

3D weed management

Paterson's curse

Echium plantagineum; Salvation Jane

Paterson's curse is an extremely widespread annual weed, covering 30 million hectares throughout south eastern Australia. The annual cost to livestock producers in eastern Australia is well in excess of \$125 million.

Although Paterson's curse is continuing to spread, the density of infestation varies greatly from season to season. It is high in alkaloids, causing chronic livestock poisoning (sometimes death) as well as losses in grazing production. It can reduce farm carrying capacity by up to 30%.

Paterson's curse is difficult to remove once widely established so prevent seed entry, take early action, particularly in winter and spring to prevent seed set and avoid bare ground that will allow it to establish.



Deliberation

Stocktake

Early detection is critical; be able to identify it.

Map infestations on your farm.

Identify sources of infestation.

Plan strategies

Prevention – aim for zero tolerance.

Eradication – prevent seed set for 10 years, prevent new seed, suppress, reduce vigour, kill existing plants and root reserves, minimise economic impact.

Containment and management – prevent seed set, winter cropping, monitor & control new outbreaks, be vigilant on bought in grain and hay.

Diversity

Use several tools

Weaken weeds, prevent seeding, prevent entry.

Competitive pastures in winter/spring.

Cultivation to kill weeds before seed set.

Herbicides in winter and spring before seed set.

Biological control to reduce seeding, prevent seed set and reduce vigour of plants.

Repeated slashing in spring to reduce seeding and prevent seed set.

Crop rotations for 3 years on arable land – use herbicides and follow with sowing competitive pastures.

Timing is critical apply tools in winter and spring to prevent seed set.

Diligence

Persist

Do it right, on time, every year.

Continue monitoring:

- For new plants – particularly after autumn rain.
- The competitiveness of pastures.
- The effectiveness of each control measure.

Follow up:

- Repeat or use other tools where controls were poor.
- Adapt grazing or pasture management to increase pasture competitiveness.
- Adjust your strategy as needed.

Prevent

Stop seed set.

Quarantine – be vigilant to prevent seed entry – clean equipment and vehicles, isolate stock and equipment from infested areas, spray perimeters and monitor entry sites.

Destroy new outbreaks – spot spray, hoe.

HELPING PRODUCERS MANAGE WEEDS IN GRAZING SYSTEMS

3D weed management

To cost effectively manage Paterson's curse use the '3Ds' of weed management:

What will it do?

Paterson's curse reduces pasture productivity which results in reduced livestock productivity. In heavily infested pastures the normal stocking rate and animal performance can be reduced by over 50 percent.

Germinating in autumn/winter, Paterson's curse quickly forms a spreading rosette that crowds out other germinating pastures such as annual clovers and annual grasses. Paterson's curse can quickly take over the pasture and render it close to useless.

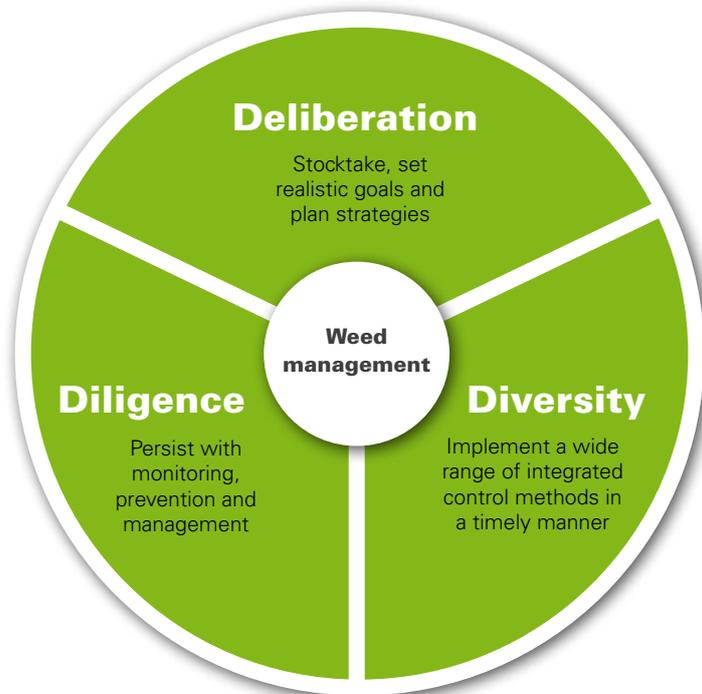
As spring approaches Paterson's curse becomes more fibrous, less palatable and more dominant in the pasture. As temperatures rise in spring and summer Paterson's curse dries off and dies.

