

3D weed management

Onopordum thistles

Onopordum spp

Onopordum thistles infest several million hectares of south eastern Australia, causing production losses of approximately \$50 million per annum.

Scotch thistle and Illyrian thistle are major weeds in pastures on the central and southern tablelands, the central and south western slopes of NSW; and across the 400-900 mm rainfall zones in Victoria, South Australia and Tasmania. Depending on the level of infestation, these Onopordum thistles can reduce farm carrying capacity by 30% or more, cause physical injury to livestock and contaminate wool. Dense patches of these thistles can restrict stock movement. Onopordum thistles are annual and/or biennial and thrive in highly fertile soils with good winter rainfall in temperate and sub tropical zones. The relatively large seeds are long lived and, given adequate moisture, can germinate throughout the year, particularly in autumn. Onopordum thistles are difficult to remove once widely established so early action is critical to prevent seed set and minimise seed entry.



Deliberation

Stocktake

Early detection is critical – be able to identify the main Onopordum species.

Map infestations on your farm.

Identify sources of infestation.

Plan strategies

Prevention – aim for zero tolerance.

Eradication – prevent seed set for at least 17 years, prevent new seed, suppress, reduce vigour, kill existing plants, deplete root reserves, minimise economic impact.

Containment and management – winter cropping, prevent seed set, monitor & control new outbreaks.

Diversity

Use several tools

Weaken and kill weeds, and prevent seed set.

Competitive pastures year round, particularly in autumn.

Cultivation – to prevent seed set and reduce vigour of plants.

Herbicides in winter, spring or summer before seed set.

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

Crop rotations on arable land for 3-4 years with herbicides followed by sowing competitive pastures.

Timing is critical – winter, spring and summer controls to prevent seed set.

Diligence

Persist

Do it right, on time, every year.

Continue monitoring:

- For new plants – particularly after winter, spring /summer rain.
- The competitiveness of pastures.
- The effectiveness of each control measure.

Follow up:

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

Prevent

Stop plants from setting seed.

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

Monitor and quickly treat likely entry sites.

Destroy new outbreaks – spot spray, hoe and burn.

HELPING PRODUCERS MANAGE WEEDS IN GRAZING SYSTEMS

3D weed management

To cost effectively manage *Onopordum* thistles use the '3Ds' of weed management:

What will it do?

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

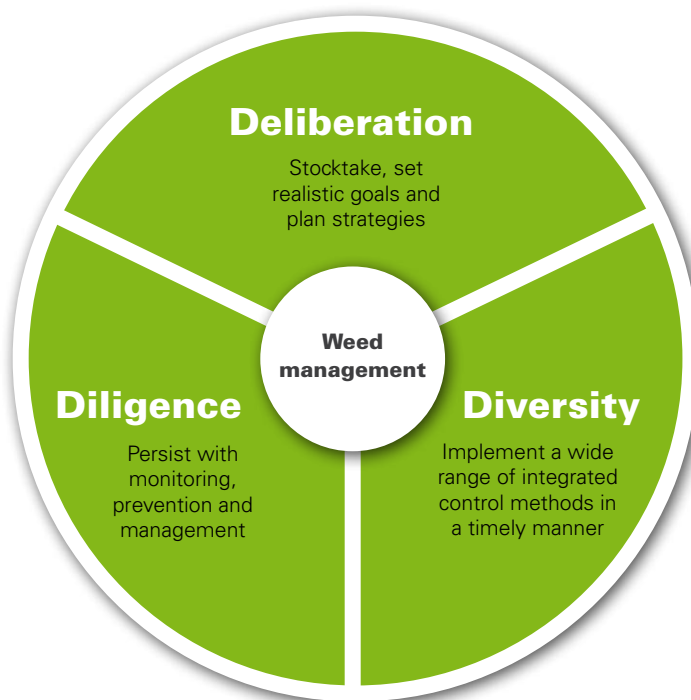
Weed levels can build up quickly and soil seed reserves take a long time to deplete. This is because each plant can set up to 40,000 seeds and the seeds persist for up to 17 years.

Onopordum thistles are unpalatable to livestock and are hairy and prickly. Stock poisoning is not common as they are rarely grazed except when little other feed is available.

They often grow in dense thickets, excluding grazing livestock from these areas. They can cause physical injury to livestock and wool contamination can be a significant issue.

Erosion risk may be increased by reduced ground cover.

Biodiversity is reduced by *Onopordum* dominance.



Deliberation

Stocktake

The first step is to gain a clear picture of *Onopordum* thistles on your farm.

