

Parthenium weed management

May 2004



This manual is sponsored by the National Weeds Program (Natural Heritage Trust),
Department of Natural Resources, Mines and Energy and
Department of Primary Industries and Fisheries

This publication is intended to provide information only on the subject under review. It is not intended to, nor does it constitute, expert advice. Readers are warned against relying solely on the information contained herein. Further professional advice should be sought before acting on the information supplied in this manual.

While all care has been taken in the preparation of this document, neither the Department of Natural Resources, Mines and Energy nor its officers or staff accept any responsibility for any loss or damage that may result from any inaccuracy or omission in the information contained herein.

© The State of Queensland (Department of Natural Resources, Mines and Energy) 2003
Copyright protects this publication. Except for purposes permitted by the *Copyright Act 1968* (Qld), reproduction by any means (photocopying, electronic, mechanical, recording or otherwise) is prohibited without the prior written permission of the Department of Natural Resources, Mines and Energy.

Copyright enquiries should be addressed to:
The Director of Product Marketing
Department of Natural Resources, Mines and Energy
GPO Box 2454
Brisbane Qld 4001
QNRM04040
ISBN 1 920920 18 8
#16967

Editing, design, proofreading and production:
Web and Publishing Services, Department of Natural Resources, Mines and Energy

Photographs: Amanda Gittens, John Chamberlain, Scott W. Dearden, K. Dhileepan, Allan Tomley, Avriel Tyson, Patty Mann, Darren Moor and staff of the Department of Natural Resources, Mines and Energy

For copies of this manual contact:
Land Protection
Department of Natural Resources, Mines and Energy
PO Box 1762
Rockhampton Qld 4700
Phone: 07 4938 4600
E-mail: CentralLP@nrm.qld.gov.au

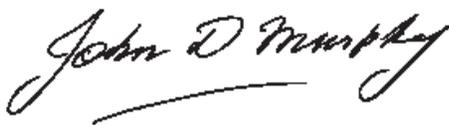
Front cover:
Left: Table Mountain, Clermont District, is in the heart of parthenium country in central Queensland. Right: Parthenium weed in the Rolleston district.

Foreword

Parthenium weed is currently found widely across the central highlands of Queensland, with smaller populations in southern and western Queensland and sporadic occurrences in New South Wales and the Northern Territory. Parthenium represents a potential threat to grazing and cropping lands and natural ecosystems across northern and eastern Australia. There is growing community concern over the spread of parthenium (both within Queensland and interstate), and its effects on agriculture, on the environment and on human health.

The Parthenium Action Group Inc. is a community group that was formed in the central highlands of Queensland in 1994. The group was contracted by the National Weeds Program through the National Parthenium Weed Management Group to produce this edition on the management of parthenium weed. It updates *Parthenium Weed Best Management Practice* (2000).

The book includes an extensive section of landholder and state agency experiences in parthenium weed control, representing a valuable opportunity to consider the merits of parthenium management strategies applied successfully by others.

A handwritten signature in black ink that reads "John D. Murphy". The signature is written in a cursive style with a long horizontal flourish underneath.

John Murphy
Chairman
National Parthenium Weed Management Group

Contents

Foreword	iii
Acknowledgments	v
Introduction	vi
Parthenium—a weed of national significance	vi
A national strategy	vii
Section 1: Parthenium weed: ecology and threat	1
Description	2
Habitat	2
Distribution	2
Germination and reproduction	4
Seed dormancy and seed-bank longevity	4
Colonisation and spread	5
Competition with pasture and native species	5
Problems created by parthenium weed	6
Impact on agricultural viability	6
Health issues	6
Dealing with parthenium weed	8
Declarations and legislation affecting parthenium weed	9
Section 2: Managing parthenium weed	11
Management practices	12
1. Minimising spread	12
2. Preventing establishment of self-regenerating populations	13
3. Managing pastures	15
4. Treating with herbicides	18
5. Introducing biological control agents	19
Section 3: Case studies	23
Strategy development in regional communities: principles and learnings	24
Containment lines and buffer zones in grazing lands	27
Experience with biocontrol agents at Hillside, 1980–2003	29
The road we have travelled	30
Discovering new approaches to parthenium management	33
Getting in early—before parthenium establishes core infestations	36
Integrated approaches—the key to managing parthenium	38
Grazing pressure and rest: key factors in managing parthenium	41
Flexibility in grazing management to accommodate parthenium	43
Parthenium behaviour in north-west Queensland	45
Parthenium in the Northern Territory: a brief history	47
Implications of parthenium in Queensland’s Channel Country	48
Dealing with parthenium in southern inland Queensland	51
New South Wales Parthenium Weed Strategy	53
New South Wales parthenium group study tour, 2002	57
Evolving cross-border approaches to managing parthenium	59
Guidelines for limiting weed seed spread	65
Summer rust, a new biocontrol agent for parthenium	67
Section 4: Appendices	71
Glossary	72
Parthenium biological control agents	73

Acknowledgments

Principal authors and compilers

John Chamberlain and Amanda Gittens for the Parthenium Action Group

Case study contributors

Dougal and Judy Atkinson, Lisburne, Blackall

Judy Atkinson, Parthenium APEC Team

Janet Barker, Queensland Murray Darling Committee, Toowoomba

Alice Beilby, Department of Infrastructure, Planning and Environment, Katherine (Northern Territory)

Evan Benney, Hillside, Clermont

Philip Blackmore, NSW Agriculture, Armidale

Damian Byrne, Department of Natural Resources, Mines and Energy, Blackall

Jeff Campbell, Mitchell and District Landcare Group, Currawarra, Mitchell

John Chamberlain, Department of Primary Industries and Fisheries, Clermont

Craig Hunter, Department of Natural Resources, Mines and Energy, Dalby

Rebecca Hutchinson, Namoi-Gwydir Noxious Weeds Advisory Committee

Col Jackson, Injune and District Parthenium Action Group

Michael Jeffery, Department of Primary Industries and Fisheries, Charleville

Bob McDonald and John Cameron, Cloncurry and Burketown

Charlie and Evon Marks, Winvic, Clermont

Jenny Milson, Department of Primary Industries and Fisheries, Longreach

David Phelps, Department of Primary Industries and Fisheries, Longreach

Allan Smith, Etheridge Shire Council, Georgetown

Howard Smith and Gail Godwin-Smith, Mt Panorama, Rolleston

Hugo and Shona Spooner, Avocet, Springsure

Allan Tomley, Alan Fletcher Research Station, Brisbane

Gary Zerner, Department of Natural Resources, Mines and Energy, Brisbane

Other contributing individuals, government organisations and institutions

Ann Doak, Department of Natural Resources, Mines and Energy, Rockhampton

Diane Goldsworthy, Central Queensland University, Rockhampton

Sheldon Navie, The University of Queensland

Allan Fletcher Research Station, Brisbane

Department of Primary Industries and Fisheries, Queensland

Land Protection, Department of Natural Resources, Mines and Energy, Queensland

NSW Agriculture

Department of Infrastructure, Planning and Environment, Northern Territory

Introduction

Parthenium—a weed of national significance

Parthenium weed is an aggressive annual herb, colonising roadsides, fallow land and overgrazed pastures where grass cover is poor. It does not normally establish in vigorous pastures or intact native vegetation. As it can only reproduce and spread by seed, the seed ecology of parthenium weed contributes greatly to its success in semi-arid environments.

Parthenium weed was introduced to central Queensland forty years ago in a shipment of grass seed from the United States of America. In that short period, it has advanced from isolated outbreaks to establish large core areas of self-regenerating populations across the central highlands of Queensland, with smaller populations in the south and west, and sporadic occurrences in New South Wales and the Northern Territory.

Coming to terms with parthenium weed, particularly in Queensland grazed landscapes, has been an intensive learning process for land managers. They have had to accept its presence, understand its ecology, and develop management strategies to accommodate parthenium weed in grazing systems.

In Queensland the annual cost of parthenium weed to grazing and cropping industries (in production losses and on-farm control costs) has been estimated at \$16 million and \$6 million respectively. Biological control programs funded by Queensland government departments have cost a further \$9 million and the expenditure on roadside controls and washdown facilities has also been significant. In New South Wales the cost of parthenium weed prevention is high. The environmental and social costs have not been quantified but the serious allergic reactions in humans are well known, and significant impacts on biodiversity have been observed.



▲ Parthenium weed.

A national strategy

A national strategy was proposed in 2001. Its vision is that 'Parthenium weed is confined to Queensland and its social, economic and environmental impacts are reduced to a minimum'.

The strategy aims to deliver four outcomes:

- Parthenium weed is prevented from spreading to and impacting on new areas.
- The community is aware of parthenium weed and provided with quality information and the skills to assist in its detection and reduction.
- The impacts of established parthenium weed are reduced.
- Parthenium weed management is coordinated at a national level.

This book describes parthenium weed and provides basic information about its ecology and biology, reproduction and spread, current distribution, and potential threat. It also provides information on management and control aspects including spread minimisation, pasture management, herbicide use, biological control and health aspects.



▲ A dense infestation of parthenium weed in central Queensland.

Parthenium weed: ecology and threat



Section 1

Section 1

Parthenium weed: ecology and threat

Description

Parthenium weed (*Parthenium hysterophorus* L.) is a branching, annual herb with pale-green lobed leaves, a deep taproot, and an erect stem with several branches. It can grow to more than two metres high.

Seedling leaves are oval while the first two true leaves are egg-shaped and hairy. Later leaves are deeply lobed (with the lobes also deeply lobed) and hairy, initially forming a rosette. Mature plants are erect.

Flower heads, each containing five black seeds, are creamy-white and about 4 mm across. They are clustered on large branched stalks that arise from the leaf forks.

Habitat

Parthenium weed is native to sub-tropical North and South America. It grows best on alkaline, clay-loam to heavy clay soils in areas where rainfall is greater than 500 mm per year and falls dominantly in summer.

Distribution

Parthenium weed is currently found widely across the central highlands of Queensland, with smaller populations in southern and western Queensland and sporadic occurrences in New South Wales and the Northern Territory.

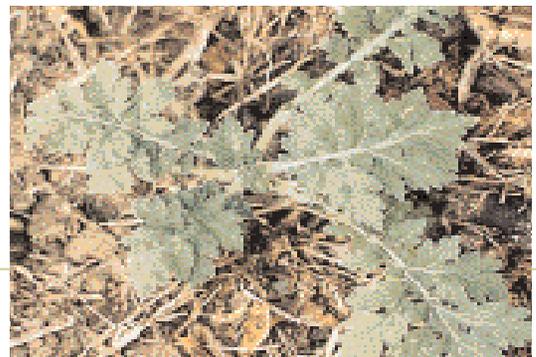
The following figures indicate, respectively, the potential distribution of parthenium weed using climate-based data; the 2003 distribution and density of parthenium weed across Queensland; and locations in New South Wales where parthenium weed has



▲ Plants germinate with rounded leaves. Lobed leaves quickly develop after germination.



▲ Mature plant.

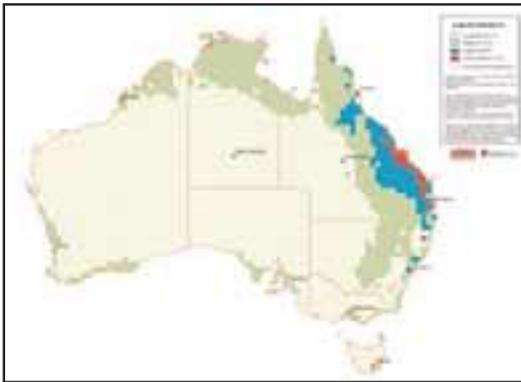


▶ Young plants form a rosette.

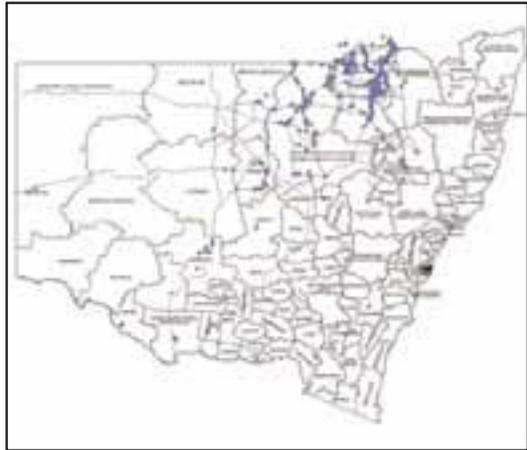


been found and eradicated since 1982. New South Wales currently has no known self-regenerating populations of parthenium weed.

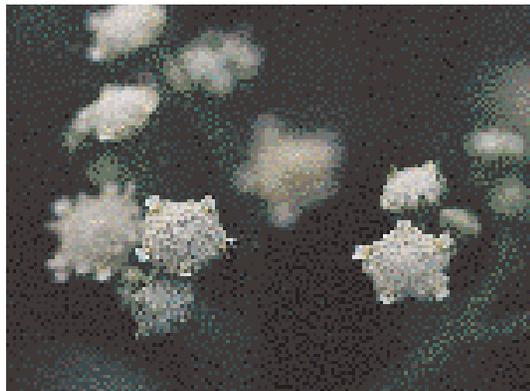
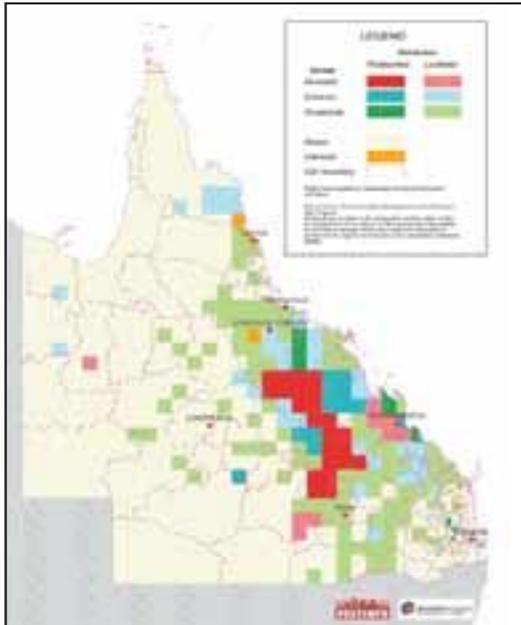
Potential distribution of parthenium weed in Australia (CLIMEX data)



Parthenium weed outbreaks in New South Wales (1982–2003)



Distribution and density of parthenium weed in Queensland, 2003



▲ Flower heads are creamy-white.



▶ Parthenium flowers.



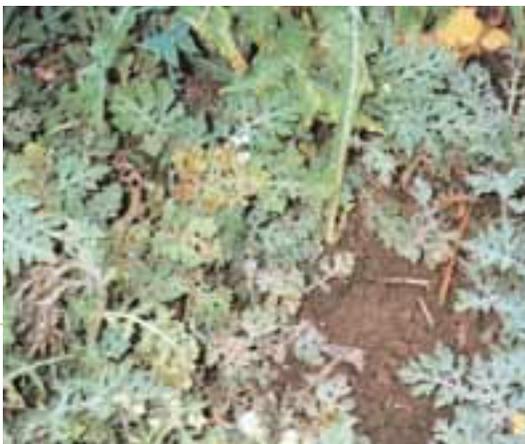


Germination and reproduction

Research shows that parthenium weed achieves highest germination rates at temperatures ranging from 12°C to 27°C, the optimum germination temperature being 22–25°C. This is confirmed by field experience.

In central Queensland it will germinate at any time but does best in September–November and March–May. In north-west Queensland it has an apparent aversion to germinating and establishing in the high temperatures of the monsoon season, and in more southern regions little parthenium germination occurs in the coldest months. Because parthenium germination depends on sufficient rain to leach germination inhibitors from the seed, the main germination flushes coincide with spring, early summer and autumn rains.

University of Queensland research found that parthenium seed has a very rapid rate of germination from the soil seed bank. Parthenium germination peaks four days after wetting with the majority germinating in one week. Germination of grasses from the same seed bank peaks at day five or six but requires about three weeks for the majority to have emerged. This trait gives parthenium weed a great competitive advantage.



Another reason for parthenium's success as a weed lies with its reproductive ability. Parthenium weed has been observed to germinate, grow, mature and set seed in as little as 28 days in central Queensland. And simulated phenology studies at The University of Queensland have indicated that parthenium weed could possibly develop seed in 50-65 days if growing at Emerald in central Queensland, in 80-90 days at Armidale in northern New South Wales, and in 85-100 days at Ballarat in Victoria. Added to that, several successive generations can emerge in a good season.