It remains as an unpalatable dry herbage mass, generally with little useful feed value.

Paterson's curse also contains alkaloids that can be toxic to livestock. Sheep will graze Paterson's curse while other stock usually avoid it unless other feed is extremely limited. For this reason, stock deaths from Paterson's curse are more common in drought seasons.

Erosion risk may be increased by reduced ground cover. Biodiversity can be reduced by dominance of Paterson's curse.

Paterson's curse sets up to 30,000 seeds per plant and as the seed can survive for up to 10 years, weed levels can build rapidly.



Deliberation

Stocktake

The first step is to gain a clear picture of Paterson's curse on your farm.

Where is it and how dense?

- Inspect each paddock for Paterson's curse, preferably in winter and spring before seed set. It is most obvious in spring but this may be too late for effective control before seeding.
- Identify weed hot spots (eg, laneways, sheds and holding yards and disturbed or bare ground).
- Plot infestations on a farm map, including the densities. For example:

Density	Plants / m ² *	Loss of pasture productivity
Scattered	0.1	Minimal but risk of spread
Moderate	5	10% or more
Dense	> 30	50 to 100%

*Average across a paddock – may be as large patches.

Is it spreading and how?

Cross-check current infestations with old maps or memory to determine:

- Are there any new outbreaks?
- Are existing infestations spreading?
- A useful tool for assessing pastures is MLA's Pasture Health Kit
- Also see: MLA Tips & Tools: Weed removers, pasture improvers – Effective weed control

Where is it coming from?

Identify sources of infestation such as farm machinery, vehicles, livestock movements, seed and hay from infested areas, nearby land and water.

Planning

Plan carefully so that a realistic strategy can be achieved that suits your farm, considering farm size, goals, farming system, budget and extent of infestation.

Set goals

Determine what you want to achieve and what is realistic both economically and practically. Be sure to consider the potential longer term impacts – although a few plants may not concern you now, if not treated, in a year or so you can have a real problem.

Develop strategies

Develop a strategy for the whole farm and each paddock.

Infestation	Strategy
Clean paddocks	Prevention – stop it entering or establishing.
Scattered plants or small areas	Eradicate – remove it.
Moderate – dense infestation	Contain – prevent seed set, reduce vigour and extent, improve competitiveness of crop or pasture.
Dense with sources of reinfestation	Manage – reduce spread and impact, improve competitiveness of pastures.

Prioritise on which paddocks to spend your time and budget:

Priority	Strategy
1	Keep clean paddocks clean – prevent seed entry, prevent seed set on sources of infestation, suppress growth.
2	Eradicate from low infestation paddocks.
3	Manage on moderate infestation paddocks.
4	Contain infestations on all paddocks.
5	Eradicate from all paddocks (needs to be long term and may not be feasible).

A staged long term strategy is usually needed for dense infestations – for example start with management to reduce and weaken the weed then gradually reduce the level of infestation.

Actions

Develop an annual operating plan that clearly identifies the timing of critical must do actions and tools for your strategy.



Identify

Early detection and identification enables quicker and easier control.
Paterson's curse:

- Flowers are bright purple and tubular, appearing in spring and early summer.
- Germinates in late summer, autumn or winter.
- Grows first as a flat rosette then up to 1.3 m tall.
- Has many stems, covered in bristles.
- Has hairy, oval shaped leaves that are about 30 cm long with a distinct lateral vein.

It can be confused with other *Echium spp.* These are far less common in Australia and can be distinguished by:

- Vipers Bugloss (*Echium vulgare*) – the flowers are smaller, bluer in colour and have four to five stamens protruding from the flower compared with the two on Paterson's curse. It is less aggressive and competitive. Flowering later and over a longer period.
- Italian Bugloss (*Echium italicum*) – flowers are more pink and the plant is hairier.



Case Study

Dick and Anthony Ord from Coolah, NSW have effectively reduced Paterson's curse growth by targeting their control strategy to prevent flowering.

