plants that establish are specifically adapted to the site and compete well (these are known as 'local provenance' species).
- Local biodiversity is conserved.
- It is far more cost-effective than other methods.

Natural regeneration will be more successful where native vegetation is intact and the Chilean needle grass infestation is recent. Techniques such as strategic grazing, spot spraying or burning can promote substantial regeneration of native species.

Monitor regularly and, where necessary, spot spray to limit germinating Chilean needle grass.

Re-establishing native flora

Where a site has limited or no potential for natural restoration (for example, where key species are missing from the seed bank), re-establishment by direct seeding or planting tube stock should be used, keeping in mind the following:

- Use only local indigenous species; this ensures the community you are attempting to re-establish is appropriate for the habitat you are working in.
- Where possible, propagate using material sourced from the area to be planted (local provenance species).
- Time weed control activities to coincide with the best time to re-vegetate (direct seeding, tube stock/cell planting).
- Regularly monitor the progress of the site and spot spray any germinating Chilean needle grass seedlings.

Soil disturbance is likely when re-establishing native ground flora, especially where using tube stock/cells. This is an opportunity for Chilean needle grass seedlings to re-establish, making monitoring a vital part of the program.

Kangaroo grass
Themeda triandra

Spear grass
Austrostipa scabra

These photos sourced from *Native Grasses: An identification handbook for Temperate Australia*, 3rd Edition, CSIRO 2002

Spray and hay

Some success has been achieved using the 'spray and hay' technique to rehabilitate native grasslands dominated by kangaroo grass (Themeda triandra), an important and widespread native Australian grassland species (Mason 1998, Mason and Hocking 2002).

The technique involves spraying Chilean needle grass with glyphosate then covering with kangaroo grass seed and mulch. Burning or removing the mulch layer in springtime will allow seedling germination and establishment of a kangaroo grass sward. Monitoring and follow-up control are essential to control any re-establishing Chilean needle grass.

This method has been successful for serrated tussock *N. trichotoma* where greater than 98 per cent replacement of serrated tussock with kangaroo grass was achieved (Philips 2000).

The opportunity exists to trial native spear grasses (Austrostipa spp.), which, like Chilean needle grass, is a 'C3' grass. That is, they have the same growing seasons and would compete for water and nutrients. A mix of spear and kangaroo grass may also be a good option.

4.5 Biological control

Biological control is a long-term management option that uses a weed's natural enemies, such as insects, rusts and pathogens (imported from the weed's country of origin), to slowly reduce the weed's density over time. A biological control program can take years to become established and will not eradicate an infestation but may reduce its competitiveness and limit its impact, thus making it easier to replace with desired species.

There are currently no biological control agents for Chilean needle grass in Australia.

POTENTIAL FOR BIOLOGICAL CONTROL OF CHILEAN NEEDLE GRASS IN AUSTRALIA

Chilean needle grass was declared a target for biological control in late 2005. The Australian government's Defeating the Weeds Menace Program has invested in a detailed host specificity program, led by the Department of Primary Industries Victoria.

The biological control program has begun in Argentina and field surveys for pathogens of Chilean needle grass (and the related grass, serrated tussock) have been conducted, with tests showing three rust fungi as potential biological control agents. These include *Puccinia nassellae, Puccinia graminella* and *Uromyces pencanus*, which is the most promising, as it is very damaging, highly host specific and is very easy to mass produce.

Rust fungi are diseases that attack many plants, including crops and weeds. They make good biological control agents for weeds as they can be highly damaging and are usually highly host specific (that is, they do not attack other plants). Fungi need specific environmental conditions to be successful and many other fungal pathogens have been released for other weeds with minor to moderate success.

If successful this will lead to the first long-term control for suitable established Chilean needle grass populations in Australia.

Further information: Anderson, F., Diaz, M. and McLaren, D. (2006). Current status of research on potential biological control agents for *Nassella neesiana* and *Nassella trichotoma* (Poaceae) in Australia. *Proceedings of the 15th Australian Weeds Conference*, Adelaide, South Australia, pp. 591-594.

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Geoff Price (Parks, Conservation and Lands), Jenny Conolly (Parks, Conservation and Lands) and Geoff Butler (Conservation Council of the South-East Region and Canberra Inc.) inspecting potted Chilean needle grass plants. These are regularly used for educations and awareness purposes in the ACT (Lois Padgham, Parks, Conservation and Lands).

An education and awareness program for identification and hygiene in the ACT

The problem

Currently, a dominance of Chilean needle grass exists with other grass species in the ACT in only several small areas of grazing land, totalling no greater than 4 ha. Yet there has been very little, if any, feedback from rural landholders and other land managers about the incidence of Chilean needle grass on their properties.

A possible explanation may lie in the difficulties of identifying the weed. Green for most of the year, Chilean needle grass is just another grass to many. It's probable that many people involved in primary production, natural resource management or community Landcare-related projects simply do not know what the weed looks like and do not see it as a problem.

This list of people is far from comprehensive and doesn't include the hundreds, and possibly thousands, of residents in older suburbs of Canberra who have Chilean needle grass growing in their front lawn and on nature strips. As a result, lawn clippings often find their way to areas of public land adjoining residences and roadsides, with the consequence that nearby nature reserves and other public land often become infested.

What is the approach?

The control of Chilean needle grass, particularly within the urban environment, continues to be an extremely difficult and frustrating task.

