

3D weed management

Silverleaf nightshade

Solanum elaeagnifolium

Silverleaf nightshade is an extremely competitive summer growing weed. It can reduce pasture and crop production by up to 70%.

Winter pasture yields have more than doubled where silverleaf nightshade has been controlled in the previous summer. It infests around 500,000 hectares across the eastern states, costing livestock and crop producers over \$50 million each year.

Silverleaf nightshade is a potential threat to properties right across the coast, tablelands, slopes and plains of the south east temperate zone. It is difficult to remove once widely established so early action is needed to minimise seed entry, prevent seed set and avoid spreading root fragments. Action in spring and summer is essential.



Deliberation

Stocktake

Early detection is critical.
Map infestations on your farm.
Identify sources of infestation.

Plan strategies

Prevention – reduce chance of entry, quickly control appearances – aim for zero tolerance.
Containment – prevent seed set, avoid cultivation, monitor and control new outbreaks – suitable for patches.
Management – prevent seed set, suppress, reduce vigour, avoid cultivation, minimise economic impact, where widely established.
Eradication is difficult – prevent seed set for 10 years, prevent new seed or root entry, avoid cultivation, kill existing plants and root reserves.

Diversity

Use several tools

Weaken weeds and prevent seed set and seed entry.
Competitive pastures in spring/summer.
Avoid tillage.
Herbicides in spring or summer before seed set.
Crop rotations for 3-4 years – minimum tillage with herbicides followed by planting competitive pastures.
Timing is critical – spring and summer controls to prevent seed set.

Diligence

Persist

Do it right, on time, every year.
Continue monitoring:
• For new plants – particularly after spring /summer 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 overall strategy as needed.

Prevent

Stop spread of roots and seed set.
Quarantine – be vigilant to prevent seed entry – clean equipment and vehicles, isolate stock and equipment from infested areas, spray perimeters, monitor potential entry sites.
Destroy new outbreaks – spot spray.
Neighbours – encourage neighbours to control silverleaf nightshade.

HELPING PRODUCERS MANAGE WEEDS IN GRAZING SYSTEMS

3D weed management

To cost effectively manage silverleaf nightshade use the '3Ds' of weed management:

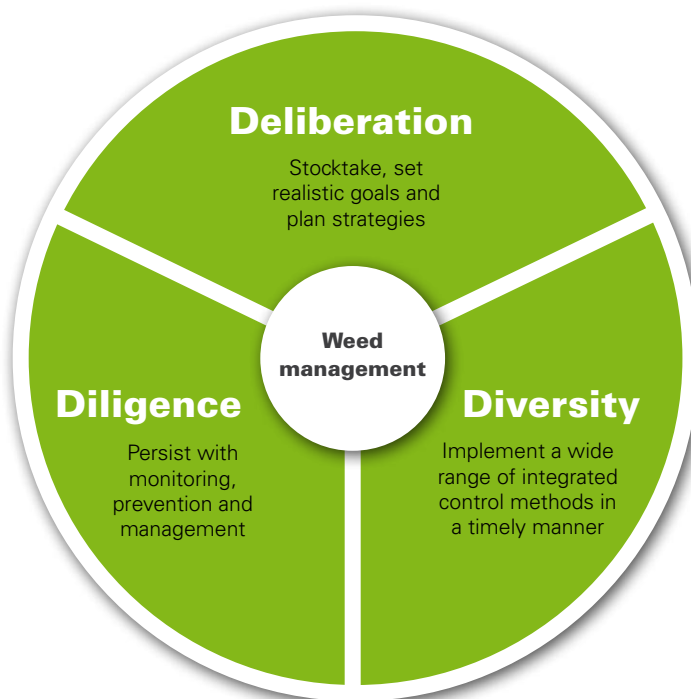
What will it do?

Silverleaf nightshade competes aggressively for moisture, sunlight and nutrients. The deep root system dries down soil moisture such that pasture and crop production can be affected all year round, particularly in drought.