Parthenium weed is a prolific seed producer capable of producing up to 15 000 seeds per plant, giving it potential to build up a seed bank very quickly. In self-regenerating populations, parthenium seed banks range from 3000 to 40 000 seeds per square metre and typically make up greater than 50 per cent of the total soil seed bank. Up to 400 million parthenium seeds per hectare can be present in the surface soil compared to 120 000 native grass seeds.

Seed dormancy and seed-bank longevity

Parthenium seed banks are persistent, with seed viability greater than 50 per cent after more than two years in the soil. Seed near the soil surface is rarely viable beyond two years. However, undisturbed, buried seed will stay dormant for a longer period. It has been recorded as viable for up to six years, and anecdotal evidence suggests even longer. In climates where rainfall is irregular, dormancy mechanisms prevent untimely germination.

The size and persistence of the seed bank has implications several years beyond a reduction in parthenium weed populations.

- ◀ Parthenium weed is a very competitive weed because it germinates much more rapidly than most grasses.

Colonisation and spread

Parthenium weed colonises a range of vegetation and soil types but the most common are the alkaline clay loam to clay soils on downs; floodplains; and softwood, brigalow and gidgee scrub country.

Parthenium weed is extremely effective at colonising and is a highly competitive plant. It will colonise weak or overgrazed pastures with low ground cover; cultivated lands; disturbed and bare areas such as roadsides and tracks; and heavily stocked areas such as stockyards and watering points.

Parthenium seed is spread easily by water, farm and industrial machinery, feral animals, humans, vehicles, stock fodder and movement of stock, grain and seed.



▲ This red loamy soil has healthy vigorous pastures. In contrast, parthenium weed is infesting the clay soil with degraded pasture.



Competition with pasture and native species

During germination, parthenium weed is capable of out-competing other plant species, especially on heavy cracking clays. However, in healthy vigorous pastures, parthenium that germinates in the growing season will find it difficult to compete with the pasture.

University of Queensland research has shown that smoke increases germination of native pastures and may inhibit parthenium germination. This may have implications for the development of innovations in parthenium weed management. Parthenium weed will become more competitive as carbon dioxide in the atmosphere increases (greenhouse effect).

◀ Heavily stocked areas such as watering points are susceptible to parthenium weed.



Problems created by parthenium weed

Parthenium weed affects the viability of primary production—both livestock and grain enterprises—as well as causing health problems for humans and animals.

Impact on agricultural viability

Parthenium weed is a serious problem. In grazing country it can dominate pastures under continued heavy grazing and has the potential to exclude useful forage plants, thus decreasing pasture productivity, carrying capacity and land values.

Parthenium weed has also spread to grain-producing areas of Queensland where it may threaten exports by contaminating grain and other produce. Parthenium weed can also taint sheep meat and dairy milk.

Parthenium weed is allelopathic, which means it can chemically inhibit pasture (and other plant species) seed germination and growth. Parthenium weed competes directly with preferred pasture species, reducing pasture vigour and seed set and leading to habitat and ecosystem changes.

Health issues

All parts of the parthenium plant at any stage of growth are toxic to humans and animals.

Humans

Parthenium weed has been shown to be related to health problems for some people living or working in close proximity to it. Individuals in contact with parthenium can develop sensitivity to the plant, which may then manifest as an allergy-type response.



▲ Parthenium weed growing in a sorghum crop.



▲ Parthenium weed infesting wheat stubble, 1999.



- ▶ Good weed husbandry resulted in a parthenium-free sunflower crop. Post harvest, 2000.



A survey in Queensland showed 10 per cent of property workers in infested areas had developed visible allergic symptoms to parthenium.(1)

Contact with any parts of the parthenium plant (such as airborne pieces of dried plant material, pollen or even root) can cause the development of sensitivity as well as the subsequent risk of allergic reactions. In contrast, a person who has allergies may also have an allergic reaction to parthenium even though they may not be sensitive to the plant itself.

Sensitisation to parthenium may occur on the first contact or may take longer to develop. Often a person will develop an allergic reaction to parthenium some hours after the initial exposure, and in this case may not realise that parthenium is the cause of their symptoms. Once sensitised, any direct contact may trigger off an allergic response. The severity of a reaction may worsen over time.

In highly sensitised individuals, indirect contact with parthenium can be sufficient to provoke an allergic reaction. Indirect contact could occur through handling or brushing against clothes which have parthenium particles on it such as minute bits of leaf, stem, stem hairs, pollen or plant root.

For some people allergic symptoms can start to show within minutes of contact, particularly if hay fever is their primary allergic symptom. For others it may take up to several hours before an allergic response shows. The type of allergic reaction depends on the individual's personal characteristics.

Whilst some people may not have any indications of sensitivity to parthenium, there remains the threat of allergic reactions at a later date. Absence of allergic symptoms to parthenium should not be assumed to indicate a lack of sensitivity, since it may take up to twenty years for such symptoms to show.

Reactions to parthenium include:

- severe contact dermatitis
- phytophoto dermatitis that develops on contact and is aggravated by sunlight
- hay fever (allergic rhinitis)
- aggravated asthma (allergic bronchitis).

Typical symptoms of an allergic reaction to parthenium include:

- skin rashes, especially on face and hands (itchy, red, irritated and weepy skin)
- peeling skin
- puffy eyes/excessive watering
- swelling and itching of the membranes of the mouth and nose
- fatigue
- wheeziness or constant cough, especially at night
- continually running nose, repeated attacks of sneezing
- itching of the roof of the mouth.

Some people also have an allergic reaction to other plants in the same family group, for example, sunflowers and chrysanthemums.

(1) Chippendale, JF & Panetta, FD 1994, 'The cost of parthenium weed to the Queensland cattle industry', *Plant Protection Quarterly*, vol. 9, pp. 73–6.





Animals

Parthenium weed is also toxic to animals. It can cause:

- dermatitis with pronounced skin lesions on all animals including horses and cattle
- mouth ulcers with excessive salivation if eaten
- eye irritation in working dogs
- loss of condition in farm animals
- death due to rupturing and haemorrhaging of internal tissues and organs.

Dealing with parthenium weed

Never pull parthenium weed out of the ground with bare hands—not even a single plant! Wear gloves, and remove it in the early morning or late afternoon/early evening when it is cooler. Make sure you remove all of the root system or the plant may regrow from root remnants left behind.

Do not pull the plant out if it is in flower as the disturbance will release pollen. To prevent seeding, spraying with weed killer must be carried out before flowering since weed killer will not kill the seeds once they are set. Protect your face. Wear a lightweight face/dust mask or scarf to prevent particles of parthenium plant getting in your nose and mouth. Face masks for nose and mouth can be purchased in hardware or garden shops and are inexpensive.

Protect your skin. Wear lightweight long-sleeved garments and remove them as soon as possible afterwards. If your skin itches after handling parthenium weed, especially on the face or arms, don't rub it. Instead, wash your face and arms thoroughly in cold water as soon as possible.

If necessary, have a shower afterwards, putting contaminated clothing in a plastic bag for dealing with later. Once they are in the bag, remove them to the laundry—away from living areas. Don't leave any contaminated clothing lying around the shower or bathroom inside the house. Take care when dealing with the contaminated garments that you do not again expose yourself to parthenium particles.

Obviously, if working on land where parthenium weed is present, it is not possible or always practical to cover oneself completely as protection. But the following measures can help:

- In dense parthenium weed growth try to protect at least the face and arms.
- Carry a water supply to wash dust and pollen off the face and arms.
- Shower, and change clothing as soon as possible.
- If you use anti-histamines (e.g. Claratyne® or Teldane®) or breathing medication (e.g. Ventolin®), take them with you. Use as directed immediately you feel any allergic response starting to develop. Since some anti-histamine medications can make you drowsy, it is important to check with a doctor as to which is safest to use for maximum effect, especially if driving or operating machinery.

The best way to prevent an allergic reaction is to AVOID contact.





Declarations and legislation affecting parthenium weed

Parthenium weed is now recognised as a weed of national significance (WONS) and declared noxious in all states of Australia. Parthenium weed is a declared Class 2 pest under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002*.

A person must not supply anything containing seed of parthenium unless they give a written notice (e.g. Weed Hygiene Declaration) to the person being supplied. Examples include fodder, gravel, machinery, mulch, packing material, sand, soil, stock, vehicles and water. Under the Act, a person must take reasonable steps to ensure that a vehicle or anything else transported on a road is free of parthenium seed or, if contaminated, to restrict the escape of seed.

In Queensland under the *Agricultural Standards Act 1994* the sale of commercial pasture and crop seed containing parthenium seed is prohibited.

Under the *New South Wales Noxious Weeds Act 1993*, parthenium weed is categorised as control category W1. The presence of a W1 weed on land must be reported to the local control authority and the weed must be fully and continuously suppressed and destroyed. This Act also contains specific provisions to prevent agricultural machinery entering from Queensland without an inspection for 'notifiable' weeds such as parthenium weed.





▲ Parthenium represents a potential threat to grazing and cropping lands and natural ecosystems across northern and eastern Australia.



▶ Charlie (pictured) and Evon Marks of Winvic, Clermont use flexible grazing management to control parthenium weed.



Managing parthenium weed



Section 2

Managing parthenium weed

Management practices

Management practices can be categorised as follows:

1. Minimising spread
2. Preventing establishment of self-regenerating populations
3. Managing pastures
4. Treating with herbicides
5. Introducing biological control agents.

The key to parthenium weed management is to integrate these practices.

1. Minimising spread

Given current resources, the spread of parthenium seed cannot be prevented absolutely, but every endeavour must be made to minimise it.

Spread at the margins of the core area of infestation is largely due to natural forces. However, humans facilitate long-distance spread or jump dispersal. Parthenium seed is dispersed on machinery, vehicles and livestock; in crop or pasture seed, grain, hay or fodder; and from roadside parthenium weed populations on previously clean vehicles.

To minimise the threat posed by these vectors and sources:

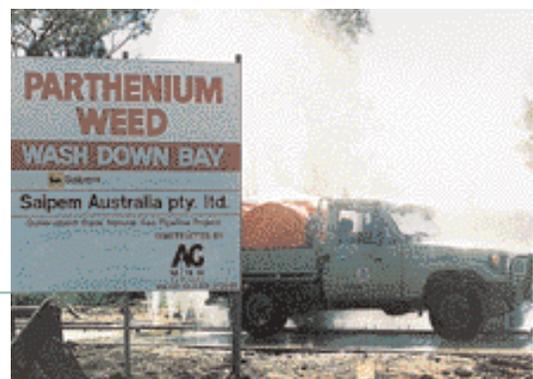
- Check machinery, vehicles and livestock moving onto clean property.
- When moving foreign vehicles and other machinery, only use roadways and tracks that are easily monitored.
- Be certain of the origin of livestock, grain, seed or hay.



▲ Parthenium seed is easily spread by vehicles.



▲ Truck washdown. Vehicles and machinery should be cleaned before leaving country infested with parthenium weed.



▶ Vehicle washdown.

- Drive visitors around in property vehicles.
- Ensure that service provider vehicles (telephone, electricity, gas, railway, etc.) are free of parthenium weed seed.
- Use vehicle and machinery wash-down facilities before leaving country infested with parthenium weed.
- Ensure a Weed Hygiene Declaration is provided when buying crop or pasture seed and livestock.
- Provide a Weed Hygiene Declaration when selling grain, seed or hay and livestock.
- Manage roadside populations.



▲ Parthenium seed can be spread through the movement of hay (above) and livestock (below).

2. Preventing establishment of self-regenerating populations

Once parthenium weed has colonised an area and established a soil seed bank, and new generations are growing, it has become self-regenerating. Every endeavour needs to be made to prevent parthenium weed from establishing self-regenerating populations by:

- creating awareness of parthenium weed
- monitoring stock feeding areas
- managing isolated outbreaks.



▲ Trucking cattle.

Awareness of parthenium weed

Awareness is essential for parthenium weed prevention. Can you recognise parthenium weed, particularly as a seedling?

It is important to monitor areas where foreign vehicles and machinery have travelled. Note that drought movements of livestock and fodder increase the likely spread of parthenium seed.



- ▶ Parthenium weed germinated in manure along with sorghum seedlings.



Stock feeding areas

For easy detection of plants, always feed stock in the same area. Monitor feedlots, chicken pens, stables, horse paddocks and other grain/fodder feeding areas on a frequent and regular basis.

- ▼ A roadside sign alerts travellers to the presence of parthenium weed.



Managing isolated outbreaks

Treat new parthenium weed outbreaks promptly. Do not pull out seeding plants as the disturbance will encourage further germination. Instead, mark the area and spray. Spot-spray isolated outbreaks with a registered residual herbicide and mark sprayed plants with a steel post. Check the site every 21 days or within ten days following rain.



- ▲ A fence line demonstrates the effect of management.





3. Managing pastures

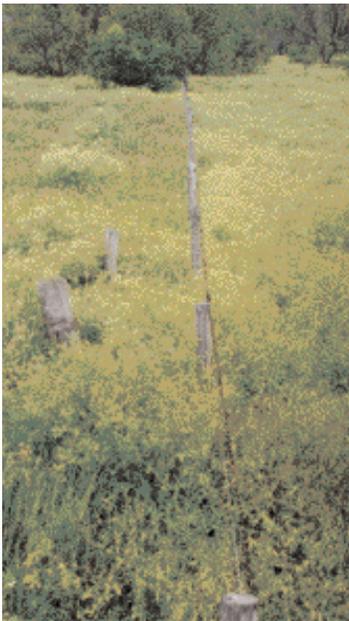
Pastures in good condition suppress parthenium weed. In general, infestations of parthenium weed are a symptom of pasture in poor condition, a problem usually associated with grazing management. Good grazing management will maintain or improve pasture condition, thus increasing resistance to parthenium weed establishment and improving livestock production.

It is important to understand that sustainable land use can only be achieved by eliminating the cause of poor pasture condition, rather than focusing on parthenium weed eradication.

Managing towards achieving healthy, robust, competitive pastures (complemented with biological control agents and strategic herbicide sprays) offers the most effective and productive parthenium weed management option.

Pasture management involves:

- achieving and maintaining pasture competition
- monitoring pasture condition
- understanding grazing pressure
- setting stocking rates
- spelling paddocks
- managing water points
- fencing different land types
- using herbicides strategically.



▲ 1998



▲ 2000



▲ 2002

- ▲ This sequence of photos demonstrates how grazing management restores pasture health, thereby increasing resistance to parthenium weed establishment.



Achieving and maintaining pasture competition

To suppress parthenium weed, maintain healthy, robust, diverse and competitive pastures. Parthenium weed will colonise land that has been put at risk by overgrazing, flood or disturbance. Adopt grazing strategies that assist degraded pastures to repair and become competitive.

Adequate pasture competition can be achieved and maintained by spelling in the growing season with rotational grazing. It is vital that stocking rate and grazing pressure are adjusted within the limits of the pasture.



▲ Parthenium weed establishes where there is little pasture competition.

Monitoring pasture condition

Our memories are typically short and selective so monitoring and recording enable comparisons to be made across seasons. Pasture condition is a statement about the grasses that make up a pasture. It is an assessment of their health and yield as well as ground cover. The desirable, perennial, productive grasses must dominate and produce seed to maintain good condition.

Monitoring assesses the current health of pastures, picks up trends in pasture condition and indicates whether pasture condition is improving or declining. It allows finetuning of grazing management before the competitive edge is lost and before animal production declines. Animal performance slips long after pasture condition starts declining.

Understanding grazing pressure

Grazing pressure indicates how heavily a pasture is grazed. It is measured by how much of the pasture animals have eaten compared with how much pasture was produced that season. In set-stocked paddocks grazing pressure obviously must vary with season.

▼ Healthy pasture.



When grazing pressure is high and prolonged, the desirable, perennial, productive grass component declines. Grass root systems contract, and grass with diminishing roots cannot make maximum use of rainfall. Pasture competition decreases and parthenium weed has room to colonise and begin seed production, rapidly increasing its soil seed bank to very high numbers. Grass is not setting seed and the grass soil seed bank can become very low.

A sensible grazing pressure takes into account the 'body of feed' available, rather than the traditional 'acres per animal' stocking rate. It should ensure that animals do not overgraze, that desirable grasses are setting seed each season, and that pasture use matches seasonal grass production.

Setting stocking rate

Manage for the dry seasons—the wet ones will manage themselves.

Because big wet years inflate the rainfall average, the long-term stocking rate needs to match the pasture that is produced in 70–80 per cent of years. If the wettest 25 per cent of years are discounted from the long-term average, the rainfall effectively *halves*, and so does the amount of grass produced. If stocking rate is set for the average rainfall, overgrazing will happen in 50 per cent of years (the dry ones) and pastures may not have time to recover in better years.