In the ACT, where Chilean needle grass is prevalent in urban areas, as well as native temperate grassland and woodland to varying degrees, the focus has shifted dramatically away from control to prevention of spread into areas of high conservation value.

What has been done?

Control programs – spot spraying

Although there is general reluctance to use flupropanate products in the ACT because of the herbicide's long-term effects on more desirable native grass species, spot spraying Chilean needle grass in temperate grasslands, woodlands and other reserve areas with glyphosate has had some degree of success.

Most success in the control of Chilean needle grass, according to a spokesperson from Parks Conservation and Lands, ACT, has occurred in areas with small scattered infestations.

"Surrounding native grasses have been able to spread into the small gaps left after spot spraying. Spraying large patches has been less successful due to the germination of numerous Chilean needle grass seedlings," the spokesperson said.

"These infestations are obviously more dense and have required rehabilitation with harvested *Themeda triandra* mulch containing ripe seed. The obvious limitation regarding this type of rehabilitation is the availability of large quantities of the mulch."

Apart from some small infestations within temperate grasslands reserves, very little, if any, targeted grazing of Chilean needle grass-affected areas is undertaken in the ACT, where there is a

Visiting sites such as the fire affected Stromlo Forest enable field day participants to see Chilean needle grass in the field (Jenny Conolly, Parks Conservation and Lands, ACT).

Des Clark (Parks, Conservation and Lands) using a blower-vac to clean down a tractor and grass slasher (Geoff Price, Parks, Conservation and Lands).

conscious effort not to graze during the seeding period to avoid the risk of panicle seed spreading.

Awareness raising programs in the ACT

- Chilean Needle Grass Identification Field Day

  A Chilean Needle Grass Identification Field Day held to raise awareness of the problem and how to tackle it proved to be an outstanding success.

  More than 120 people attended, including government agency staff involved in land management and asset maintenance, weed spraying/horticultural maintenance contractors, rural lessees, Landcare/ catchment coordinators and facilitators, volunteer and community groups.

  Activities on the day included how to identify Chilean needle grass, how to differentiate between Chilean needle grass and native stipa and introduced species, as well as demonstrations of practical control methods and rehabilitation techniques.

  The program was split into two sessions of approximately three hours, to allow attendees adequate time to identify and become familiar with Chilean needle grass, interact with the presenters and other participants.

- Education and awareness programs

  Parks Conservation and Lands have also conducted a number of weeds information sessions with community Landcare groups with a focus on identifying a wide range of environmental weeds including Chilean needle grass.

- Vehicle hygiene training

  The potential for vehicles and machinery to transport contaminants and weed seeds was the focus of vehicle hygiene training undertaken by about 30 agency staff, weed and horticultural maintenance contractors in 2005.

  Everyone who took part was involved in either contract management and supervision of works or directly involved in operational weed spraying, mowing, slashing and horticultural maintenance activities.

  Training topics ranged from current legislation, programming and sequencing of works, to practical demonstrations of techniques to decontaminate and clean different types of machinery and vehicles.

What has been the result?

As a result of all three education and awareness programs, awareness of Chilean needle grass as a problem weed has increased and identification skills have improved amongst weed managers and the community.

ACT government land management agencies involved in roadside slashing and fire fuel hazard reduction programs now place a far greater emphasis on the sequencing of works and clean-down procedures for machinery involved in these activities.

Chilean needle grass at Clifton Showgrounds (DPI&F, Queensland).

Chilean needle grass in Queensland – targeted for eradication from the state

The problem

Anecdotal evidence suggests that Chilean needle grass has been present for approximately 30 years at the Clifton Showgrounds in southern Queensland, from where it appears to have spread along major roadways to the neighbouring shires of Warwick and Cambooya.

Currently, around 100 ha of Queensland is known to be infested with Chilean needle grass, including a mixture of urban and public land, roadsides and approximately 20 mixed farming enterprises.

Although Chilean needle grass is not expected to naturalise in tropical parts of Queensland, it does have the potential to spread into sub-humid, cooler parts of southern Queensland, where it could have a severe impact on local ecosystems and agricultural industries.

Distribution of Chilean needle grass in south-east Queensland (DPI&F, Queensland).

What is Queensland's approach?

The Queensland Department of Primary Industries and Fisheries (DPI&F) established a local Chilean needle grass management group in 2005 to develop a co-ordinated strategy and management plan for the weed.

The *Queensland Chilean Needle Grass Strategy 2005-2010* has a long-term vision to eradicate Chilean needle grass from Queensland with a strategic focus on:

- communication
- education and awareness
- prevention of spread
- research and development
- eradication
- monitoring and evaluation
- stakeholders' roles and responsibilities
- an investment plan.

Annual operational plans are developed by the group, which is made up of Clifton, Warwick and Cambooya shire council officers, as well as the Department of Main Roads, Condamine Alliance and DPI&F officers.

Roadside warning sign on a main road (DPI&F, Queensland).

A slasher modified with blowers is helping reduce contamination and spread of Chilean needle grass seed (DPI Victoria).

What has been done?

In early November 2005 when Chilean needle grass was flowering, DPI&F initiated a state-wide emergency response to determine the distribution of the weed, create public awareness and undertake treatment of identified infestations.