They believe it's important to use a combination of several control measures – herbicides, spray/graze, rotations, biological control agents, competitive perennial pastures, slashing, and short periods of heavy grazing – and pay careful attention to making sure these measures are done on time and correctly. They do regular surveillance of likely new weed entry points and quickly treat new infestations.

Dick and Anthony believe that if they did not adopt an aggressive and successful control program, Paterson's curse would have put them out of business. While they haven't yet achieved eradication, their program is reducing the impact of the weed to less than 5% losses in production – which avoids a potential loss of almost \$150,000 each year to Paterson's curse.

➔ To read more about how other farmers have managed Paterson's Curse see: "3D Weed Management: Paterson's curse Case Studies" available from MLA & AWI.

The critical must do actions for any strategy are:

- ➔ Prevent seed entry.
- ➔ Prevent seed set.
- ➔ Ensure competitive pastures.
- ➔ Routinely monitor (particularly each autumn, winter and spring) all points where Paterson's curse can enter each paddock, and regrowth.
- ➔ Quickly kill new outbreaks by spot spraying, chipping or burning, repeated over several seasons, always before seed set.
- ➔ Suppress and gradually reduce vigour and extent of the weeds (competitive pastures, herbicide and biological control).

Suitable plans include a combination of tools such as:

- ➔ Non arable areas: manage for competitive, perennial pastures complemented with biological control agents and spot spraying, especially along perimeters.
- ➔ Arable areas: using herbicide control in cropping rotations followed by competitive pastures and biological control agents.

Example – Paterson's curse plan for arable land

Stocktake

- ➔ Paterson's curse heavily infested across 2 paddocks.

Source

- ➔ Purchased contaminated grain 2 years ago.

Strategy

- ➔ Eradicate Paterson's curse from these 2 paddocks.

Actions

- ➔ When removing stock from infested paddocks, quarantine them for appropriate period before moving to clean areas.
 - ➔ On infested paddocks, 3 years of winter crop, sprayed in-crop and effective summer fallow. Plant strong perennial grasses following the cropping phase, and manage grazing for high vigour and density of the perennials.
 - ➔ Foster biological controls in a nursery area.
 - ➔ Monitor and spot spray Paterson's curse in all other paddocks.
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Diversity

Effective control requires the combination of a range of tools acting on Paterson's curse over its lifecycle. Select a set of tools to achieve the critical actions – prevent entry, stop seed set, reduce vigour and extent.

The most effective strategies are a combination of carefully timed:

- ➔ Competitive autumn, winter and spring growing pastures.
- ➔ Biological control agents.
- ➔ Herbicides – in pastures or crop rotations.
- ➔ Cultivation before crop or pasture establishment.
- ➔ Chipping and spot-burning.

Prevent seed entry

Minimise the risk of seed entry and establishment by paying constant attention to likely sources of infestation shown in the following table.

Farm machinery & vehicles	Clean down and/or quarantine to designated areas that can be monitored.
Livestock movements	Seeds take up to 14 days to pass through livestock and can still be viable. Restrict livestock from unknown or infested land for 14 days to specific areas that can be easily monitored.
Seed & hay harvested from infested areas	Particularly a risk from early sown summer crops, winter crops or pastures from areas with inadequate weed control. Carefully monitor into the next season all new sowings of pastures and crops and areas where hay is fed.
Nearby land	Regular surveillance of farm boundaries.
Water movement	Carefully monitor along creeks, waterways and overland flow areas.

Pasture management

Healthy pastures that can compete strongly for moisture, light and nutrients are part of any good control plan. Pasture competition is highly effective against Paterson's curse and greatly enhances the effectiveness of other tools.

To be competitive, pastures need to be deep-rooted with a strong perennial component. To be able to suppress emerging seedlings in late summer/autumn they need to be growing strongly during autumn and winter or have strong pasture cover remaining from the summer. Consider one or more of the following pasture options:

- Strong temperate, perennial grasses with annuals.
- Annual clovers and grasses combined with competitive sub tropical perennial pastures.
- Strong native perennials with suitable annual companion component (eg, sub clover).
- Lucerne on suitable soils (not acid, shallow or prone to waterlogging).

Maintain good soil fertility and monitor and control other pests that may damage the pasture.

How competitive is your pasture now?