▲ Early growing season rest is vital.

Spelling paddocks

Match the planned rest periods to suit the needs of the pasture plants (not just the animals).

Spelling encourages pastures to improve in condition and re-establish competition. Grasses will redevelop root systems and set seed, replenishing depleted soil seed banks. Grass tussocks can also build up plant reserves, which are essential for vigorous growth.

The first six to eight weeks of the growing season provide the most effective spelling opportunity. Grass is then drawing on stored reserves for new growth and new growth needs time to replenish those plant reserves. Grass roots are also reactivating and seedlings are establishing.

Native grass establishes poorly when parthenium weed is present. Herbicide removal of a generation of parthenium weed will encourage pasture re-establishment during a rest period.

◀ High grazing pressure during drought.





Managing water points

Stock waters are points of constant, very high grazing pressure that commonly have low ground cover and low numbers of grass tussocks, and lack pasture competition. Water points are highly susceptible to parthenium weed and often become seed dispersal areas.

To overcome high grazing pressure points, establish several stock waters per paddock. Rotate stock by alternating water points in use.

Fencing different land types

Achieve better grazing management by fencing properties to land type. Pasture composition is determined by land type. Palatability differences within paddocks lead to uneven grazing pressures, creating potential parthenium-susceptible patches.

Flooded country is very prone to parthenium weed as grass is often killed by floodwaters, which may also be carrying parthenium seed. Flooded pastures need adequate rest from grazing to regain their competitive edge. Cattle may also need to be excluded to prevent parthenium seed spread.

Using herbicides strategically

Spraying pasture with herbicide can be useful. Eliminating annual weeds (including parthenium weed) provides extra water and nutrients for grass, encouraging seed production and grass establishment. It allows grasses to maximise seed production and gives grass seedlings a greater chance of survival.

- ▶ Spraying weeds in pasture reduces competition, giving grasses greater access to moisture.

4. Treating with herbicides

Selective herbicide use is another option for the control of parthenium weed. Stop the development of self-regenerating populations by treating small or isolated infestations of parthenium weed immediately.

Application of herbicides

All herbicides must be registered and applied strictly in accordance with the directions on the label—material safety data sheets should be consulted. Several applications per season may be necessary to prevent further seed production. Monitor the sprayed areas for at least two years and record the effects of the spraying on pasture.

A common strategy is to spray with a registered pre-mix of knockdown and residual herbicide, controlling existing parthenium weed plants and reducing future germination.



Correct application is the key to effective herbicide use. Timing and weather are also critical when spraying parthenium weed. Parthenium weed needs to be young (prior to seeding), with pastures actively growing and seeding. A good profile of soil moisture should be present and air temperature less than 30°C.

Spraying success depends on the environmental conditions on the day (wind, temperature and humidity) and the type, condition and efficiency of spraying equipment. Plant maturity and stress will also influence the outcome—younger parthenium weed plants are easier to kill but they will not take up the herbicide as well when under moisture stress.

For maximum herbicide effect and parthenium weed control, completely wet the plant with the herbicide mix, use wetting agents, and maintain a follow-up program.

- ▼ Boom spraying is a practical way of applying herbicide to large infestations.



5. Introducing biological control agents

The Department of Natural Resources, Mines and Energy began research into the biological control of parthenium weed in 1977. Nine different insect species and two rust fungi have been released.

Current status of biocontrol agents

Zygogramma bicolorata, a leaf-defoliating beetle, is now widespread from Moolayember Dip near Injune to Emerald. It is also found in isolated patches further north.

Listronotus setosipennis, a stem-boring weevil, is established throughout the Comet River system, from Clermont to Springsure and in the Suttor–Bowen river systems. It occurs in isolated patches in the Belyando Shire and the Isaac–Connor river systems.

Smicronyx lutulentus, a seed-feeding weevil, is now established in the Comet River system and north to Clermont.

Epiblema strenuana, a stem-galling moth, is established in all areas.

Bucculatrix parthenica, a leaf-mining moth, is established in all areas.

Conotrachelus albocinereus, a stem-galling weevil, was released in 1998 and 1999. Larvae have been recovered from release sites in the Rolleston district, but it is too early to determine if the insect is established.

Carmenta ithacae, a root-boring moth, was widely released in 1998 and 1999. Larvae have been recovered from release sites at Clermont and Wycarba. As yet, it is too early to determine if the insect is permanently established.





Platphalonidia mystica, a stem-boring moth, and *Stobaera coccina*, a sap-sucking beetle, have not become established.

Puccinia abrupta var. *parthenicola*, the winter rust, has established over a wide area from Clermont south to Injune and around Rockhampton. It is generally more active in the southern region. Sporadic outbreaks occur over the cooler months when rainfall is adequate. Higher temperatures may inhibit its establishment further north.

Puccinia melampodii, the summer rust, was released over a wide area from Injune north to Greenvale between 1999 and 2002. It is now established in most districts. However, recent drought conditions have severely reduced its activity.

- ▼ A newly constructed parthenium biocontrol nursery.



Field collection of biocontrol agents

Field collection and redistribution of biocontrol agents is the most cost-effective way of establishing them in new areas. Community involvement in the field collection and redistribution of biocontrol agents can greatly speed up their overall establishment and spread.

To locate collection sites within your area, contact your local parthenium group officers, your local government weeds inspector or the Department of Natural Resources, Mines and Energy Land Protection Officers.

Nursery sites for biological control

For best results with establishment of agents, a nursery site should be developed. This can be done individually or in collaboration with your neighbours or local Landcare group. A nursery site will provide biocontrol agents with green parthenium weed throughout the growing season. This is particularly important during periods of dry weather when the abundance of agents may decline.

A nursery site can provide agents for collection and redistribution to other areas or act as a reservoir. Where possible, nursery sites should be located close to larger infestations of parthenium weed to help agents disperse.

Nursery sites can be maintained by some form of irrigation or be sited in creek flats, gullies or swampy areas that are kept moist by a natural water source such as a spring.

Do not leave isolated patches of parthenium weed for a nursery site, as they will provide a source of seed for further infestation.



Tips for establishing biological control

Zygotomma can be found on the parthenium leaves and stems. Collect by cutting parthenium plants and placing them in loosely woven chaff bags for transport to the nursery site. Remember not to leave the bags in the sun. Large numbers should be put out at any one site. *Zygotomma* can take a number of years to establish depending on the occurrence of suitable rainfall.



▲ A parthenium plant grown in a nursery for distributing biocontrol.

Listronotus larvae can be found anywhere in the stem, but especially near soil level. It is necessary to pull up the stems to determine whether *Listronotus* is present. The larvae are 'C' shaped and white. Collect entire infested parthenium plants and leave them at a suitable nursery site.

Smicronyx larvae are located in the flowering seed head. To determine whether *Smicronyx* is present, rub the parthenium flower in your gloved hand, and look for the larvae. Collect flower heads or entire plants to leave at a suitable nursery site.

Establish winter rust, *Puccinia abrupta*, by growing cultures under artificially moist conditions and distributing the plants at suitable sites. The nursery should be set up in autumn.

The summer rust, *Puccinia melampodii*, can be established in a similar manner. Nurseries should be functioning during spring and summer.

Epiblema and *Bucculatrix* do not require collection as they have established in all climatically suitable areas.

Conotrachelus albocinereus and *Carmenta ithacae* are not yet present in sufficient numbers to allow for field collection.

Biocontrol agents may fail to establish in some areas, even after well-planned collection and distribution. Repeated releases may be necessary.



▲ Releasing biocontrol agents.



Further information

More information about biocontrol agents, including detailed illustrations, is found in the appendixes.

This information has been reproduced from *Parthenium biological control agents*, a booklet produced in 2003 by the then Department of Natural Resources and Mines, Queensland.



Case studies



Case studies

Strategy development in regional communities: principles and learnings

Judy Atkinson
Chair, Parthenium APEC Team, Blackall

Background

The Southern Queensland Parthenium APEC Strategy (APEC) identifies parthenium awareness, prevention, eradication, containment and coordination as essential for the management of parthenium weed in southern Queensland. Recent years have seen a lot of concern for managing weeds in landcare and catchment groups. At the same time, state and federal funds for weed management activities have become harder to obtain. In response, a Natural Heritage Trust (NHT) funded project (Strategic Pest Management, Queensland Murray–Darling Basin) was developed to assist local government with pest management plans and strategies for the management of high-impact pests within the Queensland Murray–Darling Basin.

A community steering committee was formed to provide direction and advice for the project. Committee members and key decision makers prioritised regional pests to facilitate the development of basin-wide strategies, actions and plans for the high-impact weeds. Parthenium weed was identified as causing most concern and posing the greatest threat to the good quality grazing land and community health of the region.

The APEC team was formed from a small group of volunteers committed to progressing options, providing direction on a course of action, representing the region on parthenium weed issues, and demonstrating awareness and understanding of effective parthenium weed management.

APEC vision

The APEC vision is to prevent parthenium weed from having a major impact on the economic viability, public health and environment of southern Queensland.

APEC strategy

Five goals form the foundation of the APEC strategy. They are:

- Broaden the *awareness and knowledge* of the wider community on the impact of parthenium weed.
- Maximise the *prevention* of new parthenium weed outbreaks.
- Enhance parthenium weed *eradication programs* where realistically and economically achievable.
- Promote and enhance existing and new control measures to maximise the *containment and reduction* of parthenium weed infestations.
- Provide a framework for the *improved coordination* of resources to enhance parthenium weed management.



The experience and learnings of the APEC strategy demonstrate how a diverse community with a common concern can come together to address their problems, communicate a common goal, and influence their future. Following are some of the principles that have been important in the development and implementation of the APEC strategy.

Guiding principles of the APEC group

Find out where the community is and lead it

Finding out where the community is provides the starting point. The APEC team recognised that parthenium weed was not a new problem and that individuals, small groups and government had been trying to address the problem for some time.

‘The community commitment was already there’, says Judy. ‘It was a matter of the APEC team defining what it was, providing support to proceed, and instilling confidence in individuals and groups.’

Processes seeking community change need community leadership—from ‘someone with a passion for the problem’, who can support, encourage and ‘stretch people out of their comfort zone’.

‘It’s important to identify activities that are achievable in the short to medium term.’

According to Judy, ‘People have rights and responsibilities in shaping their future but not always the mechanisms or capabilities to easily participate in the process. Skilled project officers help to bridge that gap.’

The APEC team project officers worked with the different natural energies and abilities of individuals, providing support, encouragement and challenges.

Communicate—it’s fundamental to success

Communication has been the basis for much of the group’s success—developing networks with different groups and organisations, keeping people informed of progress, listening to what people have to say, and making links to other similar groups at local, regional, state and federal levels.

The team took the approach that, where possible, personal contact was far more effective than indirect contact such as writing a generalised letter, media release or newsletter. The face-to-face approach provided two-way interaction, and the personal touch developed confidence, encouraged input into the APEC strategy, and established networks and trust.

‘Without trust, relationships will not develop and progress will be slow to non-existent.’

‘Respect and trust take time to build and minutes to break’ is a philosophy that has been essential to the APEC group’s success.

Address the hard issues

Judy believes that the hard issues about parthenium weed must surface before real progress can be made.

‘Consensus can seem desirable—focusing on what people will agree on, and identifying the easier solutions. But it is usually the areas that people disagree on where the real issues are. Unless these are confronted and resolved, all you leave with is a warm and fuzzy feeling.’



Explore different ideas and concepts

Project proposals need to be simple, realistic and achievable. The APEC team has used people outside their sphere of knowledge and experience to explore different ideas and concepts and to challenge currently held views and attitudes. Their approach has been: learn from others, copy successes and avoid duplicating mistakes.

Identify activities that are achievable using existing resources

The team sought to achieve change by focusing on what is important and can be achieved on a practical basis.

‘It’s important to identify activities that are achievable in the short to medium term. This puts the runs on the board and builds confidence within the community that the APEC strategy does work.’

Recognise achievement

Judy believes it is important to recognise achievement and acknowledge special input.

‘A lot of time and energy input is voluntary. We should celebrate our achievements and say thank you—it costs nothing.’

Develop a profile

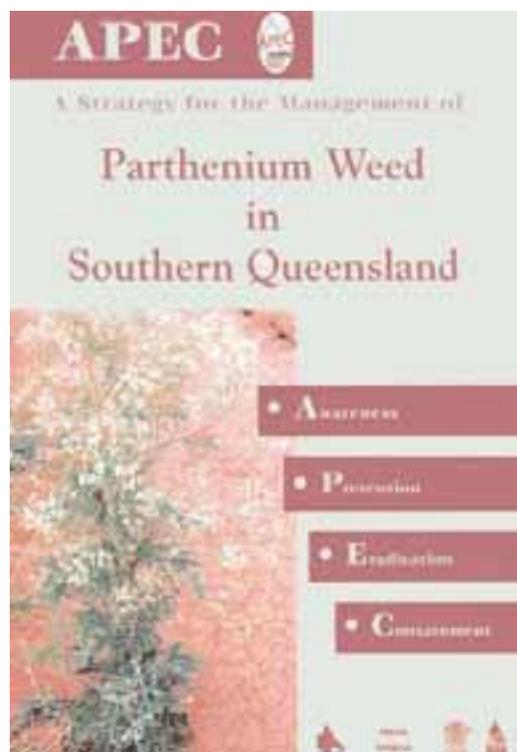
A profile develops from leadership, teamwork and effective communication.

‘Your successes are measured by what a strategy achieves. Successes demonstrate commitment and planning, and make it easier to gain additional assistance in funds and resources.’

‘Market yourselves at every opportunity.’

Final word

‘Common issues motivate individuals and groups. However, to continue to hold that motivation, a sense of being able to achieve goals is important. This is best addressed by being realistic, identifying achievable milestones, continuing to communicate, and maintaining a positive approach.’



▲ Development of this APEC strategy was characterised by broad representation of stakeholder groups, including the neighbouring regions of central Queensland and New South Wales.



Containment lines and buffer zones in grazing lands

Allan Smith, Etheridge Shire Council,
Georgetown
John Chamberlain, Department of Primary
Industries and Fisheries, Clermont

Background

A containment line should not be simply an arbitrary line on a map. It should be a geographical barrier such as a range, which parthenium weed will struggle to cross.

A buffer zone is an area of focused management that does more than just physically distance the threat from the containment line. It is biologically active with competitive pastures—a planned zone possessing all the attributes to hold back the expansion of parthenium weed from the containment line. Planners and managers may have to concede some ground to locate the most appropriate buffer zone.

A successful buffer zone requires successful land management applications. Clearly, the same land management that is practised on the heavily infested parthenium weed areas is incompatible with the required outcome.

Strategies for managing buffer zones

Practice best available pasture management

Healthy, competitive pastures will dominate and exclude parthenium weed. Grass species selection, grazing pressure control, seasonal access, pasture rest and burning schedules must be considered and specific plans put into operation. Fencing some areas may be

necessary to prevent stock from accessing the parthenium-infested areas during seed production. Some cost will be unavoidable.

Design flexibility into stock waters

Water points and the highly disturbed immediate surrounds are typically the most vulnerable areas for parthenium weed infestation. Locating additional watering points in clean areas and preventing stock access to the infested waters will allow grass to repair. Rotating access to waters so that pasture integrity is maintained will be a relatively common management function in a buffer zone.

Map and monitor

Maps need to show current locations of man-made features such as supplement lick sites, water points, tracks and rest areas, stockyards and resting paddocks and roads. These are obvious target areas to monitor in a buffer zone. The accuracy of mapping needs to be constantly audited to ensure that parthenium weed infestation developments are correctly interpreted and timely intervention occurs. Monitoring of data can assist managers in predicting trends.

The key ingredient for the success of a containment line is the 'will of the landholder'



Engage landholders and ensure their commitment

The *key ingredient* for the success of a containment line is the ‘will of the landholder’. Containment measures are only as secure as the least resolute participant in the chain of properties and public lands that comprise the buffer zone. Weak spots have to be strengthened or avoided—a buffer zone does not exist where there is a hole. All stakeholders (including local government and state agencies) must be engaged, consulted and feel that they ‘own’ the containment line. Only then can a buffer zone work.

The *Land Protection (Pest and Stock Route Management) Act 2002* was adopted in Queensland as of 1 July 2003. Importantly, landholders responsible for pest management now include all Queensland government departments.

Final word

Rangeland management in the buffer zone is fundamental to the integrity of a containment line and its ultimate success in grazing lands. It is vital to set the management parameters for the buffer zone in collaboration with the stakeholder landowners who will have to make it work.