Agency staff from around the state, supported by local council officers, undertook a comprehensive survey, mapping and control program of the region's roadsides. This was followed up with prioritised surveys, mapping and control programs on private lands.

Public awareness activities included the production and distribution of warning brochures, a 'pestfact' sheet, warning signage for Main Roads Network and Clifton Showgrounds, awareness workshops for weed and infrastructure management staff, displays at community events, a media campaign and the establishment of a 1800 call centre reporting service.

Greening Australia was contracted to assist land managers develop Property Pest Management Plans (PPMPs) for high-risk properties, which the management group are helping property owners to implement.

A strong commitment to address the risk of panicle seed movement by equipment has seen local councils, Main Roads, QRail and Ergon Energy modifiy equipment and work practices of staff operating in Chilean needle grass areas. Slashers were modified to prevent rubbish accumulation on deck, clean-down/quarantine areas were created and identified, and work patterns changed so that areas of scattered infestations were worked before areas of heavy infestations.

What are the plans for the future?

Queensland's Chilean needle grass eradication strategy is ongoing and plans for further activities include:

- Chilean needle grass survey and control programs
- awareness and identification training
- performance reviews of Chilean needle grass plans
- research into Chilean needle grass management including:
  - wick wiping herbicide application technology
  - monitoring panicle seed bank characteristics
  - herbicide toxicity on aquatic vertebrates
  - testing of residual properties of fluproponate.
- activities to minimise the risk of spread of Chilean needle grass from heavily infested areas such as Clifton Showgrounds
- establishment of a Chilean needle grass technical group to advise and support the Chilean needle grass management group on eradication practices
- continued support to property owners and land managers that have Chilean needle grass.

The development of a long-term eradication strategy, co-operation between stakeholders and a pro-active approach to management will ensure that land managers in Queensland have the necessary tools in place to eradicate Chilean needle grass from the state.

Integrated management of Chilean needle grass on a beef production property near Tamworth, NSW

The problem

Chilean needle grass is thought to have existed for about 30 years in New South Wales' Tamworth district, where one local landholder is tackling an infestation that he believes originated from the roadside approximately 10 years ago.

"I've been managing the property for about four years and Chilean needle grass was already present when I took over," said the landholder.

"At the moment we've got a patchy mix of large and small infestations, which we've tried hard to prevent spreading further by getting rid of the smaller ones, while gradually chipping away at the larger infestations."

If Chilean needle grass becomes widespread throughout his property, the landholder fears that eventually his carrying capacity will be reduced and his enterprise will become less profitable.

To complicate matters, Chilean needle grass often produces panicle seed heads twice a year in this area. Approximately two thirds panicle seed heads are produced in spring and about one third in autumn, according to the land holder's estimates.

What is the landholder's approach?

"Our major long-term aim is to prevent Chilean needle grass from producing seed heads on all of the property every year and reduce its spread. That way, the land, the environment and my pay-packet all benefit," said the landholder.

To achieve this, the landholder has adopted a well-planned integrated management strategy, incorporating annual management programs, over several years.

The key to successful management of Chilean needle grass on any property lies in awareness of the extent of the problem coupled with a strong commitment to a well-planned, multi-faceted management strategy, believes the landholder.

What has been done?

"We found the main components when managing Chilean needle grass on this property are regular monitoring, maintaining pasture health to provide strong competition, strategic grazing, herbicide control and crop rotation," he said.

He conducts regular inspections of his property and undertakes crude mapping. Over time, he has learned to identify Chilean needle grass and can now confidently identify patches of the weed not in flower by the growth habit and foliage colour.

"I am continually aware of the location of Chilean needle grass infestations on the property and can quickly spot new outbreaks. I simply mark new infestations with a stake and I can come back and spray it."

A cropping cycle is a useful tool in an integrated weed management program (DPI Victoria).

Herbicide control is carried out on a regular basis. The landholder has a sprayer unit and a 200-litre tank mounted on a trailer that is towed around the property.

All known Chilean needle grass infestations are spot sprayed about three or four times a year. A thorough spraying campaign is carried out during the main flowering/panicle seed production period in spring, then additional spraying is carried out during the flowering/seeding period in autumn. Spraying is carried out on adjacent roadsides and in key areas (for example, in crops or crash-grazed paddocks) as required.

Providing strong competition from desirable species is central to the landholder's approach and, he believes, the cornerstone of any weed management program.

"I mainly sow tall fescue and follow up with subterranean clover and white clover. Then I fertilise to make sure the pasture on the farm is maintained in good health to provide strong competition against the Chilean needle grass and other weeds," he said.

Crop rotation is also an important component of the landholder's management strategy. Cultivation and planting of forage crops, including winter wheat, oats and lucerne, is carried out in some of the worst-affected areas. This cropping cycle and the resulting effects of cultivation breaking up the mature plants, strong competition and the ease of herbicide control has reduced the abundance of Chilean needle grass.

Crash grazing is used strategically by the landholder to prevent Chilean needle grass infestations in key paddocks from seeding in spring and autumn.

"I use a high stock density on a given paddock for three to seven days. This means all the pasture species are eaten or trampled to similar levels. When the stock are removed, all the pasture species have the same opportunity to grow during the rest period.

"The number of cattle required depends on the size of the paddock and the amount of feed available, but you have to have enough grazing pressure so the cattle do not selectively pick out only the highly palatable pasture species. Following crash grazing, I'll come back soon after and spot spray any Chilean needle grass that comes up with the new growth."