Dense infestations (more than one plant/m²) can halve the carrying capacity whilst higher densities can completely suppress pastures. Where silverleaf nightshade was not controlled in the previous summer, 70% loss of productivity of winter clovers, grasses and crops has been measured.

Stock poisoning is not common as it is not grazed, except when little other feed is available. Potentially toxic levels of alkaloids are in all parts of the plant, particularly the green or ripe fruit. Stock poisoning symptoms include bloating, trembling, loose faeces, nasal discharge, salivation and breathing difficulties. Cattle seem to be the most susceptible.

Biodiversity may be reduced by dominance of silverleaf nightshade.



Deliberation

Stocktake

The first step is to gain a clear picture of silverleaf nightshade on your farm.

Where is it and how dense?

- Inspect each paddock for silverleaf nightshade, preferably in summer when it is flowering.
- Identify and mark weed hot spots on map (eg, laneways, sheds and holding yards).
- 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	1	10% or more
Dense	5 or more	> 50%

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

Is it spreading and how?

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

- Are there any new outbreaks?
- Are existing infestations spreading?
- A useful tool for assessing pastures is the MLA 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 to effectively manage silverleaf nightshade. Tailor your strategy to suit your farm situation, budget and the extent of infestation (current and potential).

Set goals

Determine what you want to achieve and what is realistic, economical and practical. Be sure to consider the potential longer term impacts – although a few plants may not concern you now, if they are 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 the weed entering or establishing.
Scattered plants or small areas (less than 5ha)	Eradication – remove it.
Moderate – dense infestation	Containment – prevent seed set, reduce vigour and extent.
Dense with sources of reinfestation	Management – reduce spread and impact.

Prioritise the paddocks on which to spend your time and budget:

Priority	Strategies
1	Keep clean paddocks clean – prevent seed/root entry, prevent seed set on sources of infestation.
2	Containment on low infestation paddocks.
3	Containment on moderate infestation paddocks.
4	Containment of infestations on heavily infested paddocks.
5	Gradual reduction of infestations.
6	Eradication from all paddocks (needs to be long term and may not be feasible).



Identify

Early detection and action is a high priority as silverleaf nightshade is hard to control once established. The plant:

- Is small, bushy, multi-branched, up to 60-80cm tall – above your boots in late summer.
- Grows from mid-spring through to autumn.
- Stems and underside of leaves are silvery and covered in dense minute white hairs.
- Has leaves with grey/green upper surfaces.
- Leaves are alternate, 2.5-10cm long, 1-3cm wide with undulating margins.
- Has prickles on the underside of veins.
- Has short slender spines on a strong stem.
- Has a deep root system with rhizomes.
- Flowers are violet, blue or white with yellow stamens, about 25cm across with 5 petals, in small groups towards the end of the branch.
- Has round, smooth fruit (berries) – green and white striped, maturing to yellow and orange.
- Is easy to confuse with other *Solanum* weeds, particularly the native species:
 - Quena (*Solanum esuriale*) – much shorter (less than 15cm tall), narrower leaves with straighter margins and a more grey-green colour. Spines are rare. Flowers are similar. Berry doesn't have white stripes and is more oval shaped. Also a deep rooted perennial, it needs similar management.
 - Narrawa burr (*Solanum cinereum*) also to 80cm tall with similar flowers and fruit, leaves deeper green with irregular wavy margins. The longer spines (~1cm) are on stems, branches and leaves.



Case Study

In Victoria's southern Mallee, Alan and Gwenda Malcolm are part of a regional catchment program to manage silverleaf nightshade.

Through the cooperation of neighbours, state government and the Lands department they are able to contain silverleaf nightshade. They use a cropping and pasture management cycle complemented by summer herbicide application to prevent seed set.

The direct costs of this control program are \$7,500 in chemicals, 50 hours of spot spraying and 60 hours of boom spraying (total cost around \$13,500 per year). By avoiding loss of crop and pasture yields this investment has returned an annual benefit of around \$50,000.