Experience with biocontrol agents at Hillside, 1980–2003

Evan Benney
Hillside, Clermont

Background

The following briefly details twenty years of personal experience in using various biocontrol agents in parthenium weed management on a grazing property in Central Queensland. Hillside is a small property near Blair Athol. It is predominantly ironbark and rosewood ridges with blue gum and box creek flats. Parthenium weed has at times taken over the creek flats.

Results of different biocontrols

The first biocontrol agent used on Hillside was *Epiblema* stem-galling moth, collected near Capella in the early part of the 1980s. It retards the growth of parthenium weed and persists well but its population goes down in dry times. The second lot of parthenium weed infested with biocontrol agents was collected from near Rolleston in the early 1990s. The agents included *Zygogramma*, *Listronotus*, *Smicronyx*.

'Summer rust was the best'

Zygogramma leaf-feeding beetle did not perform well and disappeared. Some eventually came back but then disappeared again. *Listronotus* stem-boring weevil retarded and killed parthenium weed and remained until the drought of 2001–03. It has not returned yet but it is a good agent.

Smicronyx seed-feeding weevil infested and damaged the seed heads in all plants. It has persisted well. *Carmenta* root-feeding clearwing moth was started in the late 1990s and did not become established before the drought. In good seasons it may be a good agent.

Winter rust obtained in the mid 1990s killed quite a lot of parthenium weed. However, the drought subsequently wiped out the parthenium weed generally, and so far the rust has not returned.

Summer rust was the best. This was started at Hillside in May 2000. The dried infected parthenium weed leaves came from the Parthenium Action Group which was very helpful with advice and getting it spread around the district. The summer rust devastated parthenium weed all over Hillside and was starting to infect what little weed still existed in August 2003, when the area was still in drought. At that time, irrigation was being used to rebuild the parthenium weed population in an effort to multiply the summer rust.

Final word

'From tests carried out on Hillside I believe that, seasons permitting, biocontrol agents can contribute to parthenium weed control.'



The road we have travelled

*Col Jackson
Chair, Injune and District Parthenium Action
Group, Injune*

Background

In the 1980s and 1990s Injune and district landholders with parthenium weed on their properties were facing economic, environmental and social issues:

- *Economic.* A lot of money and time was being spent on chemical control that was not proving effective, and other property work was not getting done.
- *Environmental.* Parthenium weed was competing with native and introduced pastures and there was concern about chemical use and its effect on local ecosystems.
- *Social.* Time and energy were being put into control measures that were not proving effective, aggravating a feeling of hopelessness about being able to manage the problem. There was also the risk of long-term health effects, the animosity from surrounding landholders, the stigma attached to having parthenium weed, and the potential marketing problems.

‘We realised that parthenium weed in the Injune District was a problem of a scale and nature that could not be handled on an individual basis’, says Col. To address the problem on a larger scale, the Injune and District Parthenium Action Group was formed in 1999.

Based on current parthenium weed best management practice and available research

information, an action plan was drawn up outlining how the group would deal with parthenium weed.

Vision of the group

A region proactively managing parthenium weed was the vision that the Injune and District Parthenium Action Group set itself. This is being achieved through the following strategies:

- Minimise spread of parthenium weed in the local area and neighbouring catchments.
- Establish local facilities to propagate and release biocontrol agents.
- Assist landholders to undertake integrated control measures.
- Establish locally applicable best management practices.

Key management practices

Management practices and approaches promoted by the group include the following:

- Ensure a good coverage of pastures, providing competition for parthenium weed.
- Wash down vehicles and machinery that may have driven through parthenium weed.
- Maintain a clean holding paddock for cattle that are being sent away.
- Keep roads free of parthenium weed.
- Acknowledge that feral animals may spread parthenium seed.
- Be conscious of the risks when importing feed and seed.
- Realise that parthenium seed can be transported on footwear and clothing.

- Communicate with the community about identifying and managing parthenium weed.
- Get involved with other people in groups to pool resources and knowledge.
- Know what parthenium weed looks like and deal with it early.

Funding

The Injune and District Parthenium Action Group has attracted significant funding. It received an initial \$12 700 Landcare grant in 1999, and since then has received additional support.

The then Department of Natural Resources and Mines committed \$15 000 of Drought Regional Initiative funding to implement the group's Straddle the Saddle action plan in 2000, and Bungil and Booringa shires each committed \$20 000 per year for three years to support a project officer. This funding has made it possible to establish local facilities to propagate and release biocontrol agents, and has assisted landholders to undertake integrated control measures.

'We realised that parthenium weed in the Injune District was a problem that could not be handled on an individual basis'

Taroom Shire and Oil Company of Australia have each donated \$5000 towards the biocontrol project and in 2002 the Queensland Murray–Darling Basin presented \$55 000 of WONS (weeds of national significance) funding for biocontrol over two years.

Successes

The parthenium group is justifiably proud of its achievements.

'We have implemented Straddle the Saddle action plan for dealing with parthenium weed in the district and the Injune wash-down facility was opened in 2000. We have also built two sets of growth tunnels to mass-rear biocontrols, installed irrigation for mass-rearing and employed a project officer.'

The group's achievements have been presented at the state Landcare conference, Goondiwindi in 2001; at a parthenium weed information day in South Queensland in 2002; and at the regional Landcare forum in Roma in 2002.

As well as being a finalist in the Department of Primary Industries and Fisheries achievement awards (Rural Community Achievement) in 2002, the group featured on the front cover of a 2002 Telstra phone book and was filmed for a Queensland Murray–Darling Basin Landcare promotional video.

The future in parthenium weed management

Col believes that the future of parthenium weed management lies in using biocontrol agents and grazing management.

'We need to continue mass-rearing biocontrols so that they can be adequately tested, distribute biocontrols widely enough so that mass-rearing is no longer necessary, and develop a broader knowledge of pasture and grazing management.'



Final word

'The group wants to ensure that parthenium weed is no longer a significant issue for Injune and the district. But we are also looking beyond parthenium to other ecological issues that affect sustainability.'



▲ A dense infestation of parthenium weed.



Discovering new approaches to parthenium management

*Dougal and Judy Atkinson
Lisburne, Blackall*

Background

The 26 300 ha property, Lisburne, is half bendee/mulga country and half gidgee/boree with coolibah channels in the upper Bulloo River catchment. Parthenium weed has been present in gidgee country on Lisburne since 1984, at that time covering about 16 ha.

Spraying parthenium weed with Atrazine and 2,4-D began very soon after it was detected. In 1987 Blackall Shire graded tracks for better access for spraying and in 1988 became involved in the spraying program across several neighbouring properties. Major spray campaigns were carried out in 1998, 1999 and 2000 with substantial contributions from Blackall Shire, Tambo and Quilpie shires and the then Department of Natural Resources. Despite these ongoing and well-committed efforts, parthenium weed on Lisburne now extends over 1000 ha as large patches and scattered plants.

According to Judy, 'We realised that spraying was not working—parthenium was still spreading on Lisburne and elsewhere but we didn't know what else to do about it. Spraying actually seemed to be taking out most pasture competition and leaving denuded patches, allowing parthenium to establish more easily.'

Changing attitudes

Dougal and Judy started to look at things differently after a visit in 1999 by Scott Dearden, then a Parthenium Action Group project officer, and Department of Primary Industries and Fisheries beef extension officer, John Chamberlain. Pasture management options were discussed.

'Basically, we identified that what we were doing was not the only way and that we needed to look at other options. It became obvious we needed competition so that parthenium would not always be the first thing away.'

A pasture management field day and two-day workshop in 2001, co-funded by Blackall Shire Council and the Queensland Weed Society, further highlighted the benefits of managing pastures.

'The focus was on *managing for what you want, not just what you've got*. It opened a door for many and reinforced our own thinking.'

Meeting and talking with others who are dealing with parthenium weed has contributed significantly to the change in their approach.

'Knowing where to get assistance and having a good rapport with people who can help is important. So is knowing how the government and department systems work.'





Impact of drought

Drought has also impacted significantly on Lisburne and on the Atkinsons' thinking about future management options on their property.

'Drought over two plus years has had the country in a terrible state, with no energy or reserves, and we need to give it an opportunity to come away, recover and be strong.'

Lisburne, normally carrying 7000–8000 sheep and 200–300 cattle, was virtually destocked in 2003, yet kangaroos were present in large numbers.

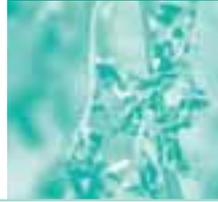
'We put in permanent waters and now we have permanent kangaroo populations. They are a real barrier to our implementing grazing strategies and will have a major impact on pasture recovery when it eventually rains.'

'The focus needs to be on managing for what you want, not just what you've got'



▲ Managing for healthy pastures rather than simply fighting parthenium weed has been a helpful emphasis for many landholders.





Biocontrol agents

Biocontrol agents have not yet been trialed in the drier 450 mm rainfall environment. However, the Atkinsons now have greenhouses and are collecting biocontrol agents from the Injune group to establish colonies for local release when weather conditions are suitable.

Government regulation

Dougal and Judy feel that government policy is impacting significantly on the available development decisions and the management of parthenium weed in a productive grazing system.

‘We have identified pasture management as the main tool in the management of parthenium and we know we need to spell country. We acknowledge the need to put in more fences and waters to rotate grazing but face the problem of not being allowed to develop country so we can run adequate livestock, spell paddocks and still make a living.’

Judy poses the question: ‘Is it wise pursuing something that is so uncertain? We are genuinely concerned as to what our future as graziers holds and also that we are given no credit for being responsible land managers’.

Final word

‘If you have a closed mind and don’t look at other options you will miss opportunities.’

Comment

Damian Byrne

Department of Natural Resources, Mines and Energy, Blackall

According to Damian, who coordinated the major spraying campaigns in the area, turning the corner and changing attitudes was a difficult step.

‘However, I have realised that the change from spray campaigns to addressing pasture competition and grazing management was inevitable. I’m sure that landholders and others involved are glad that they gave spraying their best shot as they now have the peace of mind of knowing they gave it their all.’

He acknowledges that the very high kangaroo populations are harsh on pastures, greatly compounding the problem of managing pastures and parthenium weed.

‘Fencing off infestations has had the desired effect of increasing grass cover. However, the extra feed attracted kangaroos. Their impact has been to spread parthenium seed beyond the fence. There is no easy solution.’





Getting in early—before parthenium establishes core infestations

*Jeff Campbell
Chair, Mitchell and District Landcare Group,
Currawarra, Mitchell*

Background

Parthenium weed has been moving slowly down the Maranoa catchment from the clay soils of the Merrivale River where it has been established for 20 years. Currawarra is at the downstream end of the main infestation.

The Mitchell and District Landcare Group includes 11 adjoining properties along 90 km of the Maranoa River upstream of Mitchell to Currawarra. As dominantly sandy box and cypress pine, this stretch of country presents a natural barrier to parthenium weed—almost the only place where it establishes is in silt deposits on the river bends. The landcare group realised that this gave them an opportunity to locate and treat plants relatively simply, and so slow the advance of parthenium down the catchment.

‘Where we can lock up the river to restrict and manage grazing, we are getting much less parthenium’

Management initiatives

In 2000 the National Heritage Trust funded a three-year project to fence out the river and place waters off-stream so that the riparian area could be managed. To 2003, 80–90 per cent of the Maranoa River from Currawarra to Mitchell had been fenced. Under WONS funding, tracks were graded for better access in 2003.

To avoid large-scale spraying in the river country, the group is treating isolated parthenium weed plants in silt patches but not blanket spraying the large patches upstream. Access is a problem when the river runs and some of the parthenium weed can seed before it is sprayed.

Spraying is carried out 6–7 times a year with 6–7 men per time. Using Toyotas, four-wheeler bikes with spray gear and men on horses spotting plants, the 90 km can be done in two days. The Booringa Shire assists with manpower and vehicles as well as providing and mixing herbicide for re-supply of the sprayers.

‘Where we can lock up the river to restrict and manage grazing, we are getting much less parthenium than where the banks are open to grazing. The increased grass growth is also making parthenium difficult to find. We have been tempted to burn river bank grass to improve visibility but as yet have resisted the temptation.’



According to Jeff, 'We are slowing parthenium down and that gives us time to get our house in order with pastures, both in the riparian area and elsewhere. This is a management approach—getting in early before the parthenium establishes a core infestation.'

In general, they feel the approach is working.

Final word

'Our group benefits from working and socialising together as well as from improved grazing management. Many are now rotation grazing to strengthen perennial native grasses.'

Integrated approaches: the key to managing parthenium

Howard Smith and Gail Godwin-Smith
Mt Panorama, Rolleston

Background

Mt Panorama is an 8100 ha property 10 km south of Rolleston, central Queensland, with the Carnarvon Ranges as a backdrop. Situated in a 650 mm rainfall area, it comprises 5600 ha of scrub country and 2500 ha of alluvial soil. When the Smith family purchased Mt Panorama in 1988, it was heavily infested with parthenium weed. This was at a time when little was known about control and management strategies.

By 2003, the property has its parthenium weed problem well under control. According to Gail, 'It has been a process of trial and error, putting strategies into place and adopting management practices that minimise the impact of parthenium weed'.

Key management strategies

Blade plough and sow buffel

Sucker country was blade ploughed to control woody weeds and at the same time sown to buffel and silk, both aggressive and vigorous pastures identified as competitors for parthenium weed. Howard used silk as a pioneer species that establishes rapidly—the idea being to out-compete the parthenium'.

In the early stages of property development, Alley® herbicide was applied after blade ploughing to reduce parthenium weed, which

was abundant after soil disturbance. This allowed the buffel and silk to establish.

'We use parthenium as an indicator—if parthenium is becoming aggressive in pastures, we need to look at what we are doing in relation to management.'



▲ The presence of parthenium weed together with sparse pasture in this research plot points to overgrazing.



Fence to land type and put waters off-stream

The Smiths obtained comprehensive mapping identifying specific soil and land types from Queensland Government departments, and fenced accordingly.

‘Fencing gives us greater control of how grazing occurs; where, when and for how long.’

In addition they established strategic watering points within paddocks and also off-stream. This encourages cattle to spread out, ensuring more even grazing. It also minimises soil disturbance at existing watering points, thus reducing weed impacts.

Stocking rates were adjusted in line with seasonal conditions and rotation-grazing practices were adopted to ensure even grazing of pastures.

Encourage biocontrol agents

In the early 1990s the Smiths worked with researchers from the Tropical Weeds Research Centre, Charters Towers and the Allan Fletcher Research Station, Brisbane. Numerous biological control agents were released and their progress monitored and recorded over several years. There were a number of successes and these agents have played a vital role in parthenium weed control on the property.

The most effective has been the leaf-feeding beetle *Zygogramma bicolorata*.

‘The beetles stripped the parthenium plant to a point that only the stalk remained, causing the plant to shut down. This allowed other competitive species such as buffel to establish and eventually out-compete the parthenium.’

Summer rust, the seed-feeding weevil *Smicronyx lutulentus*, the stem-boring weevil *Listronotus setosipennis*, and the stem-galling moth *Epiblema strenuana* have also contributed.

With the forming of the Parthenium Action Group in the mid 1990s, trial sites were established and supported on Mt Panorama, and field days were held to enable the transfer of information to the broader community. Property managers with parthenium weed infestations came to collect biocontrol agents to establish them on their own properties.

The Smiths acknowledge that the biocontrol agents have played a significant role in reducing the impact of parthenium weed on Mt Panorama. However, they point out that these agents are not the ‘silver bullet’ for parthenium weed eradication and control.

‘Rather, they play an important and crucial role in the overall management of parthenium weed and, used in conjunction with best management practices, are a very efficient and cost-effective way of achieving results.’





Make use of parthenium weed as an indicator species

By the mid 1990s the Smiths could see ‘the light at the end of the tunnel’ in managing parthenium weed on their property.

‘Even with the adoption of best management practices, it will be impossible to totally eradicate parthenium weed’, Howard admits. However, they are finding it can be useful as an indicator.

‘Overgrazing is a common reason for parthenium to establish. So if parthenium is becoming aggressive in pastures, we know we need to look at what we are doing in relation to management.’

Howard monitors paddocks, taking into account seasonal conditions, to ensure that over-grazing does not occur. During the growing season, paddocks are spelled to enable aggressive pastures such as buffel to out-compete weeds.

Embrace minimum till farming practices

Farming was established on the most productive areas of Mt Panorama and now comprises approximately 1620 ha. In the mid 1990s the Smiths embraced minimum till farming. Minimal till practices minimise soil disturbance, and use herbicides applied by boom spray to control weeds rather than ploughing the conventional way.