What are the plans for the future?

Steady progress is being made and the landholder is confident that believes his approach to managing Chilean needle grass has successfully reduced the spread and size of existing infestations within his property as a result of the gradual depletion of the panicle seed bank.

"I try to be proactive and I'm always keen to apply any new approaches to managing Chilean needle grass that may improve the overall result," he said.

Such a strong commitment to keep on top of Chilean needle grass now will prevent costly outbreaks, whilst leading to significant savings in both time and money in the future.

"I believe the biggest challenge in the future is outside the boundaries of my property. I think that the movement of Chilean needle grass panicle seed in flood waters, along roadsides and on animals will increase, which will remain a continual threat to the productivity of my place."

Managing heavy infestations of Chilean needle grass with intensive strategic grazing

The problem

"Chilean needle grass first became apparent here during the early 1990s and we believe it probably moved up from the south of the property via slashing along the roadsides," reports a farmer from a family-owned and managed property on the northern outskirts of Melbourne.

"Back then, the problem was isolated to about 10 hectares of road boundaries and one hill".

"We also noticed the weed's spread on the farm was assisted by seeds sticking to fleece of sheep and later dropping off in clean pastures. We actually often found new infestations near stumps where the sheep would rub."

Currently, the farm's Chilean needle grass infestation is over 30 ha. The weed's ability to contaminate fleeces and cause abscesses on stock, stick to machinery and livestock, is the farm's greatest problem and cause of its spread.

What is the approach?

Like other producers in Victoria, this particular farmer has had to change his production system to cope with Chilean needle grass invasion. In his case, the infestation got to the stage where, combined with sheep production, it was nearly impossible to manage effectively, forcing him to abandon sheep production entirely and replace it with an intensive bull beef production system instead.

To ensure Chilean needle grass doesn't spread right across a property, it needs to be identified early and stringently managed says the farmer.

"Once Chilean needle grass is established, it can become very difficult to manage due to its ability to spread and the development of the seed bank," he said.

What has been done?

"During 1996, the low returns from sheep plus the frustration of not being able to stop the spread of Chilean needle grass without frequent shearings, led to our complete change of farming enterprise to bull beef," said the farmer.

"We now produce Friesians for meat but also have Jersey bulls, which are breeding stock agisted to the property from Gippsland. We've found the Jersey bulls feed better on the Chilean needle grass than the Friesians."

To feed the stock, the farmer has both set stock and strategic grazing paddocks – many of which have heavy infestations of Chilean needle grass. In these paddocks, the bulls are run through a strategic grazing system with a 120-day rotation.

The 'cells' within this system are set up in a series of laneways that are approximately 0.9 ha in size.

"Depending upon the rate of pasture growth and seed head emergence throughout the season, we usually allocate ten bulls per cell and move them every second day," said the farmer.

"Over the summer, the majority of bulls are sold and we keep a small mob moving through the rotation to clean up any residual seed heads."

Strategic grazing increases the palatability and reduces panicle seed production of Chilean needle grass (DPI Victoria).

By controlling the feed on offer, the farmer manages the level of grazing for each cell and residual standing feed.

What has been the result?

The farmer believes that strategic grazing of Chilean needle grass with cattle has distinct benefits, including:

- cattle's greater ability to reduce the amount of viable Chilean needle grass panicle seed
- the increase in production of palatable vegetative growth
- a better environment for competition from desirable pasture species.

Better production rates result from strategic grazing than from set stock paddocks.

> "In a set stocking system, stock are free to pick and choose the 'strawberries and cream', but in a cell grazing system like ours, stock are forced to eat their 'Brussels sprouts', including Chilean needle grass," he said.

Although the cattle system doesn't have the complications of contaminated fleeces, the farmer still notices Chilean needle grass panicle seeds adhering to the hair on the tails and surrounding the pizzles of the bulls, not to mention panicle seeds piercing his dogs. The cattle also often regurgitate indigestible Chilean needle grass panicle seed and stem.

From the farmer's experience, Chilean needle grass on grazing land is best managed by:

- undertaking strategic grazing and allowing stock rates to increase
- increasing grazing pressure during times of panicle seed production
- maintaining ground cover to inhibit seedling germination
- reducing the risk of panicle seed spread by grazing stock with low seed-carrying potential (for example, cattle) and cleaning farm vehicles and equipment before moving off infested paddocks when Chilean needle grass is in seed.

"By combining the strategic grazing system with measures to prevent panicle seed spread, desirable pasture species will have a much more competitive chance, while reducing the proportion of Chilean needle grass within the pasture," he said.

Before: Rocky riparian edge of the Skeleton creek site in August 2003; weeds pictured include Chilean needle grass, serrated tussock, brassicas, artichokes and boxthorn.

Rehabilitation of rocky grasslands at Skeleton Creek, Victoria

The problem

Skeleton Creek is the third major watercourse after the Werribee River, in City of Wyndham, Victoria, and its heritage value areas of rough rocky terrain and conservation-significant basalt salt marsh make it a key environmental asset.

By 1999, however, urban expansion, a history of bad land management and overgrazing had left Skeleton Creek in a sorry state of neglect, with limited native vegetation, a significant rabbit population and numerous environmental weeds including Chilean needle grass, which was the most persistent and problematic weed identified at the site.