Where are they and how dense?

- Inspect each paddock for *Onopordum* thistles in autumn/winter. Although they are easier to identify at flowering, earlier detection allows more effective control.
- Identify weed hot spots (eg, laneways, sheds, holding yards, sheep camps, dams and other 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 high risk of spread
Moderate	1	10% or more
Dense	5 or more	over 50%

*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 new outbreaks occurring?
- Are existing infestations spreading?
- ➡ A useful tool for assessing pasture condition is MLA's Pasture Health Kit

Where are they coming from?

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

Planning

Plan carefully so that *Onopordum* thistles can be controlled as part of your overall farm management approach.

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 not treated in a year or so you can have a real problem.

Develop strategies

Develop a suitable strategy for the whole farm and each paddock, depending on level of infestation and available resources:

Infestation	Strategy
Clean paddocks	Prevention to stop it entering or establishing.
Scattered plants or small areas	Eradication to remove it.
Moderate – dense infestations	Containment and gradual elimination.
Dense with sources of reinfestation	Management – reduce spread and impact and aim for gradual elimination.

Prioritise on which paddocks to spend your time and budget. This will vary with each situation but the general order of priorities is:

Priority	Strategies
1	Keep clean paddocks clean – prevent seed entry, prevent seed set from various sources of infestation.
2	Eradicate from low infestation paddocks and contain on all other paddocks.
3	Manage moderately infested paddocks.
4	Eradication from all paddocks.

A staged long term strategy is usually needed for moderate and dense infestations – for example, start with management to reduce and prevent seeding, weaken and gradually debilitate the weed for later eradication.



Identify

Early detection and identification will allow quick control. The main *Onopordum* weed species are:

Scotch thistle (*Onopordum acanthium*) and **Illyrian thistle** (*Onopordum illyricum*) are whitish-grey with woolly stems and leaves. They can be annual or biennial. Purple, round flowers with spines appear in spring to early summer. The flowers of Illyrian thistle protrude from the head more so than Scotch thistles.

Stemless thistle (*Onopordum acaulon*) – does not have the extended stems that scotch and Illyrian thistles have. The rosette leaves are woolly but broader than Scotch and Illyrian thistles. Flowers are purple or white and surrounded by sharp spines. It is an annual weed that germinates in autumn and flowers and seeds in spring and early summer.

They can be distinguished from other thistles with grey/green foliage purple flowers:

- **Artichoke thistle** (*Cynara cardunculus*) has white, grooved spiny stems.
- **Nodding thistle** (*Carduus nutans*) leaves indent almost to the midrib. Mature flowers droop or “nod”.
- **Winged slender thistle and slender thistle** (*Carduus* spp) which have a slightly woolly leaf appearance and narrow heads with short pink or purple petals in stalkless clusters.



Case Study

Tony and Patty-Anne Gay from Reid's Flat in southern NSW, believe Onopordum thistles have little impact on their Merino grazing enterprise if thistles are regularly managed as part of an overall weed management strategy.

Left unmanaged, thistles can readily spread, causing contamination of wool, difficulty in mustering sheep and scabby mouth. Tony and Patty-Anne keep thistles at a manageable level by actively spraying thistle patches in autumn each year, focussing on larger patches and susceptible areas like sheep camps. Crown weevils released on their farm by CSIRO 6-7 years ago have persisted, multiplied and spread and stem weevils have entered the property. By reducing seed set, these biological control agents are an important part of the control program used together with herbicides and pasture improvement.

➡ To read more on how other farmers have managed Onopordum thistles, see "3D Weed Management: Onopordum thistles Case Studies" available from MLA & AWI.

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 Onopordum thistles are:

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

Suitable plans include a combination of tools such as:

- ➔ Non-arable areas: manage for competitive, perennial pastures, introduce biological control agents, and spot spray, especially along perimeters.
- ➔ Arable areas: as for non-arable areas plus herbicide control in crop rotations.

Example – Onopordum thistles plan for arable land with crop-pasture rotations

Stocktake

- ➔ Onopordum thistles scattered in light patches covering 5% of 5 paddocks.

Source

- ➔ Purchased hay 12 months ago.

Strategy

- ➔ Eradicate Onopordum thistles from these 5 paddocks.

Actions

- ➔ Quarantine and remove stock from infested paddocks.
- ➔ On all infested paddocks, grow 3 years of winter crops with herbicide in-crop and summer fallow, then plant strong, autumn and winter active perennial pastures.
- ➔ Rotate stock through the 5 paddocks during winter, spring and summer, moving them every 2-30 days and allowing 40 days recovery.
- ➔ Introduce biological control agents to suitable nursery sites on the farm.
- ➔ Monitor all paddocks carefully through the year, particularly in autumn. Use in-pasture herbicide or chip weeds if required.