‘Minimal till drastically reduces the possibility of parthenium contamination in grain crops grown on Mt Panorama, as well as reducing the risk of weed seed spread. Today, parthenium weed is not a problem on our farming country.’

Avoid complacency

Howard and Gail continue to look for innovative ways of managing their property, including parthenium weed management, in a sustainable way.

‘It’s important that we do not become complacent when dealing with parthenium. We are committed to implementing practices to ensure long-term success with parthenium weed management and to sharing these with others.’

Final word

‘There are always ways to achieve better outcomes and, while we have come a long way with how we manage parthenium weed, we believe that a focus on integrated management practices is the key to controlling the problem.’



Grazing pressure and rest—key factors in managing parthenium

*Hugo and Shona Spooner
Avocet, Springsure*

Avocet is undulating to hilly with light sandy loam to heavy clay soils. It has a mix of box, lancewood, wattle, brigalow and downs country best suited to store cattle production.

Hugo's parents emigrated from East Africa to take up the 4600 ha Avocet in 1957. Hugo completed his tertiary education at Queensland Agricultural College (Gatton) in 1968 and opted to work off-farm on a number of cattle holdings to broaden his experience over the next five years.

Hugo, Shona and three daughters all share an interest in the property venture. They have adopted innovative stock and land management concepts in an endeavour to manage parthenium weed and with a desire to enhance environmental diversity on Avocet.

Avocet was subjected to severe drought in the late 1960s, mid 1970s and early 1980s. Continuous stocking was severely degrading the country with its light carrying capacity, and by the late 1970s the double frontage to Sandhurst Creek and the downs country was overrun with a heavy parthenium weed infestation.

Key management strategies

Stock for the drier years

When Hugo took on the management role, he opted for a major change in philosophy to halt the pasture degradation and productivity decline.

With the 1986 drought imminent, Hugo decided not to drought feed and aggravate the degradation. Instead, the herd, including 450 breeders, was reduced by 30 per cent, with the intention of rebuilding numbers when the situation improved.

'Lower stocking (grazing) pressure resulted in a 15 per cent fertility increase, a reduction in store steer turn-off age of 12 months, an improved profit bottom line, and increasing control of parthenium infestations. This conservative stocking rate has been adopted as a permanent measure.'

'We have not survival fed in drought since, just used dry season supplements. In wetter, better years, we avoid the temptation of breeder herd build-up.'

'However, Avocet and its pastures are still vulnerable. Parthenium seed is still present, and we cannot afford to relax or make a mistake.'

'We avoid the temptation of breeder herd build-up in wetter, better years'



Rest pastures after the first good rains, when grass is germinating and seeding

Avocet's Sandhurst Creek frontages were always grazed preferentially on the first rains. Pastures were severely overgrazed and grass seed reserves became depleted. Unstable creek banks became infested with dense parthenium weed.

'We needed to have the capacity to totally exclude grazing animals when the grass is germinating and seeding. Our option was to fence creek frontages out and provide off-stream waters, allowing pastures a total rest for a minimum of eight weeks in the growing season (September to March) after the first good rains.'

Creek bank pastures are now productive and competitive with parthenium weed under control. The grass seed reserves are replenished and the frontage ecosystems are improving.

They are aware, however, that parthenium seed is still coming from upstream, and that late (May) rain will produce parthenium seedlings in a non-competitive environment when the grass is dormant and biologically inactive.

Graze pastures rotationally

In March 1998 Avocet bluegrass downs pastures were in poor condition with severe parthenium weed infestation. Run-off was high with accelerated erosion and poor production.

'Our option was to enforce pasture rest by rotating grazing. However, rotational grazing with big numbers in small paddocks needs

precise management. The cattle need to be moved early (rather than late) as one day can make an enormous difference in sensitive country.'

By March 2002 there was a return to bluegrass dominance and productive grazing, with ground cover high and parthenium weed under control.

Actively encourage parthenium weed biological agents

In the Spooners' experience on Avocet, *Epiblema* gall moth has the biggest impact on isolated outbreaks, and builds up over 10 years. *Zygogramma* beetle is most effective in creeks.

However, they feel that until improved grazing management has a positive impact on pastures, biocontrol agents have a limited effect.

Final word

'Grazing management *must* be the priority—pastures need rest when grass is germinating and seeding.'





Flexibility in grazing management to accommodate parthenium

*Charlie and Evon Marks
Winvic, Clermont*

Background

Winvic, a 2675 ha ballot block in the Kilcummin subdivision, was drawn in 1957 by Charlie's father. An additional area, Yidney, was granted in 1968, bringing the total area to 4575 ha. Charlie and Evon took over Winvic in 1983.

Winvic is 70 per cent heavy black soil downs country, which by the late 1970s had developed a serious parthenium weed problem. The balance is pulled gidgee scrub country with buffel grass. The property runs a beef breeding and finishing enterprise as well as 600 ha of cultivation for grain and forage cropping.

Charlie admits that they used to 'hammer' their downs country native grasses with constant grazing at set stocking rates.

'Yet, at that time our only weed problems were native ones like jute and rosella. It wasn't until we recognised and accepted parthenium as a management problem did we realise our perennial pastures were deteriorating.'

Key management strategies

Spray herbicides when you know grass seedlings will establish

Charlie's first reaction to parthenium weed was to spray with herbicides. However, 'we

largely wasted our time because we were not thinking about why the parthenium was there and what would replace it', though spraying 'hot spots' (such as around waters) helped contain the spread of parthenium seed.

When one spraying program happened to coincide with the beginning of the wet season, they found that grass seedlings were able to establish and replace parthenium weed. After that, their policy was to spray when they knew seedling grass would establish and replace parthenium weed, and to keep the area destocked until the new grass seeded.

Keep pastures in good order

Charlie acknowledges that parthenium weed will only establish where it has room.

'Keeping pastures in good order reduces the opportunities for parthenium. Spraying is not an option over large areas or in rough country, so it is all the more important to maintain healthy native pasture.'

'Our desirable native grasses need 500 to 700 mm of rain per year to perform, and then parthenium finds it difficult to establish.'

Along with better than average seasons, biocontrol agents have greatly benefited Winvic pastures in recent years. Charlie believes that parthenium weed is more likely to build up in drier years when the grass and the biocontrol agents are depleted.





Accommodating parthenium weed in the grazing system has meant introducing some flexibility in stocking rate and grazing management on Winvic.

‘Our overall stocking rate has reduced by a third compared to 30 years ago. Now we might have the cattle in for half the time but at double the numbers. We are using paddocks for shorter periods with heavier stocking rates.’

‘It wasn’t until we recognised and accepted parthenium as a management problem did we realise our perennial pastures were deteriorating.’

Spell in the growing season

When the season breaks the Marks destock as much country as possible to let it rest, grass up, and allow seed bank build-up. They can then be confident that when perennial pastures are depleted by the next drought, the seed bank is there for quick pasture recovery.

Charlie regards growing season rest as essential in keeping pastures healthy and acknowledges the great impact it can have.

‘Until we spelled paddocks we never saw king bluegrass [*Dichanthium queenslandicum*]. My conclusion is that even at constant light stocking, king bluegrass will be grazed out. It is preferred grazing and its seed bank simply runs out.’

Another benefit of growing season rest is the change in proportion of desirable to undesirable native perennial grasses.

‘Continuous grazing allows the less desirable grasses to produce seed and build a seed bank. By comparison, the desirable grasses are eaten, produce little seed and their seed bank runs down.’

‘King bluegrass is a good example. When it is allowed to accumulate a seed bank, its population builds quickly as its seedling establishment is better than any other grass on downs country.’

Maintain ground cover

Charlie considers ground cover important for moisture retention and grass seedling establishment.

‘However, once the grass has seeded and we have the essentials—good seed bank and ground cover—we don’t mind eating it down. For every kilogram of grass they eat, cattle trample a few more and that’s ground cover.’

The dramatic effect of ground cover on temperatures of downs soil has been measured on Winvic. A temperature probe recorded over 60°C in the top 2 cm of bare black soil; under good cover it was 20°C cooler.

‘What is the fate of grass seed in the soil at such high temperatures? Without cover wet black soils will crust in 24 hours. No seedling can cope with that.’

Final word

‘Bluegrasses evolved over many thousands of years and are well adapted for survival on our difficult soils in this harsh environment. What nature put there, nature will put back if we give it a hand.’



Parthenium behaviour in north-west Queensland

John Chamberlain
Department of Primary Industries and
Fisheries, Clermont

Background

Parthenium weed has been present in the Gulf Plains in north-west Queensland since 1988 and in the Highlands since about 2000. It has spread very little (if at all) from the initial infestations and is affecting a negligible area.

Parthenium weed has an apparent aversion to germinating and establishing in high temperatures. On the Highlands it prefers the shelter of mimosa bushes (*Acacia farnesiana*) in which to germinate and grow, and on the Gulf Plains it is not favoured by extended periods when soils are waterlogged/saturated.

The north-west Queensland environment has a well defined wet season with very high temperatures and prolonged rainfall. The probability of 'out of season' rain when temperatures are more favourable for parthenium weed to establish is low.

The native (and exotic) grasses are well adapted to these monsoonal conditions. They respond rapidly to monsoon rains and very quickly become extremely competitive in the wet season.

In north-west Queensland parthenium weed is currently not under any pressure from biocontrol agents.

Key management strategies for the north-west Highlands

Fence parthenium weed out with a good downstream/down-slope buffer

Wet season rest will be the means to managing parthenium weed in this monsoonal environment. Fencing to control livestock access will allow the native (and exotic) grasses to respond rapidly to monsoon rains without grazing pressure, very quickly out-competing any parthenium germinating in this unfavourable (for parthenium weed) season.

The pasture rest will also build up a grass bulk to filter downstream/down-slope seed movement. If fenced well down from the infestation, the grass should provide a buffer that confines parthenium seed movement to the 'quarantine' paddock.

Parthenium weed prefers the better, soft country soils in the Highlands. These soils only occur in the narrow valley bottoms, restricting the extent of parthenium weed colonisation but also creating difficulty in scouting for infestations in the fragmented landscape of the Highlands. The exact extent of parthenium weed infestation is uncertain. Fencing well beyond the known infestation boundaries will encourage a fair degree of confidence in quarantining the outbreak.

Fencing out a few thousand hectares in this region of large holdings will not be a great sacrifice and may serve well as a holding paddock if close enough to yards.



Cattle movement would be strictly one-way—through *to* the yards only. Any seed movement should then be restricted in the direction of the yards. Cattle moving away *from* the yards would avoid the ‘quarantine’ paddock.

Treat roads/tracks traversing the ‘quarantined’ area with herbicides

Spraying the roads and property tracks that necessarily traverse the ‘quarantine’ paddock as per NRM&E roadside spraying protocols will reduce the possibility of seed spread via traffic.

Close off access to parthenium weed outbreaks (with appropriate signage)

Restricting vehicle access to the actual infestations will limit the possibility of seed spread via this very common means. Appropriate signage will hopefully encourage compliance.

Introduce biocontrol agents

The biocontrol agents that need hot humid conditions for best effect should have a major impact in this environment.

Key management strategies for the Gulf Plains

Treat known infestations with herbicides atrazine and 2,4-D

The known infestations are accessible in the wet season when parthenium weed will be germinating. Early wet season application of atrazine and 2,4-D will remove a generation of seedlings and provide a residual effect for some months until the later wet season. Any parthenium weed appearing in the late wet season can be controlled with Brushhoff®.

Patrol rivers for further infestations

Although anecdotal evidence suggests no downstream movement, a thorough check should be made.

Close off access to outbreaks (with appropriate signage)

Restricting vehicle access to the actual infestations will limit the possibility of seed spread via this very common means. Appropriate signage will hopefully encourage compliance.

Introduce biocontrol agents

The biocontrol agents that need hot humid conditions for best effect should have a major impact in this environment.



Parthenium in the Northern Territory: a brief history

*Alice Beilby
Department of Infrastructure, Planning and
Environment, Katherine*

Background

Parthenium weed was first recorded in the Northern Territory in the early 1970s on Elsey Station 120 km south of Katherine. Control was attempted but lack of resources, poor wet season access, and limited knowledge of parthenium weed were all reported as stumbling blocks.

In the late 1970s, the seriousness of the problem was recognised, leading to the establishment of what is now known as the Weed Management Branch of the Department of Primary Industries and Fisheries.

Management efforts

Concerted efforts have successfully eradicated parthenium weed on Elsey Station. By 1998 none had been recorded for over seven years and it was declared eradicated. Sporadic outbreaks of parthenium weed on rural blocks around Katherine during the 1980s and 1990s have been detected early and successfully treated.

In 2001 two outbreaks of parthenium weed were detected in the Northern Territory Gulf country.

On the Carpentaria Highway near Borroloola, two plants had established on cracking black soil about a metre off the bitumen and were reported to the District Weed Officer at Borroloola by a station manager droving cattle. One plant had seeded and the other plant was about 8 cm in height with no seed formed.

As tourist vehicles from Queensland were suspected as responsible for the seed transport, all boat ramps, camp grounds and roadsides in the Borroloola area were monitored for parthenium weed.

At Limen Bight Fishing Camp, north of Borroloola, approximately 55 parthenium weed plants were found with 20 already seeded. The area, near a tap in the middle of the campground, covered 5 sq m. All plants (average height 60 cm) were hand pulled and the ground treated with Brushoff® at 20 g/100 L.

Again, it is assumed the source of entry was through Queensland. The nearest known self-regenerating parthenium weed population is located near the Gregory River Hotel in the Gulf country north of Cloncurry.

**'Concerted efforts have
successfully eradicated
parthenium on Elsey Station'**



Implications of parthenium in Queensland's Channel Country

*John Chamberlain, Department of Primary Industries and Fisheries, Clermont
Jenny Milson and David Phelps, Department of Primary Industries and Fisheries, Longreach
Michael Jeffery, Department of Primary Industries and Fisheries, Charleville
Damian Byrne, Department of Natural Resources, Mines and Energy, Blackall*

Overview

Parthenium weed grows best on alkaline clay soils so is unlikely to be a problem in spinifex, mulga or sand dune country. However, it has already established self-regenerating populations in gidgee country in the upper Bulloo River catchment. It also has the potential to grow in the inter-tussock spaces in Mitchell grass and on clay soils within the Channel Country.

Parthenium weed outbreaks currently occur close to the Barcoo River catchment near Blackall and have recently occurred near the Thomson River south of Longreach—both in the Cooper Creek catchment. They are under active control programs.

Tourism, imports of drought feed, restocking, and machinery transport during and after drought all increase the risk of parthenium seed imports.

Landscapes potentially at greatest risk

Alluvial flooded ecosystems with enormous drying margins are potentially most at risk from parthenium weed establishment. These landscapes are all on alkaline cracking clay soils and include:

- floodplains of the Thomson, Barcoo, Upper Diamantina, Upper Georgina rivers and major tributaries which experience one to four weeks inundation
- lower floodplains and ephemeral lakes of Cooper Creek downstream from Windorah, the Diamantina downstream from Brighton Downs, and the Georgina downstream from Marion Downs—these experience up to six months inundation
- internal draining local catchments—clay bottoms between sand hills.

Parthenium weed in the flooded Channel Country landscapes

Currently, the drying margins of floodplains, ephemeral lakes and internal draining catchments all grow annual herbaceous plants such as sesbania pea bush. Parthenium weed is also an annual herbaceous plant and could well occupy this huge niche, potentially with major impacts. While floodplains do contain some perennial plants, annuals dominate and there are scalded areas exposed to potential parthenium weed colonisation.

Parthenium seed germinates very quickly, peaking only four days after rain. This gives



parthenium weed a competitive edge over slower germinating plants. The speed of germination of the estimated 250 annual species in the Channel Country is unknown. Some annuals in the Channel Country actually need inundation to start the germination process whilst parthenium weed does not—50 to 100 mm of rain will start parthenium germination.

Parthenium weed appears to have some aversion to establishing in the high ambient and soil temperatures of summer. However, winter rain in more southern areas which naturally produce annual herbage could also produce parthenium weed if seed was there and viable.

In the monsoon heat of north-west Queensland, parthenium weed appears to prefer the shelter of shrubs such as mimosa bush in which to establish. Woody weeds like prickly acacia, mesquite and parkinsonia may well provide that niche in the Channel Country.

Bore drains, both from capped bores and those in use, are highly disturbed and would provide ideal parthenium germination sites. Bore drains are also often used as drought feed-out sites, multiplying the danger of the possible import of parthenium seed.