What is the approach?

In an innovative response to managing rocky and weedy terrain, Skeleton Creek became the focus of a conservation project, piloted by VicUrban in association with Collie Landscaping.

The Skeleton Creek project, carried out by works contractor, Native Vegetation Management Services(NVMS®), sought to demonstrate a cost-effective and environmentally positive alternative to mulching and planting out, by instead using incremental weed control, ecological burn processes and broadcasting of native grass and forb seed.

A sustained management program to reduce input into the panicle seed bank in the long term, while increasing and enhancing competition from native species, was undertaken from 1999–2006.

What has been done?

NVMS® operators were thoroughly trained to recognise Chilean needle grass and other weeds at different stages of growth.

Selective herbicide control was carried out repeatedly at the site, in a technique dubbed Consistent Micro Application of Selective Chemicals (CMASC).

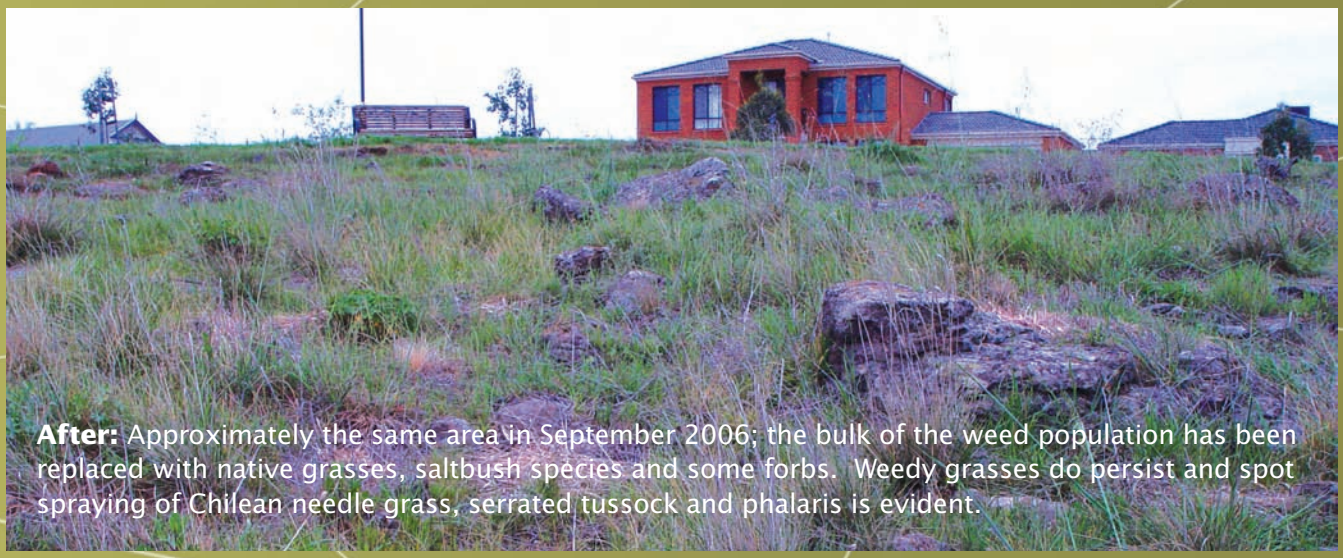
Herbicides targeting weeds only, were applied several times a year to ensure that desired plants were protected and to allow operators to target missed and new plants for as long as the project budget permitted.

Ecological burning was an important part of the management program, both to reveal the landscape and to create conditions that would encourage seed germination of both the weeds and the native species.

The vigorous regeneration of native grasses and herbs after burning was supplemented with a spot-spraying campaign to place continual pressure on re-emerging Chilean needle grass population.

Native ground flora was re-established by direct broadcast seeding, to fill the gaps and provide strong competition against any re-emerging weeds.

Species that were broadcast seeded include Kangaroo-grass (*Themeda triandra*), spear grasses (species of *Austrostipa*), wallaby grass (species of *Austrodanthonia*), red-leg grass (*Bothriochloa macra*) and windmill grass (*Chloris truncata*). These species were direct seeded



After: Approximately the same area in September 2006; the bulk of the weed population has been replaced with native grasses, saltbush species and some forbs. Weedy grasses do persist and spot spraying of Chilean needle grass, serrated tussock and phalaris is evident.

during spring and autumn, following site preparation using burning and spraying.

What has been the result?

This three-pronged attack on Chilean needle grass enhanced the effect of natural regeneration, reduced the panicle seed bank and resulted in a reduced abundance of Chilean needle grass and other weeds.

The sustained management program between 1999 and 2006 has seen Skeleton Creek well on the way to being transformed from the original weedy jungle to an urban grassland habitat that will be appreciated by the local community.

Ecological assessment by Biosis Research has evaluated the vegetation quality at three sites on the creek using the habit hectare method, concluding that management activities had contributed to the improving quality of vegetation within each area.

It was found that the direct seeding operations had succeeded in re-establishing kangaroo grass and other indigenous grasses, and a small number of herb species. Although all three areas still contained a relatively high proportion of weeds, this seemed to be much reduced from earlier levels, and the native flora species had expanded their cover.

A rich diversity of native grasses and herbs are establishing and survival of direct seeded herbs through an intensive drought indicates a longer term stability. These are able to compete with Chilean needle grass and each year, there has been further reduction in the weed population. As a result, management costs continue to decrease.