➔ To read more about how other farmers have managed Silverleaf nightshade, see "3D Weed Management: Silverleaf nightshade Case Studies" available from MLA & AWI.

A staged long term strategy is usually needed for dense infestations – for example, start with management to reduce and weaken the weed enough to then contain it in small areas until better options are available for eradication.

Actions

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

The critical must do actions for any strategy are:

- ➔ Prevent seed and root entry.
- ➔ Prevent seed set.
- ➔ Minimise the spread of root fragments (avoid cultivation).
- ➔ Ensure competitive pastures.
- ➔ Routinely monitor, (particularly each summer) all points identified in the stocktake where silverleaf nightshade can enter each paddock along with any new outbreaks and regrowth.
- ➔ Quickly kill plants and root reserves (spot spraying, chipping repeated over several seasons) always before seed set.
- ➔ Burning may be used to prevent seed set.
- ➔ Suppress and gradually reduce vigour and extent of the weeds (competitive pastures, herbicide).

Suitable plans include a combination of tools such as:

- ➔ Non arable areas – manage for competitive, perennial pastures with spot spraying, especially along perimeters.
- ➔ Arable areas – as for non arable land, plus herbicide control in cropping rotations followed by competitive pastures.

Example – Silverleaf nightshade plan for arable land with crop-pasture rotations

Stocktake

- ➔ Silverleaf nightshade scattered in dense patches covering 15% of 3 paddocks.

Source

- ➔ Purchased hay 5 years ago.

Strategy

- ➔ Contain silverleaf nightshade to these three paddocks, reduce its density and eventually eradicate it.

Actions

- ➔ Quarantine stock movements by keeping stock off infested paddocks in summer.
- ➔ On all 3 infested paddocks, 3-4 years of zero-till winter crops with fallow sprayed in December.
- ➔ After the final crop, plant subtropical and perennial grasses, and manage grazing for high vigour and density of the summer perennials to compete with silverleaf nightshade.
- ➔ Spot spray with broadleaf herbicides in grass pastures.
- ➔ Monitor and spot spray silverleaf nightshade in all other paddocks.

Diversity

Effective control requires the combination of a range of tools acting on silverleaf nightshade over its lifecycle to achieve the critical actions – prevent entry, stop seed set, stop spread of root fragments, reduce vigour and extent.

The most effective strategies are a combination of carefully timed tools:

- Competitive, summer growing pastures.
- Herbicides (in pastures or crop rotations).
- Slashing, chipping and spot-burning to prevent seed set.

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 in designated areas that can be monitored.
Livestock movements	Seeds take up to 14 days to pass through livestock and can remain 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 summer crops or winter crops or pastures from zero till areas with poor weed control. Carefully monitor all new sowings of pastures and crops into the next season.
Nearby land	Regularly check farm boundaries to keep new plants out.
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 greatly enhances the effectiveness of other tools.

To be competitive, choose a pasture that has:

- Deep-rooted perennial plants.
- Strong spring and summer growth eg, sub tropical perennial pastures.
- Sufficient density and vigour.
- Annual clovers and grasses to improve early season competitiveness of sub tropical perennial pastures.
- Lucerne on suitable soils (not acid, shallow or prone to waterlogging).
- Not solely annual plants – these are highly prone to invasion.

Maintain good soil fertility and monitor and control other pests to look after the pasture.

Understanding silverleaf nightshade

Understanding the biology of silverleaf nightshade will be helpful in planning an effective control strategy.

Growth: Silverleaf nightshade is a very deep rooted perennial plant that extracts moisture and nutrients from depth. It grows from early to mid spring, through summer to mid autumn and becomes dormant in late autumn and early winter. Growth peaks when soils are moist during summer. It flowers in late spring and summer.