Implications

If not recognised and treated quickly, it is highly likely that parthenium weed will grow and have large impacts in alluvial flooded landscapes. It is already in the Barcoo and Thomson catchments, and threatening to move down to the Cooper Creek channels.

Parthenium weed awareness is essential because in this vast landscape outbreaks will be discovered largely by chance. Parthenium weed recognition is imperative.

Early reporting of parthenium weed is also vital if intervention is to prevent outbreaks from producing seed and growing new plants from the seed bank. Eradication becomes virtually impossible once a self-regenerating population becomes established.

Seed spread in the alluvial flooded ecosystems will be by water and could well be aided and abetted by feral pigs. They can transport seed over large distances and will also create mass germination sites through their gross soil disturbance. Dust storms and water birds could also disperse parthenium weed seed.

The beef industry in the Channel Country is building a 'clean, green' image. The presence of parthenium weed would impact on both the environment and the beef industry, with implications and issues involving control options and grazing management.

Knowledge gaps

The following are gaps in knowledge about parthenium weed in the context of the Channel Country:

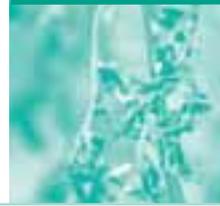
- parthenium seed survival in flooded ecosystems
- germination times—when parthenium weed would germinate best
- germination conditions—flood/rainfall
- germination rate of native annuals
- potential competitors
- speed of the infestation's forward movement





- soil salt levels differ between catchments (Cooper < Diamantina < Georgina) and the implications
- tolerance/sensitivity of parthenium weed to salinity
- soil physical limitations to parthenium germination, e.g. coarse surface texture
- soil temperature effects on parthenium seed survival, germination and desiccation
- impact and survival of biocontrol agents
- burning—impacts for parthenium weed.





Dealing with parthenium in southern inland Queensland

*Craig Hunter
Department of Natural Resources, Mines and
Energy, Dalby*

Background

Outbreaks of parthenium weed are occurring on roadsides and on properties throughout southern inland Queensland. The majority of these can be attributed to contaminated items travelling on roads and being brought onto properties.

Sometimes the parthenium weed seed falls close to a property house, so it is noticed and quickly identified. In other situations, the seed falls off in isolated parts of properties where it may not be identified as an infestation for a few seasons.

In this region the community are aware that parthenium weed is a problem but few have seen it first-hand. This has been identified as a major limiting factor in eradicating parthenium weed. It is not until the parthenium weed is out of control and the infestation increasing in size that landholders start to ask what weed it is. Then the penny usually drops—*parthenium!*

At that point, landholders with an outbreak face the dilemma of whether or not to report the parthenium weed to local authorities. Some feel they will be victimised if they admit they have parthenium weed on their properties. This approach is not a concern if the landholder has the technical knowledge and capacity to eradicate the infestation.

However, in situations where landholders have tried to eradicate parthenium infestations themselves and have not been successful, parthenium weed has increased its infestation size and contaminated other properties and waterways. In some of these cases, getting help earlier would have meant control costs in the hundreds of dollars rather than tens of thousands. The problem of possible victimisation then wanes in comparison to the eventual infestation size and associated costs.

In general, the sooner assistance is engaged for these properties, the sooner the problem is rectified. Landholders that surround infected properties are usually willing to give assistance in inspections and participate in control strategies. They feel it is important to get the problem sorted out on the infected property rather than waiting for parthenium weed to jump the fence into their places. Following are key guidelines for coping with parthenium weed in southern Queensland.

Key tips to landholders

Prevention—ensure everything that comes onto a property is considered clean of weed seed

A simple act of letting dirty machinery into a paddock can result in a five-hectare infestation of parthenium weed and more than \$20,000 in treatment costs. This is the most common scenario and can be easily prevented.





‘Getting help earlier can mean control costs in the hundreds of dollars rather than tens of thousands’

Identification—be aware of what parthenium weed actually looks like

Accurate identification is the key to catching the weed early.

Report infestations

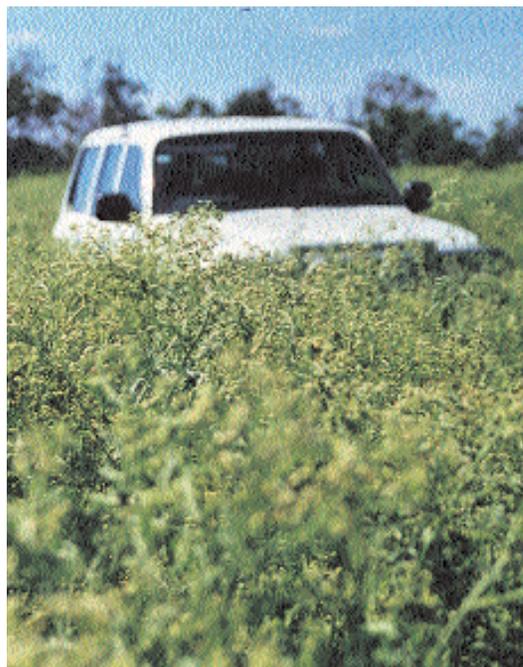
Enlist the support of local and state government in helping to formulate a plan of attack.

Help your neighbours—their parthenium problem could soon be yours

If the infestation is considerable, landholders need to realise that the only way through the problem is to engage outside assistance in the form of expert advice. That assistance can also include funding and equipment. This is more logical than trying to eradicate the weed themselves and realising after a year that they can’t do it.

Final word

‘If action is not immediate, we may miss the only window of opportunity to eradicate parthenium ‘



▲ Without early action an infestation can take over.



New South Wales Parthenium Weed Strategy

*Philip Blackmore
Noxious Plants Advisory Officer, NSW
Agriculture, Armidale*

The challenge for New South Wales and the goal of this strategy is to prevent parthenium weed from establishing self-regenerating populations.

Desired outcomes

The desired outcomes of the NSW Parthenium Weed Strategy are that:

- New South Wales remains free from self-regenerating populations of parthenium weed.
- The community is aware of parthenium weed and provided with quality information and skills to assist in its detection.

These will be achieved through the following broad approaches:

- intercepting known carriers of parthenium seed at the Queensland border
- minimising parthenium seed introductions
- identifying new entry pathways for parthenium seed
- supporting local government to find and eradicate new outbreaks of parthenium weed
- raising the community's awareness of parthenium weed—identification and reporting
- encouraging the Queensland government to suppress parthenium weed in southern Queensland.

Background

Parthenium weed is endemic throughout the Central Highlands of Queensland and regular outbreaks occur in surrounding areas. Of greatest concern to New South Wales are outbreaks on roadsides and private property on the Darling Downs, Maranoa and the Lockyer Valley in southern Queensland.

Roadside infestations are eradicated promptly. Outbreaks on private property are regarded as a greater threat since they are more difficult to find and are usually larger when discovered. Forty-six outbreaks have been discovered on farmland in New South Wales. Another 12 outbreaks on private property have occurred on off-farm sites, including machinery sale yards, commercial feedlots, grain handling and processing facilities, and the driveway of a residence. All outbreaks on privately owned land have been eradicated or fully suppressed.

The number of outbreaks of parthenium weed, including those on private property, has been steadily declining since the peak in 1989.

Source of infestations

The source of most parthenium weed infestations on roadsides in New South Wales is probably heavy vehicles travelling into New South Wales from Queensland. However, they may also be caused by vehicles that for varying reasons have been off-road. On privately owned land, headers and grain harvesting operations have been linked with the majority of outbreaks. Other sources of spread on private land have been



contaminated grain by-products used as stock feed and contaminated pasture seed. The majority of infestations have occurred in areas close to Queensland although parthenium weed has been found as far west as Condobolin and as far south as Jerilderie.

Potential for spread

CLIMEX climate modelling has predicted that parthenium weed could become established over much of the eastern half of New South Wales. The Northern Rivers area and the lower Hunter Valley are thought to be particularly suited to its establishment though parthenium weed has not yet been found in these areas.

Parthenium weed has a weakness that may be exploited to limit its spread. It reproduces only by seed and that seed is not especially well adapted to being spread by wind, water or animals. Wind (whirly winds in particular), rivers and streams, and animals will spread an infestation locally but they will not spread the infestation over a long distance in a short time.

Spread at the margins of the core area of infestation, therefore, tends to be due to natural forces. By contrast, long-distance parthenium spread or jump dispersal is solely by human agency of moving contaminated machinery, vehicles, livestock or produce. For this reason, it will be possible to minimise the entry of parthenium weed seed into New South Wales as long as southern Queensland is largely free of this weed.

The NSW Parthenium Weed Strategy is made up of specific strategies and accompanying implementation, as follows.

Specific strategies

Strategy 1: Minimise entry of parthenium seed to New South Wales from Queensland

Retain structures that can intercept known entry pathways.

- Maintain clean-down facilities at the Queensland border.
- Retain mandatory inspection procedures for agricultural machinery entering New South Wales at the Queensland border.

Encourage both government and voluntary efforts to minimise parthenium seed introduction into New South Wales.

- Encourage development and adoption of codes of practice by agribusiness, transport and earthmoving interests to reduce weed seed contamination.
- Encourage purchasers to be aware of the source of any livestock, produce, seeds for sowing or equipment.
- Encourage the Queensland government to continue to require the eradication of new small outbreaks and the containment and suppression of larger outbreaks in southern Queensland.

Retain structures to identify new entry pathways and to propose appropriate counter measures.

- Maintain the parthenium weed taskforce with representation from NSW Agriculture, Queensland government, local government, farmer groups, grain harvester associations, and such other representation that would assist the implementation of this strategy.
- The parthenium weed taskforce will report to the State Weed Control Coordinator.



Use enforcement as a management tool.

- Persons in charge of agricultural machinery who habitually make false or misleading declarations under Section 31 (5) of the *Noxious Weeds Act 1993* (New South Wales) are to be prosecuted.
- Persons in charge of agricultural machinery who are in breach of Section 31 (4) of the Act are to be prosecuted.

Strategy 2: Eradicate all infestations

Retain structures that can find and destroy parthenium weed infestations that enter through pathways that are either unknown or cannot be intercepted.

- Encourage landholders and other members of the community to report sightings of parthenium weed.
- Inspect all roads and highways during the growing season.
- Inspect all other high-risk sites during the growing season.
- Maintain procedures for receiving and responding to reports of infestations—rapid response capability.
- Maintain a monitoring system for controlled outbreaks:
 - regularly re-inspect outbreaks on private property
 - ensure follow-up control treatments.
- Maintain detailed records and reports on all outbreaks:
 - maintain a parthenium weed database.

Develop a best practice protocol for new parthenium weed incursions.

- Develop a protocol for use by NSW Agriculture and local control authorities by June 2004.

Minimise the impact of new parthenium weed infestations.

- Ensure new infestations are contained within two working days of discovery.
- Ensure new infestations are managed in accordance with best practice.

Use enforcement as a management tool.

- Increase landholder/land manager awareness of responsibility to report infestations under the Act.
- Provide training to inspectors and authorised officers on procedures and guidelines for inspection of properties, machinery, and enforcement of legislation.
- Ensure that the power to inspect and require cleaning of vehicles is available and used by authorised officers.
- Enforce the Act where appropriate.

Strategy 3: Promote awareness and commitment

Raise the community's ability to recognise parthenium weed and understand its impacts and the need to report its presence.

- Develop a targeted awareness program including:
 - how to identify the weed and report its presence.
- Deliver the awareness program by:
 - television community service announcements
 - press releases
 - promotional material (posters and hand-outs).
- Train key stakeholder staff in identification and reporting protocols (e.g. council staff, electricity and telephone field staff).
- Measure the impact of the parthenium weed awareness program by surveys at the beginning and end of the strategy.



Increase stakeholders' commitment to parthenium weed management.

- Ensure decision makers understand the importance of parthenium weed management and address the requirements for parthenium weed management during planning and resource allocation cycles.
- Raise the profile of parthenium weed as a significant issue for all stakeholders in New South Wales and garner the support required to manage it effectively.

Strategy 4: Coordinate management

Monitor implementation.

- Establish an ongoing evaluation methodology for the parthenium weed strategy:
 - Evaluate projects on outcomes not outputs.

Coordinate communication about the strategy.

- Conduct communication activities to ensure awareness of the strategy, opportunities and achievements.
- Ensure linkages with other strategies to maximise awareness.

Strategy 5: Implement monitoring and evaluation

Evaluate on outcomes rather than outputs.

- Monitor by audits of six local control authorities per annum.



▲ Vehicle washdown facilities help to reduce parthenium weed spread across borders.



New South Wales parthenium group study tour, 2002

Rebecca Hutchinson
Parthenium Project Officer, Namoi-Gwydir
Noxious Weeds Advisory Committee

Background

The threat of parthenium weed establishment in New South Wales has been a concern since it first established in Queensland in the 1970s, and the prevention of outbreaks will never be guaranteed while there is movement of produce, stock and machinery across the Queensland border.

While the *current situation* for parthenium weed in New South Wales is very good, with few outbreaks occurring, the likely *future situation* is not so good. More outbreaks are inevitable, doubtless accelerated by the drought of 2001–03. In fact, New South Wales' parthenium weed problem is not one of *dealing with* outbreaks. It is one of *locating* outbreaks, and this has been given high priority by NSW Agriculture and NSW shire and county councils.

In April 1997, weeds officers from western, southern and northern parts of New South Wales participated in a successful study tour conducted by the Macquarie/Lachlan Valley Weeds Advisory Committee. The committee ran another parthenium weed study tour in April 2002, catering for the needs of weeds officers with no previous parthenium experience as well as those who had participated in the previous tour.

Participants were 45 shire council and county council weeds officers from across the state. Sponsorship from the National Parthenium Weed Management Group (under the devolved grant program) and from several chemical companies contributed significantly to the cost.

Study tour objectives

The objectives of the tour were to:

- observe parthenium weed in its habitat and the results on land productivity
- discuss issues with personnel working in the parthenium weed field in Queensland
- study the effect that biological control agents are having on parthenium weed
- gain first-hand experience in parthenium weed
- continue to build awareness about the benefits of keeping parthenium weed out of New South Wales.

Study tour activities

The tour involved two full days in the parthenium-prevalent areas of Queensland (Emerald and Clermont) studying:

- biological control work
- grazing best practices
- chemical control methods
- health effects on humans and stock
- methods of fostering community and government partnerships
- the experience of local landholders
- success of control in Queensland to date.



Study tour outcomes

The Parthenium Weed Study Tour of 2002 proved to be very successful. It improved identification skills and knowledge concerning parthenium weed. It also clearly demonstrated to all participants that should parthenium weed establish in New South Wales, it would have a significant effect on both agriculture and the health of many NSW communities.

Participants found it very beneficial to talk directly with people who deal with parthenium weed and took every opportunity to ask questions. They also collected as much resource material as possible for future reference. Important friendships were also formed, both among the NSW participants and between them and the Queensland people who shared their experiences. These friendships will enable people in both states to work together more effectively in the fight against parthenium weed.

‘Participants found it very beneficial to talk directly with people who deal with parthenium’

Weeds officers have returned to their local areas with the confidence to identify the weed in the field and to inform their communities on the importance of keeping it out of the state.

Strategic benefits

The tour provided important strategic benefits in the overall effort to manage parthenium weed in eastern Australia. These include:

- Increased commitment—shire and county councils in both states demonstrated their commitment to the issue and to the importance of staff training by funding the tour.
- Greater understanding—NSW weeds officers acquired understanding of the national and state strategies for parthenium weed.
- Progress in developing local strategies—participants collected information that will be important in developing their own local area strategies and action plans in case of an outbreak of parthenium weed.
- Understanding the need for coordination—the experience demonstrated the need for a coordinated approach between all stakeholders, including the community.
- Stronger networks—the tour strengthened working relationships between NSW weeds officers and the project officers of the Parthenium Action Group, the Department of Primary Industries and Fisheries, the Department of Natural Resources, Mines and Energy, and local Queensland farmers.

Final word

Everyone came home with a much stronger understanding of parthenium weed and the importance of keeping it out of New South Wales.





Evolving cross-border approaches to managing parthenium

Janet Barker, Queensland Murray Darling Committee, with contributions from Rebecca Hutchinson, Namoi-Gwydir Noxious Weeds Advisory Committee, and Darren Moor, Department of Natural Resources, Mines and Energy, Queensland

Background

Unlike licence plates, daylight saving and school holidays, weeds do not abide by state borders. Parthenium weed is no exception. This weed of national significance (WONS) is spreading from high levels of infestation in central Queensland down into southern Queensland and into New South Wales.