What are the plans for the future?

The campaign of selective herbicide control, ecological burning and re-establishment of native ground flora at Skeleton Creek continued until mid-2007 when the low-maintenance site was handed over to Wyndham City Council.

The experience of managing of Chilean needle grass as part of a greater project plan at Skeleton Creek and other grasslands continues to help refine management techniques of the agencies involved. It has also generated ideas that may improve understanding of Chilean needle grass management in native grasslands.

Wyndham City Council plans to retain Skeleton creek as a major open space link, while continuing to protect and enhance the creek's natural environmental conditions.

For further information please contact:

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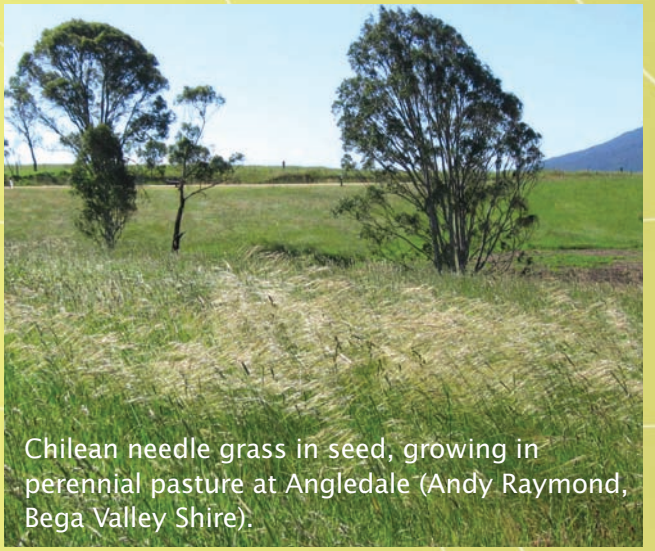

Chilean needle grass in seed, growing in perennial pasture at Angledale (Andy Raymond, Bega Valley Shire).

Seeding of desirable pasture species by direct drill (Andy Raymond, formerly Bega Valley Shire).

Local government and landholders join forces to tackle Chilean needle grass in Bega Valley Shire, NSW

The problem

In November, 2004, the first record of Chilean needle grass in the Bega Valley was identified by the District Agronomist, Harry Kemp, on a number of properties in a small area in Angledale, just north of Bega.

The sighting triggered a thorough inspection of the surrounding area to establish the extent and density of Chilean needle grass, including inspection of other properties in the shire known to be associated with the infested properties through stock and machinery movement.

Of the 24 properties inspected, Chilean needle grass was found on six, infesting a total area of approximately 12.1 ha, and also on three small infestations on council-managed roadsides. The infestation densities ranged from isolated individual plants to heavily infested core areas.

As investigations continued, some land owners with Chilean needle grass on their property speculated that it may have been present on their land for at least 20 years.

What is the approach?

A control and recovery project was undertaken using a grant of $7000 from NSW Department of Primary Industries, an extra $2000 from Bega Valley Shire Council to implement inspection and control work, and $3500 from Southern Rivers Catchment Management Authority (CMA).

The aim of the project was to identify and treat all Chilean needle grass infestations in the area and to establish desirable pasture species, where appropriate, to compete with the weed.

A public campaign launched through local media to inform land managers and residents of the infestations and the council's planned inspection and eradication program was well received across the shire.

What has been done?

Initially, all Chilean needle grass panicle seed heads were cut, bagged and disposed of in landfill, to prevent further inputs into the seed bank.

All affected land managers agreed to have their infestations of Chilean needle grass sprayed as part of the control program and in late 2004 and early 2005 all infestations were spot or boom sprayed at no cost to the land owner.

The spraying program achieved good results, with approximately 90 per cent of all Chilean needle grass plants controlled.

Bega Valley Shire Council's weeds inspectors then organised a meeting with all land managers dealing with Chilean needle grass infestations and the local agronomist from NSW DPI, where it was agreed that competitive pasture species be sown to reduce the likelihood of re-invasion by Chilean needle grass.

Tall fescue emerging in spring (Andy Raymond, formerly Bega Valley Shire).

What has been the result?

In early September 2005, the previously sprayed areas were boom sprayed to kill any newly emerging plants. The following day, a quick-growing perennial pasture mix of tall fescue, clovers and fertiliser was sown by direct drill. Most of these areas were fenced off from stock for approximately two to three months to allow the pasture to establish.

After good rainfall during spring 2005, the sown seed successfully germinated and a little Chilean needle grass re-established in the sprayed and re-sown areas. In areas previously untreated, however, there was substantial germination of Chilean needle grass, as well as the discovery of new infestations. The new infestations were targeted by spot spraying and manual control by land managers and Bega Valley Shire Council weeds staff.

A re-inspection program in November 2005 targeted properties with known infestations and found that all had been controlled before panicle seed set. The inspection program was expanded to include neighbouring properties on the northern side of the Brogo River and no Chilean needle grass was found.

Unfortunately drought caused failure of much of the 2005 pasture rehabilitation work. A further $6000 was allocated bythe Southern Rivers CMA for further pasture rehabilitation to ensure vigorous pastures are established to provide effective competition.

Every infested property now has a Chilean needle grass management plan in place and all known infestations were re-inspected during the 2006–2007 season.