Determine whether the species composition and density of your pastures is adequate to compete against Paterson's curse. Competitive perennials require adequate pasture plant density – ideally (there are significant differences between species) these are:

Rainfall zone	Ideal pasture plant density	Groundcover
Low	10 plants / m ²	>70%
Medium-High	15-30 plants / m ²	>70%

→ MLA Tips & Tools "Grazing management for perennial based pastures"

Understanding Paterson's curse

In planning an effective control strategy it is helpful to understand something of the biology of Paterson's curse.

Growth: An annual plant, it germinates late summer and autumn and remains in the rosette stage until late winter or early spring. As spring approaches the plant becomes more fibrous and commences flowering in early to mid spring. As the temperatures increase in spring and summer Paterson's curse dries off and dies.

Spread: Paterson's curse can establish from seed or be transplanted. The seeds may not all germinate in the first year and can persist over a few seasons. Introduction can easily occur via purchased seed (crop or pasture seed), livestock (the seed can cling to wool or hides and can take up to 2 weeks to pass through animals undigested), hay, visiting farm vehicles, water movement and wildlife (including birds).

Weakest point: Target control measures to the weakest points in the plant's lifecycle – as seedlings and when plants are actively growing. It is also weaker when transferring nutrients after flowering to developing seed.

Grazing management

Livestock types vary in how selectively they graze around Paterson's curse. It has been observed that when sheep are removed from the grazing system Paterson's curse can increase in dominance.

Grazing management of pastures with Paterson's curse aims to encourage the autumn, winter and spring competitiveness of the pasture through high plant densities. This is particularly important for pastures degraded by drought or overgrazing.

Improve the persistence, density, vigour and productivity in autumn/winter of pastures by not over grazing in summer and enabling them to rebuild root reserves and set seed:

- Maintain, where possible, 1,000-3,500 kg/ha dry matter by using appropriate stocking rates, hay or silage making or slashing.
- Use some form of rotational grazing. Even converting from set stocking to a three paddock rotation is helpful.

- For temperate perennial pastures minimise grazing pressure during spring, especially in dry years, as it is important for these species to build root reserves and complete flowering.
- On all perennial pastures, minimise grazing pressure during the early regrowth phase, flowering and seeding.
- Allow good recovery periods for most perennials during their active growth phase after grazing (generally 30-50 days).
- Relatively short grazing periods (2-30 days) are often appropriate for perennial pastures during active growing phases.

➔ **MLA Tips & Tools "Grazing management for perennial based pastures" and "Managing Paterson's curse to boost pasture production"**

Herbicides

Herbicides are valuable tools for managing Paterson's curse. The range of herbicides available to control Paterson's curse is large and there are many effective products to choose from. Herbicides are most effective where

pastures and/or crops are strong and able to compete with the weakened weeds. Be aware that winter spraying can provide effective control, but may also reduce dry matter available for grazing. Ensure the herbicide used is suitable for your pastures.

Timing is critical:

- Spray at the rosette stage. Good control can also be achieved up until the beginning of seed set but needs higher rates.
- Herbicide is most effective on actively growing plants – winter and spring but before seed set.

Spot spraying is used to stop the weed spreading, reduce the perimeter of the main weed problem, remove straggling weeds after other control measures and to treat non arable areas and pockets of infestation such as lane ways, fence lines, gullies or rock outcrops.

Selective herbicides such as 2,4-D amine that don't harm grass are useful in grass pastures. Glyphosate is used where killing surrounding plants is not a concern, eg, in-fallows or small areas.

Choose a diversity of carefully timed tools for the must do actions

Tools	Prevent new seed entry	Prevent seed set	Kill existing plants	Reduce vigour	Minimise impact
Grazing	Hold stock 14 days before moving from infested to clean paddocks.			Keep pasture herbage above 1000kg/ha and below 3500kg/ha dry matter in winter and spring.	
Pastures				Ensure pastures are competitive in late summer – autumn to suppress seedlings, maintain competition through winter and spring. Maintain 70% groundcover.	
Herbicides	Spray any new entrants and seed sources.	Spray before flowering – autumn, winter, early spring.	Spot or broad-acre spray depending on level of infestation – autumn, winter, early spring.		
Cropping	Clean equipment before use.		Zero-till crop for 3-4 seasons using herbicides (crop and fallow) to prevent weed seeding.		Plant profitable crops as part of a sound rotation.
Mechanical	Clean equipment before use.	Slashing in early spring (rarely totally effective on its own).	Chip or burn individual plants.		Cultivate in spring/autumn.
Biological		Release of biological control agents such as Crown weevil, Root weevil, Flea beetle and Pollen beetle.			
Quarantine	Minimise risk of entry & watch all entry sites.				