In Queensland, parthenium weed has been present since the 1950s, and well established in central Queensland since the 1970s. The core infestation area has been estimated at 8.2 million ha, or around 5 per cent of Queensland. Twenty-eight south Queensland shires form the northern 25 per cent of the Murray–Darling Basin, with serious implications for New South Wales if parthenium weed is not contained north of the border.

In New South Wales, control authorities dealing with parthenium weed outbreaks aim for eradication—the only real option for preventing parthenium weed from establishing permanent populations.

Eradication is achieved by quick action to reduce the seed bank. The majority of parthenium weed infestations in New South Wales have been eradicated promptly though some larger property outbreaks have taken longer, with re-germination occurring for many years after the initial outbreak. Any parthenium weed outbreak reported in New South Wales is monitored by the local control authority for at least ten years.

On a national scale, approaches to parthenium weed management vary greatly according to levels of infestation and attitudes towards parthenium. Best practice methodologies for parthenium weed management, and the science behind them, continue to improve.

However, knowing how to manage parthenium weed is only one hurdle. Encouraging landowners to adopt best practice is another challenge as it requires new learning, changes to traditional practice and, in most cases, significant economic outlay.





Parthenium weed in eastern Australia—states of infestation and prevailing approaches (2003)

Western Queensland *Localised, occasional*

- Isolated to scattered outbreaks common
- Good understanding of control mechanisms
- Mostly eradication with some containment situations
- Monitoring of spread essential due to larger property sizes and small populations
- Public awareness campaign strong

Central Queensland and Burdekin *Widespread, common to abundant*

- Containment and prevention of spread
- Learning to live with it
- Employing land management strategies, pasture management, shifting watering points
- Adjusting stocking rates
- Chemicals used primarily on roadsides and high traffic areas
- Biological controls active
- Weed seed spread awareness high
- Community ownership high
- Emerging broad community understanding of the value of sound pasture management
- Moving on from parthenium weed as a single issue to broader NRM issues

Southern Queensland *Rates of infestation vary—localised, common to abundant*

- Stigma attached to having the weed
- Stressful issue for landholders with infestations that can't be eradicated
- Starting to differentiate between containment and eradication areas
- Prevention of spread a priority, particularly along waterways
- Chemicals still primary means of control
- Experimentation with biological controls increasing
- Recognition of the plant still increasing
- Weed seed spread awareness medium but increasing
- Community ownership increasing

New South Wales *Localised, occasional*

- Limited reported outbreaks
- Eradication is the only goal
- Fear factor present (indicates a good understanding of impacts)
- Recognition of the plant increasing
- Increased capacity to manage outbreaks
- Awareness of weed seed spread increasing

Victoria/South Australia

- Very few reported outbreaks
- Limited knowledge of identification, management, impacts and spread mechanisms amongst the general public and agencies

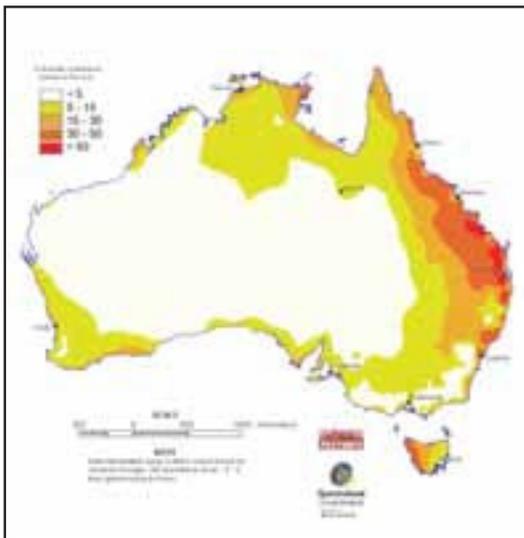


Potential spread in Australia

While the spread of parthenium weed is currently limited to north-east Australia, the Department of Natural Resources, Mines and Energy have mapped the potential distribution using climate-based data. Parthenium weed has a long way to spread before it reaches the limit of its potential habitat.

The figure shows the potential distribution is mapped based on the Ecoclimatic Index (EI). If the EI is less than five, the potential for permanent population is low; where the EI is greater than fifty, the potential for permanent population is very high.

Parthenium hysterophorus: potential spread in Australia



Source: Department of Natural Resources, Mines and Energy

Developing management strategies: southern Queensland and northern New South Wales

Southern Queensland and northern New South Wales are the regions of Australia where parthenium weed is currently establishing. Much has been achieved in the past five years to try to prevent these areas from becoming an extension of the core infestation.

In 1998 it was recognised that parthenium weed was the highest priority pest for southern Queensland. A community-based committee was formed, made up of stakeholders representing graziers, grain producers and harvesters, state and local government, service industries and landcare and catchment management. This committee was originally supported by the Department of Natural Resources, Mines and Energy and, subsequently, the Queensland Murray Darling Committee through provision of a project officer and secretariat support.

Its mandate was to develop a strategy for parthenium weed management in southern Queensland. Realising that the strategy would be meaningless without consultation with the neighbouring regions, central Queensland and New South Wales, the team ensured that representatives from these two regions were involved in developing the strategy.

The result was the Southern Queensland Parthenium APEC strategy, endorsed in May 2000, representing:

- awareness—of the identification, impacts and control of parthenium weed



- prevention—of new outbreaks, particularly in New South Wales
- eradication—of outbreaks where realistically and economically feasible
- containment—of existing outbreaks through updating best practice
- coordination—of resources like equipment, knowledge and expertise, chemicals, networks and funding to improve rapid weed management.

The NSW Parthenium Taskforce was formed around the same time, and is also made up of a range of stakeholders from state and local government and relevant industry. The NSW strategy for parthenium weed management focuses on maintaining a containment line at the Queensland border and establishing a framework for early reporting and eradication of any new outbreaks. Cross-border communication between these two groups identified distinct roles in the process of developing strategies.

Outcomes

Some of the outcomes that have been achieved include:

- Incorporation of the southern Queensland and New South Wales strategies and actions into the National Parthenium Management Strategy.
- Decisions regarding structure of, and representation on, the National Parthenium Management Group.
- Development of national awareness materials, magnets, stickers, posters, television advertising, and display trailers to make the most of available funds.
- Training opportunities for weed management staff to travel interstate and observe management strategy

development in different scales of infestation.

- Increased investment in the development of weed seed spread management frameworks, such as clean-down facilities on the Queensland/NSW border, guidelines, vendor declarations, and incorporation into new state legislation.
- Continued update of new parthenium weed outbreaks in neighbouring regions, potential vectors of spread, and best practice control options.
- Expansion of best practice guidelines to incorporate parthenium weed management outside of the core infestation area.

The declaration of parthenium weed as a weed of national significance and the subsequent National Heritage Trust (NHT) funding made available by the Commonwealth have ensured that these outcomes were achieved. NHT funding has provided the means to realise many of the joint strategies developed between Queensland and New South Wales.

Evolution in understanding over ten years

It is instructive to compare the situation in New South Wales today to that of Southern Queensland a decade ago. Ten years ago in southern Queensland, there was a major parthenium weed infestation in the north of the Maranoa–Balonne catchment (Queensland Murray–Darling Basin), with little known about infestations elsewhere. The challenges faced by southern Queensland at the time were:

- Lack of control options. The Queensland government spent around \$250 000 in chemical control on this infestation, which



was ineffective. Alternative control measures such as pasture management, altering of stocking rates, biological control, and establishing containment systems had yet not been tested for effectiveness.

- The concept of containment was undeveloped. There were no wash-down facilities or guidelines for limiting weed seed spread, and no recognition of spread vectors by the community.
- The wider community was not aware of parthenium weed impacts, or how to identify it.
- There was, and still is, no legal obligation to report outbreaks to local or state authorities.

As a result, there are parthenium weed infestations in southern Queensland that could possibly have been eradicated, but are now permanent in the landscape.

Currently, New South Wales has a limited number of parthenium weed outbreaks, but has the threat of some larger ones imminent to the north in Queensland. However, New South Wales has established a greater capacity to avoid permanent parthenium weed populations. Specific aspects include:

- An increased capacity to deal with outbreaks through training opportunities in Queensland, or access to improved best management practice information.
- A greater awareness of the vectors of spread, and of the areas where outbreaks are likely to occur.
- A commitment to eradicating new outbreaks and monitoring the sites for up to ten years.

- An active awareness campaign that has been running for at least five years, so that the broader community is more likely to identify new outbreaks.
- An obligation on the part of individuals to report new outbreaks to local and state authorities.
- Regulations requiring header clean-down by compressed air on the Queensland–New South Wales border.

Ten years on, as a result of information sharing and the development of joint strategies between the two states, there is a much greater chance of containing the spread of parthenium weed. While, traditionally, weeds are an issue managed by state government, the opportunities provided by the Commonwealth program have filled the gaps that were hampering progress in dealing with the spread of parthenium weed.

Key issues for the future

The joint strategies and initiatives developed between Queensland and New South Wales have only just been implemented.

Future goals are:

- Improved containment line on the New South Wales/Queensland border—that is, extending compulsory clean-down to earthmoving equipment and other vehicles that may carry weed seed.
- Continued opportunities for NSW staff and landowners to experience parthenium weed management situations in central and southern Queensland at first hand.
- Increased use and understanding of vendor declarations to protect vendors and consumers from the possibility of new outbreaks going unnoticed.

- The establishing of joint mapping systems between the two states to record outbreaks.
- Improved signage on the entrance points to each region.
- Provision of resources to ensure that follow-up monitoring, eradication and containment of existing outbreaks is possible.
- Increased community participation in research.
- Improved infrastructure throughout both regions for prevention of weed seed spread (i.e. wash-down facilities).
- Increased incentives for industry to adopt weed seed spread principles.
- Streamlining of state legislations regarding pest management.

Increased capacity for cross-border coordination

Cross-border coordination of parthenium weed management has demonstrated many positive outcomes. While parthenium weed is currently the pest that is attracting attention and resources, due to its impacts on the environment and economy, other weed

species that are present on both sides of the border have also been identified by the Queensland Murray Darling Committee as candidates for more cross-border coordination. These are:

- African boxthorn
- African lovegrass
- giant rat's tail grass
- lippia
- blue heliotrope
- Patterson's curse.

Activities undertaken as part of the campaign to improve parthenium weed management that would be beneficial to duplicate for other species are:

- developing joint management strategies for the species
- pooling research findings
- pooling awareness resources and budgets
- providing training activities across the border
- identifying vectors of spread between the two states
- establishing containment lines and plans
- exchanging information on best practice management.



- ▲ This mobile information trailer is used to promote awareness of parthenium weed, especially in areas where people are not familiar with it.

Guidelines for limiting weed seed spread

*Gary Zerner
Department of Natural Resources, Mines and
Energy, Brisbane*

Background

The establishing of state guidelines for limiting the spread of weed seed is assisting industries, organisations and rural communities to develop protocols and codes of practice that reduce the potential for weed seed spread into, from and across Queensland. Driving the development of guidelines and codes of practice is the growing concern within rural communities and government over the economic and environmental costs of weeds. The cost to Australian agricultural industries is estimated at over \$4 billion annually.

Traditionally, resources have been dedicated to controlling and containing established weed outbreaks with little attention given to preventing weed spread and early intervention. Each year new, isolated parthenium weed outbreaks are found, often located hundreds of kilometres from core infestations. Such jump dispersal results from unintentional transport of weed seed in machinery, livestock, vehicles, fodder, grain, material and equipment during normal day-to-day activities.

Construction, primary production, transport, mining, infrastructure, maintenance and service providers are key groups at risk of contributing to parthenium seed spread. Protocols and codes of practice can reduce the risks. The resultant strengthening of

management practices will assist in restricting the spread of parthenium weed seed to new areas.

The guidelines regarding the spread of weed seed are aimed at helping these industries coordinate a standard approach to minimising parthenium seed spread, raising the awareness and education of personnel, and protecting Australia's primary production and natural environment.

Industries and organisations developing protocols for minimising parthenium seed spread are rewarded through the promotion of hygienic practices and services to client groups. Accepting their responsibility also ensures that their day-to-day business activities are in line with tightening legislation and they are protected from the threat of civil action.

The guidelines detail procedures for vehicle and machinery inspection and clean-down, and construction of wash-down facilities. It also contains a voluntary vendor declaration (VVD). The 'Prevention of weed seed spread' CD and VVD are available from the Department of Natural Resources, Mines and Energy.

Key issues and strategies in preventing weed seed spread

The capacity to effectively minimise the spread of weed seed depends on a number of key issues, each of which is being addressed by specific strategies.



Awareness and education

Raise the awareness of personnel in relation to the problems and implications associated with parthenium weed infestations. Develop competency standards for personnel.

Duty of care

Develop appropriate codes of practice to suit industry/company/individual requirements to minimise weed seed spread and address duty-of-care requirements.

Economic impact

Implement codes of practice and procedures that are cost effective, practical and effective in minimising the spread of parthenium weed.

Environmental impact

Maintain productivity while protecting the environment, native and desirable species from parthenium weed invasion.

Social impact

Protect public facilities, private land and the health of the community through minimising parthenium weed spread.

Stakeholder consultation and involvement

Develop protocols that have input and ownership from all key stakeholders.

Legislation

Establish clear lines of responsibility and authority according to relevant legislation and policy directives.

Local government area pest management planning process

Develop protocols and codes of practice which complement existing pest management activities and are consistent with local government pest plant priorities.

Stakeholders in limited weed seed spread

Agricultural production	Service industries	Government	Industry
Grain and oilseeds	Public utilities	Local	Mining
Beef	Service providers	State	Extractive
Dairy	Contractors	Federal	Infrastructure
Intensive livestock			Agriculture
Cropping and horticulture			Transport
Merchants			Tourism
Industry bodies			Recreation



Summer rust, a new biocontrol agent for parthenium

Allan Tomley
Senior Plant Pathologist, Alan Fletcher
Research Station, Brisbane

Background

Summer rust (*puccinia melampodii*) fungus is a naturally occurring parasite of parthenium which co-evolved with its host in the Mexican region of Central America. Extensive studies of this rust's biology and host specificity were carried out both in Mexico and in quarantine in the United Kingdom by CABI Bioscience under contract to NRM&E's Alan Fletcher Research Station (AFRS). The project was jointly funded by Meat and Livestock Australia and NRM&E.



▲ Summer rust causes parthenium plants to collapse.

Importation and field release was approved by the Australian Quarantine and Inspection Service in June 1999. A single shipment was imported into the AFRS quarantine in September 1999, reared through one generation to ensure that it was free from parasites and diseases, and released into the greenhouse for bulking up and field release. Field release was commenced in December 1999 and is continuing.

How summer rust works

Summer rust can complete its life cycle in 9 to 12 days. Following infection and incubation, plants show symptoms after 7 to 9 days. Incubation depends on temperature, and is quicker at higher temperatures. The first visible signs of infection are the appearance of defined round chlorotic yellow spots on the leaves. The rust fungus appears on the lower leaf surface after another two to three days.

Brown patches of teliospores, seen under the leaves, are firmly embedded in the leaf tissue. They germinate in situ when conditions are favourable, producing a whitish bloom of basidiospores, the spores which initiate new infections. The teliospores enable the rust to survive between seasons and will not germinate under adverse conditions. The rust completes all of its life cycle on the one host.

Field observations in Mexico showed that submerged teliospores remain viable for three days. Dried teliospores remained viable for at least four weeks under laboratory conditions.



Climatic requirements

Summer rust tolerates a range of climatic conditions and appears to be climatically suitable for target areas in Australia.

Teliospores tolerate temperatures in a range of 5°C to 30°C. The optimum lies between 15°C and 30°C, the ideal being 25°C.

High humidity is sufficient to germinate the teliospores and allow some infection. The minimum dew period necessary for consistent infection is five hours.



▲ The brown patches on the leaf are caused by summer rust.

Summer rust is most active during the wet season but can also cause high levels of disease with moderate rainfall. It appears to persist well under dry conditions and was collected from an area where no rain had fallen for four months. Activity is low during conditions of low humidity but sufficient residual inoculum remains to initiate new infections when moisture levels rise.

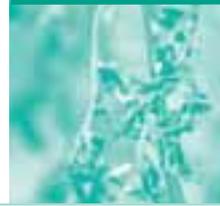
Impact on host

Surveys and field evaluation of the rust's severity and incidence revealed that it can be extremely damaging to its host and has a high climatic tolerance.