What is the plan for the future?

Bega Valley Shire Council is committed and well prepared to control Chilean needle grass through community education and awareness programs, by identifying and eradicating new infestations and by managing existing infestations appropriately.

Inspection, mapping and control programs are ongoing. The declaration of Chilean needle grass as a Class 4 noxious weed under the *Noxious Weeds Act 1993,* in Bega Valley Shire in March 2006, has made it easier for weeds officers to ensure that land managers control its occurrence.

Continuing education programs mean that awareness of the problem is now widespread throughout the shire, and land managers and Council staff are now experienced at identifying and controlling Chilean needle grass.

'Brushdown point' sign in Hume City Council, Victoria (Hume City Council).

Roadside management of Chilean needle grass by Hume City Council

The problem

The results of a mapping program in 2002 highlighted significant spread of needle grass species (both Chilean needle grass and Texas needle grass, *N. leucotricha*) since previous mapping had occurred in 1997. Its consequent occurrence was on most slashed roadsides in Hume. A total of 25 km of needle grass management zones (roadsides with low and patchy infestations) was recorded, as well as approximately 16 km of needle grass-free zones (roadsides with no infestations).

Residents' concerns about the problem of needle grasses, and the advice of the council's Weeds Advisory Committee saw Hume City Council begin development of the *Hume Needle Grass Action Plan* in November 2002.

What is the approach?

The *Hume Needle Grass Action Plan* plan aimed to reduce the needle grass threat to Hume City and the surrounding basalt plains and to encourage awareness of needle grasses, in particular:

- their serious impact on land productivity and environmental values within the municipality
- the potential for council roadside management activities to lead to their spread.

The major objectives to achieve this include:

- mapping and signposting "*needle grass management zones*" (that is, roadsides with low and patchy infestations) and *"needle grass-free zones"* (roadsides with no infestations)
- protecting these zones from importing further Chilean needle grass seed through council activities, including slashing and road maintenance works
- reducing the current cover of needle grasses within the needle grass management zones through appropriate herbicide application during spring and autumn
- monitoring needle grass spread through repeated mapping of needle grass management zones and needle grass-free zones
- annual auditing of signs and maps and repairing/re-mapping when necessary.

What has been done?

The Action Plan

This consisted largely of an annual program of mapping and spraying of roadside infestations. The 2002 mapped 'management' and 'free' zones were the focus of management, re-mapping and extension works in the following years.

Patches within management zones were sprayed with a non-selective herbicide in autumn 2003, and later sown with a dry-land turf seed mix.

Infestations were mapped again in spring 2003, with zone boundaries revised and marked with a 'wash-down point' sign. Slashing contractors were directed to brush down machinery at these signs to minimise spread into needle grass free zones.

Adjoining landholders were also informed of the needle grass threat and management options.

The mapped needle grass management zones were re-sprayed in 2004.

Spot spraying Chilean needle grass along a roadside (Hume City Council).

During spring 2005:

- Current Chilean needle grass and Texas needle grass management zones were re-mapped, including GPS co-ordinates, and signage audited.
- Signs were repaired where necessary.
- Area, density and absolute area cover of needle grasses within every control zone was recorded.
- Flowering needle grasses within every control zone were sprayed.
- Variations of absolute and area coverage over zones, years and species were recorded.
- Potential 'non-roadside' needle grass management zones: Albert Road Reserve, Emu Bottom Wetland Reserve and significant roadside areas, were mapped and assessed.
- Needle grass spread within and across needle grass fronts in management zones was minimised through herbicide control and weed hygiene procedures.

Vehicle hygiene guidelines

Hume City Council also introduced vehicle hygiene guidelines for staff and contractors operating on roadsides. This included use of the 'wash-down point' signs in management zones. In addition, the council are taking part in trials and supporting research into best practice needle grass management and improving vehicle hygiene.

What has been the result?

The plan has been a catalyst for strengthening partnerships within council and with state agencies, particularly the Department of Primary Industries (DPI) and their work together on a number of research initiatives targeting needle grasses. Council's relationship with VicRoads, managers of major roads, continues to improve.

Volunteers, predominantly landholders and members of the Weeds Advisory Committee, continue to help deliver the Action Plan.

Hume City Council's proactive approach has caused interest from numerous councils across Australia, and even by a Weed Officer from a district council in New Zealand. The council has been able to provide advice on the development of strategies and management of needle grasses.

What is the plan for the future?

The *Needle Grass Action Plan* has been incorporated in Hume City council's Sustainable Land Management Strategy. Implementation of the plan is ongoing and continues to draw on ongoing evaluation and wider needle grass management research.

Council is about to begin a large-scale weed mapping program using the latest in GIS technology. Once the data is collected in the field, it will be uploaded onto council's standard mapping system, which can be easily accessed by all staff.

This 'cross-council' approach will help many different departments to tackle not only Chilean needle grass and Texas needle grass but many other weeds as well.