Spread: Silverleaf nightshade can germinate from seed in autumn or establish from root fragments. Seed can easily enter via purchased seed (crop or pasture seed), hay, livestock (seeds cling to wool or hides and take 14 days to pass through animals), visiting farm vehicles, water (creeks or overland flow) and wildlife (including birds). Each fruit contains about 60 seeds. The hard seed may not all germinate in the first year and can persist over a few seasons. Given enough soil moisture, plants can readily establish from root fragments.

Weakest point: The weakest points in the lifecycle are the seedlings, after winter dormancy or recovering from spraying (plants are drawing on root reserves) and after flowering when seed is developing. Control measures are most effective at these times.

Case Study

At Narrandera in the NSW Riverina, Andrew King has significantly reduced the extent of silverleaf nightshade over 8 years, with a long term aim to eradicate it. His strategy involves careful quarantine and stock management; competitive pastures (lucerne after crops and phalaris on river country); herbicide in crop rotations (fluroxypyr on lucerne); and spot spraying.

Andrew's tips for managing silverleaf nightshade are:

- Be able to recognise and identify it.
- Plan and monitor over time.
- Be vigilant with managing the weed year to year.
- Manage stock to stop spread and quarantine areas.
- Try not to let one plant get away.

How competitive is your pasture now?

Determine whether the species composition and density of your pastures can compete against weeds. Typically (there are significant differences between species) ideal pasture plant densities 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"

Grazing management

Manage grazing to achieve high pasture plant densities to increase the summer competitiveness of the pasture, particularly where degraded by drought or overgrazing.

To enable pastures to rebuild root reserves and set seed to improve persistence, density, vigour and productivity in spring and summer:

- Keep spring herbage (annual grasses, clovers, weeds) below 3,000 kg/ha dry matter – adjust stocking rates or slash.
- Use some form of rotational grazing. Even converting from set stocking to a three paddock rotation is helpful. On most perennial pasture types:

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

Tools	Prevent new seed entry	Prevent seed set	Minimise spread of roots	Kill existing plants	Reduce vigour	Minimise impact
Grazing	At seeding time, hold stock for 14 days before moving from infested to clean paddocks.				Keep spring pastures below 3000kg/ha dry matter by increasing stocking rates or slashing.	
Pastures					Ensure pastures are competitive in spring & summer. Maintain 70% groundcover.	Keep pastures competitive.
Herbicides	Spray any new entrants and seed sources.	Spray before flowering – spring/summer.		Spot or broadacre spray depending on level of infestation – spring, summer.		
Cropping	Clean equipment before use.		Avoid cultivation.	Zero-till crop for 3-4 seasons using broadleaf or fallow herbicides before seed set (summer).		Plant profitable crops to offset lost production.
Mechanical		Slash before flowering – spring/summer.	Minimise cultivation.		Chip individual plants.	
Quarantine	Minimise risk of entry & watch all possible entry sites.					

- Exclude stock during the pasture's early regrowth phases, flowering and seeding.
- Allow good recovery periods after grazing (30-50 days).
- Graze for relatively short periods (2-30 days) during active growing phases.

Herbicides

Herbicides are critical strategic tools for silverleaf nightshade.

Herbicide options include glyphosate, 2,4-D (may be mixed with picloram) and fluroxypyr.

Complete kill is not guaranteed because of the deep, rhizomatous root system.

Repeat treatments prevent seeding and gradually weaken the plant.

Herbicides are most effective where pastures are strong enough to compete with the weakened weeds.

Timing is critical for herbicide applications:

- Late spring or summer at flowering but before pod set – even green pods have viable seed.
- Most effective on actively growing plants in spring/summer, avoiding extreme heat.
- Two applications a season – late October (plants are about 10 cm tall) and summer (flowering or at very early pod set) or
- One spray per season at flowering or very early pod set.

Spot spraying is important in most programs 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 laneways, fence lines, gullies or rock outcrops.