Diversity

Effective control requires the combination of a range of tools acting on Onopordum thistles over their 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, spring growing pastures.
- Herbicides (in pastures or crop rotations).
- Cultivation and/or chipping.
- Biological control agents.

Prevent seed entry

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

Farm machinery & vehicles	Clean down and/or quarantine to designated areas that can be monitored.
Livestock movements	Restrict livestock from unknown or infested land for 14 days to specific areas that can be easily monitored.
Seed & hay harvested from infested areas	Carefully monitor all new sowings of pastures and crops in the year of establishment as well as into the following seasons and monitor areas where hay is fed.
Nearby land	Regularly monitor and treat farm boundaries.
Water	Carefully monitor along creeks, waterways and overland flow areas.
Wind	Wind moves seeds only relatively short distances – monitor areas close to infestations.

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, pastures need to be deep-rooted, with a strong perennial component.

The largely biennial *Onopordum* thistles can germinate throughout the year so competition is needed year round. Autumn is a significant germination time for the weed, so summer/autumn pasture competitiveness is important to suppress emergence. Consider one or more of the following pasture options:

- Strong temperate, perennial grasses, with annuals.
- Winter growing annuals like sub clover and grasses that improve competitiveness of the perennial pasture.
- Lucerne on suitable soils (not acid, shallow or prone to waterlogging).

Maintain good soil fertility and monitor and control other pests that can lower the competitiveness of pasture.

How competitive is your pasture now?

Determine whether the species composition and density of your pastures is adequate to compete against *Onopordum* thistles. Typically (there are significant differences between species) the 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”

Understanding *Onopordum* thistles

In planning an effective control strategy, it is helpful to understand something of the biology of *Onopordum* thistles.

Growth: The growth pattern of Scotch and Illyrian thistles (*Onopordum* spp) is similar to that of winter annuals such as sub clover and temperate perennials like phalaris, cocksfoot, fescue and perennial ryegrass.

Onopordum thistles can be either annual or biennial. From an autumn and winter germination, they generally behave as an annual, growing as a rosette until they receive their “cold requirement” in the winter then running up into stems and heads in the spring and summer. If they germinate in spring or summer they behave as biennials, growing as a rosette through summer to winter and then flowering in the following spring/summer. Because of their often biennial habit and fast early growth, they form a deep root system that adds to their competitiveness.

Spread: *Onopordum* thistles are prolific seeders. A single plant can produce 40,000 seeds, and the seed can remain dormant in the soil for at least 17 years. They are extremely difficult to eradicate because of this.

Weakest point: Target control measures to the weakest points in the plant’s lifecycle – at the rosette stage and when the plants are actively growing in spring, before seed set.

Grazing management

Generally, grazing management aims to ensure pastures are competitive to suppress emerging thistles, particularly in autumn. Managing the grazing pressure is important in pastures degraded by drought or overgrazing.

To improve the persistence, density, vigour and productivity of pastures, ensure they are able to rebuild root reserves and set seed:

- Maintain herbage levels (perennials, annual grasses, clovers, weeds) at 1000-3500 kg/ha dry matter. Heavier stocking rates, combined with mowing/slashing or cutting some areas for hay or silage during late winter/spring may help keep pastures within these dry matter targets in good seasons.
- Use some form of rotational grazing. Even converting from set stocking to a three paddock rotation is helpful. On most perennial pasture types:
 - Exclude or restrict stock during the pasture's early regrowth phases, and occasionally during the flowering and seeding period.
 - Allow good recovery periods after grazing (30-50 days).
 - Relatively short grazing periods (2-30 days), depending on seasonal conditions, species and time of the year during active growing phases.

Goats may be used to graze down thistles.

Herbicides

Herbicides are valuable tools for control of *Onopordum* thistles. Options include glyphosate, dicamba, chlorsulfuron, clopyralid and 2,4-D.

Herbicide application needs to be carefully targeted because thistle leaves are hairy and difficult to wet.

Timing is critical:

- At the rosette stage is preferred. Good control can be achieved up until maturity if rates are increased.
- Herbicides are most effective on actively growing plants.
- Spray before seed reaches the 'dough' stage of maturity.

Herbicides are most effective where pastures are strong enough to compete with the weakened weeds and when used in cropping phases of the rotation.