Broadacre spraying in winter and spring on crops, fallow or pastures is effective against Paterson's curse:

- Summer crops – choose a crop like millet or forage sorghum that allows in-crop use of broadleaf herbicides such as atrazine.
- Winter cropping – spray pre-sowing and in-crop.
- Grass pastures – autumn, winter and spring herbicide options are available for effective control and the prevention of seed set.
- Pastures with a legume component – while there are less herbicide options with pasture legumes a number are registered for use and can be effective in controlling Paterson's curse.

Rope wick wipers selectively apply herbicide to Paterson's curse when surrounding pasture is eaten down. Useful on small areas to once Paterson's curse has grown above the rosette.

Spraygraze Paterson's curse with sub lethal level of herbicides like MCPA or 2,4-D a week before grazing with a high stocking rate for a short period of time. This can reduce the weed level in pastures and is most appropriate if the pasture base is strong, if adult, non-breeding sheep are used and when the weed is in the rosette stage.

Cropping rotations

The main benefit of crop rotations is use of herbicides in winter and spring in crop or fallow that help deplete the weed seed bank.

To be effective against Paterson's curse crop rotations need to:

- Ensure that cultivation, if used, effectively removes weeds and avoids transplanting them.
- Have three or more consecutive crops with effective herbicide use (including fallow and preparation period) to prevent seed set.
- Be followed by planting a strong, perennial, competitive pasture.

Mechanical control

Cultivation can successfully remove Paterson's curse. Cultivate in spring prior to summer cropping, followed by autumn weed control cultivation prior to sowing crops or pastures.

Mowing and slashing is generally unreliable and the weeds tend to regrow, often lower to the ground. However, repeated slashing around early flowering can reduce seed set.

Chipping (hoeing) or spot burning (eg, flame throwers) can be used for a few, sparse new Paterson's curse invasions. It can be a useful part of an integrated program including competitive, well managed, perennial pastures and biological control agents.

Biological control

Biological control agents help to reduce weed seeding and vigour. They are not entirely effective on their own but are a valuable part of an integrated control program. Several biological control agents have been released and a combination of different types is usually the most effective.

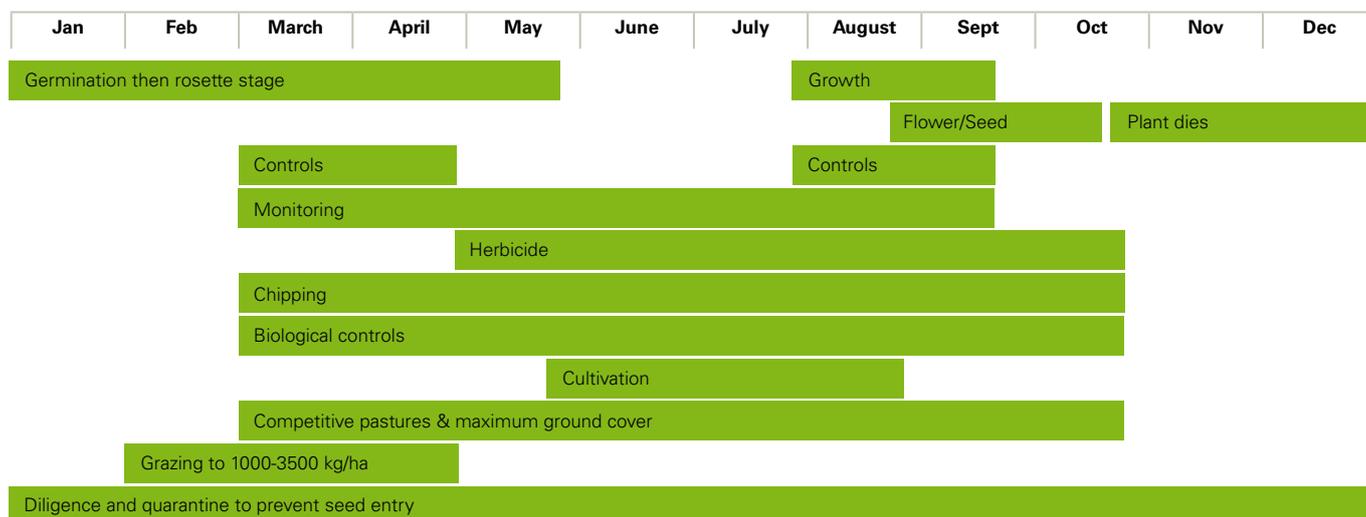
These include:

- Paterson's curse crown weevil adults emerge in February to April eating leaves, crown and leaf stalks. The larvae feed within the leaf stalk, the crown and top of the tap root. Adults emerge again in late spring feeding on leaves until becoming dormant in hot weather.
- Paterson's curse root weevil adults emerge from dormancy in April – May and feed on the rosettes. The larvae feed on the leaf stalk and mine into the tap root before pupating. Adults emerge again in spring and feed on leaves and flowers. When plants die off the adults enter dormancy in the soil.
- Paterson's curse flea beetle larvae mine into and feed on the tap root and secondary roots.
- Pollen beetle adults feed on the flowers when they open. Larvae mine into the flower bud, feeding on pollen, ovules and immature seeds. Adults continue to feed on the flowers before entering dormancy.

They vary greatly in the time taken to build up populations and the optimal management. It is advisable to seek further information on each of these.

➔ **Contact your local Department of Agriculture and Primary Industries for information on how to access biological control agents.**

Match control strategies to the biology of the weed



Diligence

Paterson's curse is likely to be an ongoing challenge for many properties. The key is to be diligent to achieve critical outcomes:

- Persist with control to keep on top of it.
- Prevent seed set.
- Prevent it from entering.

Monitor constantly, particularly in autumn, winter and spring and after control measures, the areas of infestation by updating farm maps and/or counting weed density in quadrats to determine:

- Is the weed density reducing?
- Is it contained to existing areas?
- Are infested areas reducing in size?
- Are there signs of biological control agents?
- How effective was each control activity?
- Are autumn/winter/spring pastures healthy and competitive?

Timing must be right – be sure control measures are effective before seed sets in spring/summer. Plan carefully so Paterson's curse control activities fit with other workloads.

Put into your farm diary the critical actions for your strategy:

- Autumn/winter and again in spring – monitor to detect outbreaks and assess control measures.
- Autumn/winter/spring – herbicide, chipping, biological control agents, ensure pastures are competitive.
- Late summer / autumn – graze infested paddocks within the range 1,000-3,500 kg/ha dry matter.
- Winter – herbicide, cultivate.

Follow up – if control measures have not worked, repeat or use another tool before seed sets.

Integrate your weed management plan with your overall farm management strategy to ensure that it can be achieved.

Review and modify the plan based on progress, successes and failures. Adapt to seasonal conditions if needed to ensure pasture is competitive and to act on unusual outbreaks.

Photos page 1 & 3: Kerry Winsor, DPI, Victoria
Photo page 4: Hassall & Associates

Further information



For more information on Paterson's curse or pasture management, contact your local agricultural office or agronomist. You may also find useful information from:

Australian Wool Innovation

www.wool.com.au
Ph: 1800 070 099

Meat & Livestock Australia

Tips & Tools: Managing Paterson's curse to boost pasture production

www.mla.com.au
Ph: 1800 675 717 – option 3

3D Weed Management: Paterson's Curse Case Studies

available from MLA and AWI

Pasture Management for Weed Control

Weeds CRC/NSW DPI / CSIRO /MLA

WEEDeck – identification

www.weeds.org.au/weedeck

CRC for Australian Weed Management

Cultural weed management:
Paterson's Curse

www.weeds.crc.org.au
Ph: 08 8303 6590

NSW Department of Primary Industries

www.dpi.nsw.gov.au
Ph: 02 6391 3100

Department of Primary Industries Victoria

Landcare Note LC0383: Paterson's curse management

Landcare note LC0173: Paterson's curse – identification

www.dpi.vic.gov.au
Ph: 136 186

CSIRO Entomology

The Biological Control of Paterson's Curse Fact Sheets

www.csiro.au/weeds
Ph: 02 6246 4001