Telia of the rust form predominantly on the lower leaf surface. Initially distinct, telia coalesce over time and sporulation can occur over the entire leaf area leading to necrosis and eventual dieback of the affected leaf. Successive infection cycles can cause severe stunting and premature death of the plant. While summer rust is primarily a leaf parasite, infection of stem tissue also occurs as a result of water deposition.

Inoculations at weekly intervals produced severe damage to plants held under greenhouse conditions in the United Kingdom. Inoculated plants started to die back after five weeks whereas uninoculated control plants continued to grow. Inoculated plants were 50 per cent shorter and had 30 per cent less leaf tissue, and root and stem weight was 70–80 per cent less. It can be reasonably concluded that continued infection cycles in the field could result in a significant loss of vigour together with an elimination of flowers and subsequent seed production.





Field-releasing summer rust

As summer rust does not produce robust, dry, wind-borne spores (like rubber vine rust), the opportunity to harvest and store inoculum which can be later mixed with water and sprayed onto plants in the field is not an option.

Three methods of inoculation of plants in the field are available.

Leaf pieces with pustules can be collected, dried, taken to the field and distributed amongst the plants to be inoculated. These leaf pieces are best pinned to the stems of the growing parthenium weed plants.

Infected plants can be field collected and taken to a new site where they are distributed amongst growing plants.

In both cases the inoculum material should be kept cool and dry to prevent premature germination of the spores before it is deployed. Both of these methods, while convenient, present a relatively narrow window of opportunity for infection of the field plants to occur (7–10 days) before viability of the inoculum is lost.

An alternative method, in which infected potted plants are transplanted into the soil amongst growing plants, can give better results provided they are kept alive by watering. Living plants will keep producing spores over an extended period of three to four weeks during which favourable dew periods are more likely to occur.

The setting up of nursery sites by landholders and community groups from which inoculum can be harvested and redistributed is well worthwhile. These areas can be irrigated during periods of dry weather to maintain a culture of the rust. Leaf material can be directly harvested for redistribution or potted plants can be infected by setting them out amongst infected field plants. New sites can be started with three to five potted plants about 30 cm high provided that dew is sufficient. Infected leaf material from a similar number of plants is also sufficient.

Monitoring the progress of summer rust

Field releases have been made since December 1999 throughout the range of parthenium weed in Queensland, from Blackall in the south to Greenvale in the north. In April 2001, recoveries of the rust were made at 21 out of 25 sites between Injune and Charters Towers. In north Queensland good establishment and spread have been achieved along the Burdekin River near Charters Towers.

In central and southern areas, rainfall for the 2001 and 2002 summer seasons has been below average. While establishment of the rust was recorded at several sites, spread and intensity of infection were lower than that observed for the northern releases. The release program is continuing.





Appendices

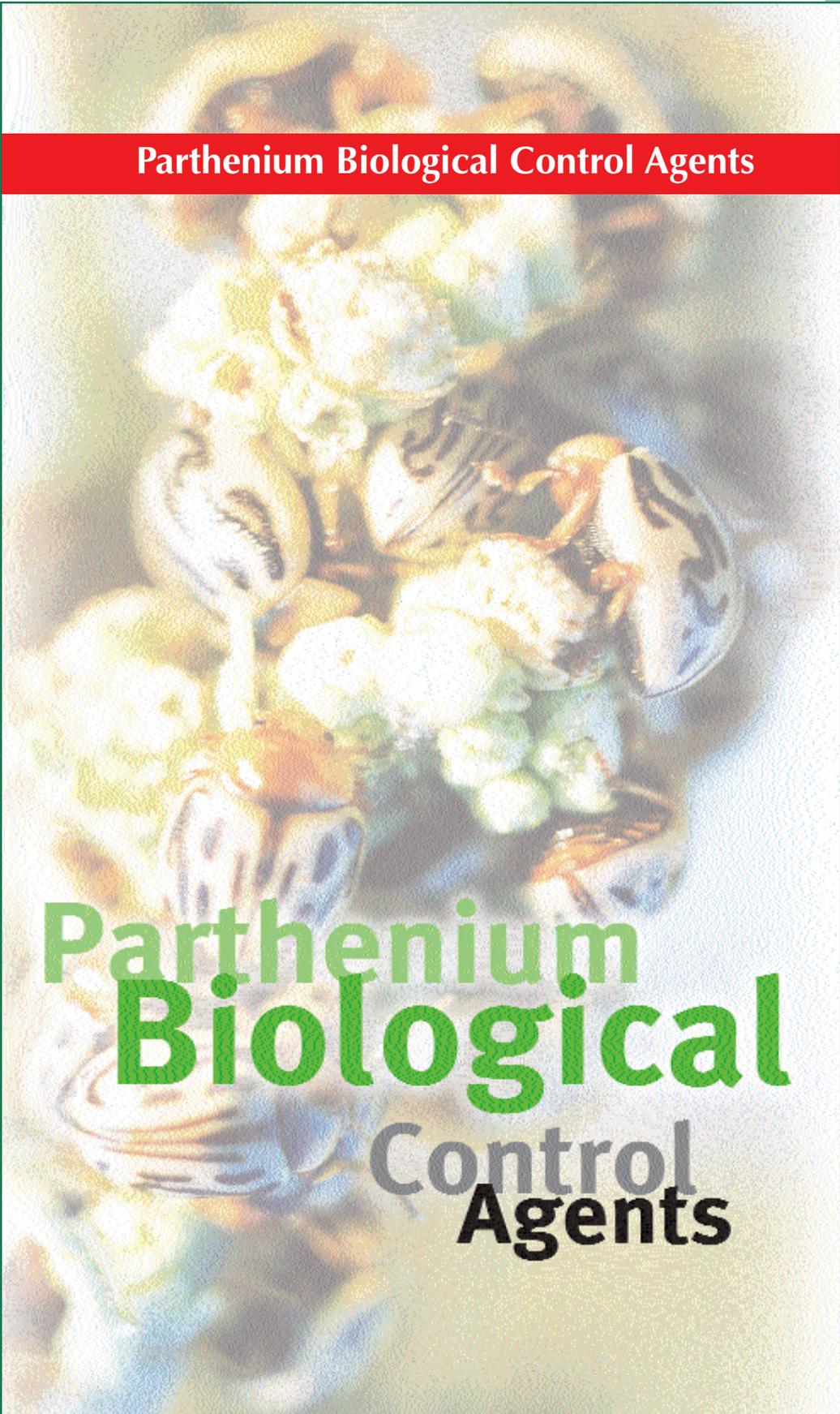


Section 4



Glossary

allelopathic	Releasing a chemical substance that inhibits the growth of nearby plants, thereby reducing competition.
basidiospores	Spores which initiate new infections.
biocontrol agent	Natural pests and diseases imported from the region where parthenium originated.
chlorotic	Unhealthy and pale.
colonise	Occupy disturbed habitats, e.g. overgrazed or flooded pastures.
core infestation	A situation where a weed has a well-established self-regenerating population, the risk of further establishment is high, and eradication is neither practical nor possible.
germination	Physical and physiological processes in a seed that initiate growth.
indicator species	Plants that by their presence or prevalence are an important indicator of the health of a grazed pasture.
minimum till	A method of land preparation with a limited number of cultivations, in which herbicides are used to remove weeds in place of cultivation. Sometimes referred to as no tillage or zero tillage.
phenology	Study of the development of plants, particularly vegetative and reproductive phases.
phytophoto dermatitis	Occurs when allergic dermatitis, caused by sensitivity to plants, is exposed to sunlight, resulting in blistering which may be severe, with redness and soreness.
reproduction	Process by which new individuals of a species are formed and the species perpetuated.
soil seed bank	The number of seeds per square metre present in the soil.
self-regenerating populations	Situations where the weed has colonised an area and established a soil seed bank, and new generations are growing.
set-stocked	Cattle numbers are constant year round and not adjusted for differing seasons.
teliospores	The form in which a fungus overwinters, a resting spore that germinates in situ when conditions are favourable, producing basidiospores.



Parthenium Biological Control Agents

Parthenium
Biological
Control
Agents

Smicronyx lutulentus (seed feeding weevil)



- adults feed on flower buds

lay eggs in flower buds

- from Mexico
- summer feeding weevil
- adult emergence from soil is triggered by rainfall
- *Smicronyx* larvae are located in the flowering seed head. To determine whether *Smicronyx* is present, rub the parthenium flower in your hand, and look for the larvae. Collect flower heads or entire plants to leave at a suitable nursery site.

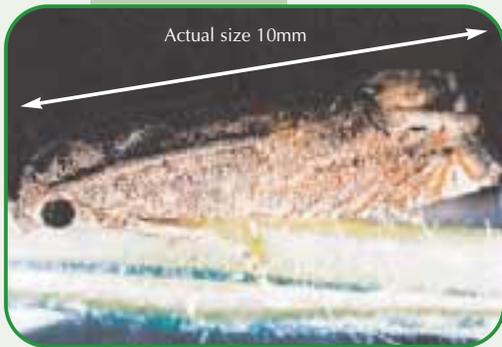
adults emerge



- larvae feed in seeds
(1 larva/seed) and eat the contents

seeds drop off the plant
and larvae burrow into
the soil to pupate

Epiblema strenuana (stem galling moth)

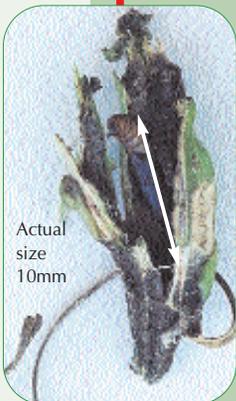


lay eggs on leaves

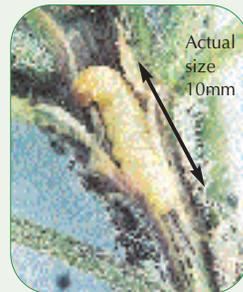
- larvae initially feed on leaves then bore into stems



- from Mexico
- life cycle 4 weeks in summer
- can produce up to 6 generations per year
- larvae are straight and yellow or cream, with a brown head
- up to 30 larvae per plant
- overwinters as resting larvae in dead stalks
- adults emerge in early spring
- also feeds on Noogoora burr
- *Epiblema* is established in all climatically suitable areas.



- larvae pupate in the galls



- larvae produce galls in mature and young plants
 - they continue to feed in these galls
 - gall size varies depending on the plant

Carmenta ithacae (stem boring caterpillar)



- adults active during the day



- eggs laid singly near the veins or mid-ribs hatch in 10–14 days

- from Mexico
- 12,500 moths released at 30 sites, 1998–2001
- 3–4 generations
- not yet established, recovers only from irrigated nursery sites so far.



- larvae are stem-borers that feed in the lower stem and crown for 5–6 weeks



- larvae pupate in the stem, moths emerge in 10–12 days

Puccinia abrupta var. *partheniicola* (parthenium rust)

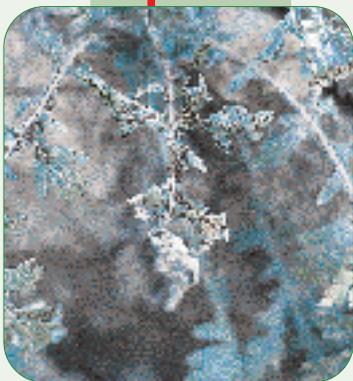


• light infection in autumn

- from Mexico
- dependent on temperature and moisture (rain/dew)
- 1 generation/14 days at optimum conditions
- spores are powdery and wipe off easily
- *Puccinia abrupta* var. *partheniicola* can be established by growing cultures on plants under artificially moist conditions and distributing the plants at suitable sites. The nursery should be established in the cooler months.

low levels of rust survive until weather conditions improve

cool night temp (15-16°C) + 6 hours leaf moisture



• causes yellowing and twisting of leaves



• heavy infection in autumn to early summer

cool night temp (15-16°C) + 6 hours leaf moisture

Puccinia melampodii (summer rust)



- teliospores under leaves remain on leaves 9-12 days after infection



- germination at 15-30°C and 5+ hours of dew



- yellow blotches early signs of infection 7-9 days

- from Mexico
- dependant on temperature and moisture
- 1 generation/9 days at optimum conditions
- spores underneath leaves won't wipe off
- similar to noogoora burr rust
- *Puccinia melampodii* can be established by growing cultures on plants under artificially moist conditions and distributing the plants at suitable sites. The nursery should be established in the cooler months.



- grey bloom = germinating teliospores



- basidiospores carried by wind to infect new leaves

Conotrachelus albocinereus (stem boring weevil)



- adults feed on leaves and stem tips at night

- from Argentina
- adults active at night
- 3–4 generations per year
- 15,000 weevils released between 1998 and 1999
- not yet established, only limited recoveries made so far.



- eggs laid on the leaves near the leaf axil

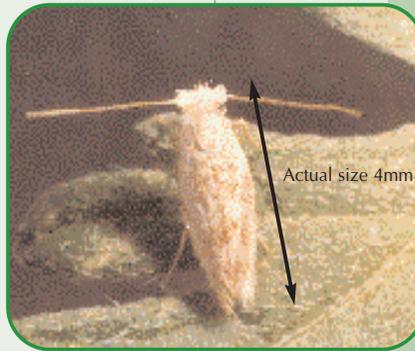


- larvae pupate in the soil

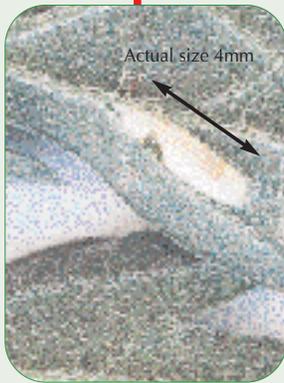


- larvae bore into the stems, feeding causes galls

Bucculatrix parthenica (leaf mining moth)



eggs are laid on leaves



• larvae pupate in cocoons on the underside of leaves and stems

- from Mexico
- adults live for 4-5 days
- mate after 1 day
- larvae mine for 14 days
- cocoons last for 7 days
- life cycle about 28 days
- *Bucculatrix* is established in all climatically suitable areas.
- *Bucculatrix parthenica*, a leaf-mining moth, is established in all areas.



• larvae mine into the leaf leaving thread-like trails



• larger larvae feed and produce windows on the leaf

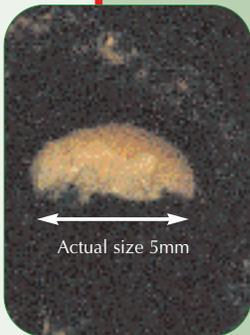
Listronotus setosipennis (stem boring weevil)



- nocturnal adults feed on leaves and flowers

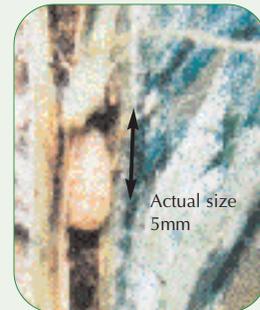


- lay eggs in flower heads or leaf bases



- pupate in soil inside fibrous capsules

- from Argentina and Brazil
- larvae are shaped like a "c"
- larvae are white with a brown head
- survive dry weather in soil
- *Listronotus* larvae can be found anywhere in the stem, but especially near soil level. It is necessary to pull up the stems to determine whether *Listronotus* is present. The larvae are 'C' shaped and white. Collect entire infested plants and leave them at a suitable nursery site.



- larvae bore into flower stalks and stems



- mature larvae leave stem and move to root crown where they feed on crowns and tap roots



adult emergence
triggered by rainfall

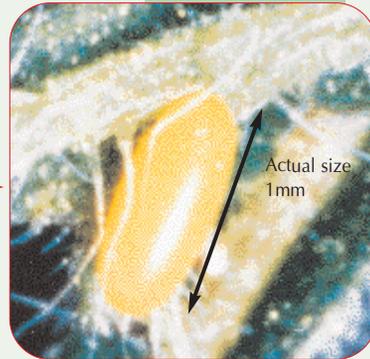
hatch 3-5 days later

Zygogramma bicolorata (leaf feeding beetle)



Actual size
6mm

- adults feed on leaves and flowers



Actual size
1mm

- eggs laid on leaf underside

4-6 days

- from Mexico
- overwinter in soil
- emergence triggered by rain
- most damaging agent where found
- *Zygogramma* can be found on the parthenium weed leaves and stems. Collect by cutting parthenium weed plants and placing them in loosely woven chaff bags for transport to the nursery site. Remember not to leave the bags in the sun. Large numbers should be put out at any one site. *Zygogramma* can take a number of years to establish depending on the occurrence of suitable rainfall.



- young adults emerge in large numbers and feed ferociously



Actual size 6mm

- larvae feed on leaves and buds



- full grown larvae enter the soil and pupate in earth capsules