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

Broadacre spraying in spring or summer on crops, fallow or pastures is effective against silverleaf nightshade:

- Summer crops – choose a crop like sorghum or millet that allows in-crop use of broadleaf herbicides such as 2,4-D amine or 2,4-D plus fluroxypyr.
- Winter cropping – spray the fallows.
- Grass pastures – summer application of 2,4-D, at relatively low rates to prevent seed set.
- Lucerne pastures – there are few options other than 2,4-DB.

Rope wick wipers selectively apply herbicide to silverleaf nightshade when surrounding pasture is eaten down. They are useful in small areas.

Cropping rotations

The main benefit from crop rotations is the ability to use herbicides in spring or summer in crop or fallow, to help deplete the weed seed bank.

To be effective against silverleaf nightshade, crop rotations need to be:

- Zero or minimal tillage to avoid spreading silverleaf nightshade root fragments.
- Three to four years, with effective herbicide use to prevent seed set.
- Followed by planting a strong perennial competitive pasture.

Mechanical control

Avoid cultivation as it drags root fragments which can establish elsewhere, particularly with summer rain. Where cultivation is absolutely essential, apply a systemic herbicide about two weeks before cultivation.

Mowing and slashing at flowering can dramatically reduce weed seed set, especially if repeated on regrowth. With reasonable soil moisture it regrows readily and often lower to the ground.

Chipping (hoeing) can be used for a few, sparse new silverleaf nightshade invasions. Whilst this is unlikely to kill plants and follow up treatment (eg, with herbicides) will be needed, it may be helpful in an integrated program.

Match control measures with the biology of the plant

Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Peak growth		Growth		Dormancy				Growth			Peak
									Flowering		
										Seed set	
									Herbicides		
									Chipping		
								Competitive pastures			
								Maximise groundcover			
Diligence and quarantine to prevent seed entry											

Biological control

No biological control agents are available for silverleaf nightshade. Research is underway to assess potential options with nematodes, *Verticillium* wilt and allelopathic eucalypts.

New silverleaf nightshade research

A research project funded by MLA is currently assessing a number of options to improve control of silverleaf nightshade. This research (at the Graham Centre, Wagga Wagga, NSW) is examining issues like the most competitive pasture type (eg, temperate perennials, summer-active perennials, lucerne), effective herbicides and herbicide combinations, and a search for effective biological control agents and natural allelochemicals.

Diligence

Silverleaf nightshade 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 spread of root fragments.
- Prevent it from entering.

Monitor constantly particularly in spring, summer and after control measures. Review and record the areas of infestation by updating maps and/or count weed density in quadrats to determine:

- Is the weed density reducing?
- Is it contained to existing areas?
- Are infested areas reducing in size?
- How effective was each control activity?
- Are summer pastures healthy and competitive?

Timing must be right – be sure control measures are effective before seed sets in summer. Plan carefully so silverleaf nightshade control activities fit with other workloads.

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

- Spring & summer – monitor to detect outbreaks and assess control measures.
- Late spring/summer – herbicide, chipping at flowering, before seed set.
- Spring/summer – ensure pastures are competitive.
- Winter & spring – graze infested paddocks down to less than 3,000 kg/ha dry matter.

Follow up – if control measures haven't 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.

Further information



For further information on silverleaf nightshade or pasture management, contact your local agricultural office or agronomist. You may also find useful information from:

Australian Wool Innovation

Weed, pasture and grazing management information

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

Meat & Livestock Australia

Weed Removers Course

Pasture Health Kit

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

3D Weed Management: Silverleaf Nightshade Case Studies

available from MLA and AWI

WEEDeck – identification

www.weeds.org.au/weeddeck

CRC for Australian Weed Management

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

NSW Department of Primary Industries

Silverleaf nightshade brochure

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

Pasture Management for Weed Control

Weeds CRC/NSW DPI / CSIRO /MLA

Department of Primary Industries Victoria

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

Queensland Government Natural Resources and Water

www.nrm.qld.gov.au
Ph: 07 3237 1435

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