For further information please contact:

Sustainable Environment Department
Hume City Council
Broadmeadows, Victoria.
(03) 9205 2200

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Section 6 Further information

6.1 Declaration details of Chilean needle grass in Australia

State	Declaration status (October 2007)	Areas covered	Legal Restrictions
ACT	**D** – Declared Pest Plant *[Land (Planning and Environment) Act 1991]*	All ACT	Requires that a plan be prepared to control the spread of these plants. The declaration does not require the immediate removal of these plants from gardens in the ACT. The plan will identify as one of its components public education about the threats these plants pose to the environment.
NSW	**Class 3** *(Noxious Weeds Act 1993)*	30 local council areas** in NSW	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.
	Class 4 *(Noxious Weeds Act 1993)*	Remaining local control authorities in NSW	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.
NT	**Schedule Class A/C** *(Weed Management Act 2001)*	All NT	Schedule Class A – To be eradicated. Schedule Class C – Not to be introduced into the Territory.
QLD	**Class 1** *[Land Protection (Pest and Stock Route Management) Act 2002]*	All Qld	Plants not commonly present in the state and, if introduced, would cause an adverse economic, environmental or social impact. Class 1 plants established in the state are subject to eradication. It is an offence to introduce, keep or sell Class 1 plants without a permit.
SA	**Class 2** *(Natural Resources Management Act 2004)*	All SA	Generally requiring notification in at least part of the state and control of the plant throughout the whole state.
TAS	**D** – Declared weed *(Weed Management Act 1999)*	All Tas	Details on actual restrictions or measures for each declared weed are contained in the weed management plan for that weed. Must not import or allow to be imported, must not sell or distribute; must not propagate, harvest or store; and may be required to reduce, eradicate or restrict the weed.
VIC	**R** – Restricted weed *(Catchment and Land Protection Act 1994)*	All Victoria	Trade in these weeds and materials containing them is prohibited.
WA	**Prohibited** *(Plant Diseases Act 1974)* **P1** *(Agricultural and Related Resources Protection Act 1976)*	All WA	Prohibited – Plant species on the Permitted and Prohibited list not permitted entry into WA. P1 – Prohibits movement of declared plants and/or their seeds through the prevention of trade, sale or movement of plants into the state or that area of the state.

****NSW Local Councils where Chilean needle grass is declared Class 3:** Albury, Balranalo, Berrigan, Bland, Carrathool, Central Murray County Council, Conargo, Coolamon, Cootamundra, Corowa, Deniliquin, Greater Hume, Griffith, Gundagai, Hay, Jerilderie, Junee, Leeton, Lockhart, Murray, Murrumbidgee, Narrandera, Temora, Wakool, Tumbarumba, Tumut, Urana, Wagga Wagga, Wentworth, Windouran.

6.2 Contacts

Region	Telephone number	Website
National		
Department of Agriculture Fisheries and Forestry (DAFF)	(02) 6272 3933	http://www.daff.gov.au/
National Chilean needle grass Taskforce National Chilean needle grass Coordinator	For current contact details visit website	www.weeds.org.au/WoNS/Chileanneedlegrass/
Australian Capital Territory		
Parks, Conservation and Lands	13 22 81	http://www.tams.act.gov.au/live/environment
New South Wales		
Department of Primary Industries	(02) 6391 3100	www.dpi.nsw.gov.au/
Queensland		
Department of Primary Industries and Fisheries (DPI&F), incorporating Biosecurity Queensland.	13 25 23	www.dpi.qld.gov.au/
South Australia		
Department of Water, Land and Biodiversity Conservation (DWLBC)	(08) 8303 9620	www.dwlbc.sa.gov.au/
Tasmania		
Department of Primary Industries and Water (DPIW)	1300 368 550	www.dpiw.tas.gov.au/
Victoria		
Department of Primary Industries	13 61 86	www.dpi.vic.gov.au/

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6.4 Glossary and acronyms

Term	Definition
awn	a fine bristle-like appendage that is attached to the seed.
C3 grass	grasses that utilise the C3 photosynthetic pathway; these grasses are usually adapted to cool temperate zones.
corona	a crown; in grasses, a ring of hairs at the tip of the lemma.
family	a unit of taxonomic classification above the level of a tribe.
genus	a unit of taxonomic classification above the level of a species. The genus name is the first part of a scientific name, for example *Nassella* (genus) *neesiana* (species). (plural genera).
glume	of a grass, one or two sub-opposite empty bracts subtending the floret or florets in a spikelet.
inflorescence or seed head	collective name for the flowering part of a grass.
lemma	outer bract of a grass floret, enclosing a palea and a flower.
ligule	a membranous or hairy outgrowth on the adaxial surface of a leaf, at the junction of sheath and blade, especially in grasses and some sedges.
palea	the upper husk enclosing the flower.
panicle	an inflorescence branched in large loose clusters; a branched raceme.
stamen	a male organ of a flower, consisting of a filament and anther (which bears pollen).
tribe	a unit of taxonomic classification above the level of a genus but below the level of a family.
tiller	of a grass, a branch developed from a bud at the base of a stem.
tussock	large clump or tuft as formed by some perennial grasses and sedges.

Term	Definition
ACT	Australian Capital Territory
APVMA	Australian Pesticides and Veterinary Medicines Authority
CMA	Catchment Management Authority
NSW	New South Wales
PPMP	Property Pest Management Plan
TAFE	Technical and Further Education
DAFF	Department of Agriculture Fisheries and Forestry
DPI	Department of Primary Industries (New South Wales, Victoria)
DPI&F	Department of Primary Industries and Fisheries (Queensland)
DPIW	Department of Primary Industries and Water (Tasmania)
DWLBC	Department of Water, Land and Biodiversity Conservation (South Australia)