Spot spraying is important in most programs to kill invading infestations, 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, stock camps, dams or rock outcrops.

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

Broadacre spraying in winter, spring or summer on crops, fallow or pastures is effective against *Onopordum* thistles.

- Summer crops – choose a crop like forage sorghum or millet that allows in-crop use of broadleaf herbicides such as 2,4-D amine.
- Winter cropping – effective herbicides should be used in the summer fallow period as well as within the crop growing period.
- Grass pastures – winter, spring and summer options to apply effective herbicides.
- Lucerne pastures – few options other than 2,4-DB.

Rope wick wipers selectively apply herbicide to *Onopordum* thistles when surrounding pasture is eaten down and can be useful on small areas.

Cropping rotations

The main benefit of crop rotations is the range of effective herbicides that can be used in winter, spring or summer in crop or in fallow.

Match control strategies to the biology of the weed

Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Rosette stage & slow growth								Active growth			
								Flowering			
New seedlings grow as a biennial		New seedlings grow as an annual						New seedlings grow as a biennial			
Monitoring											
					Herbicide, cultivate			Herbicide/ chip/ hoe			
								Release bio-control agents			
			Competitive pastures with 1,000-3,500kg/ha dry matter								
>70% groundcover from competitive pastures											
				Crop rotations for 3-4 years with in-crop & fallow herbicide controls							
Diligence and quarantine to prevent seed entry											

To be effective in controlling *Onopordum* thistles, crop rotations involve:

- Cultivation or herbicides to effectively remove weeds, especially in the pre-sowing phase. Cultivation must guard against weeds being transplanted.
- A three to four year crop rotation with effective herbicide use in crop or fallow to prevent seed set.
- Sowing a strong competitive perennial pasture to follow the final crop.

Mechanical control

Cultivation as part of a cropping and seed bed preparation for pastures can be successful in removing *Onopordum* thistles.

Mowing and slashing around flowering time is generally unreliable, although sometimes helpful. The weeds tend to regrow, often lower to the ground.

Chipping (hoeing) can be used for isolated *Onopordum* thistle plants and can be a useful part of an integrated program.

Biological control

Current biological control agents alone will not remove *Onopordum* thistles but when used in combination with other measures can reduce weed vigour and reduce or even prevent seeding.

Australian Wool Innovation and Meat & Livestock Australia funded the release of biological control agents by CSIRO and NSW DPI.

A combination of biological control agents is most helpful as they attack the weed at different stages. Those that are effective against thistles include:

- **Seed-head weevil** (*Larinus latus*) larvae destroy the seed in the flower head in December and January. The adults emerge in late summer and feed on the foliage of host thistle until winter.
- **Stem-boring weevil** (*Lixus cardui*) adults chew holes in the leaves of rosettes and developing stems. The larvae bore into and feed on the stems during summer.

→ **Crown weevil** (*T. brieseli*) larvae feed in the leaf petioles and can also bore into the crown and root of the plant. They are active from spring to early autumn.

→ **Petiole moth** (*Eublemma amoena*) larvae feed on the crown of the rosette during autumn, winter and spring. Adults feed on stem leaves during spring and summer.

These biological control agents are quite widespread. They may be introduced to a farm by carrying stems from thistles in areas where the agents are present and placing these in a nursery area in summer/spring.

Nursery areas help to encourage biological control agents to build up and to retain a resident population. Nurseries are small fenced areas carefully managed to ensure thistles or similar species survive.

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 herbage levels, where possible, between 1000-3500 kg/ha dry matter, especially in autumn and winter.	
Pastures				Ensure pastures are competitive year round. Maintain 70% groundcover.	
Herbicides	Kill any new entrants before seed set.	Treat before flowering autumn/winter/spring.	Spot spray or broad-acre depending on level of infestation – winter, spring, summer.		
Cropping	Clean equipment before use.		Crop for 3-4 seasons using in-crop & fallow herbicides before seed set.		Plant profitable crops as part of a sustainable rotation.
Mechanical	Clean equipment before use.	Cultivate winter/spring/summer.	Chip individual plants.		
Biological		Release biological control agents such as Seed-head weevil, Stem-boring weevil, Crown moth & the Rosette weevil.			
Quarantine	Minimise risk of entry & watch all entry sites.				

Diligence

Onopordum thistles are 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 after control measures) the areas of infestation by updating farm maps and/or counting weed densities in quadrats:

- 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 summer/autumn pastures healthy and competitive?

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

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

- Summer/autumn/winter – ensure pastures are competitive.
- Autumn/winter and spring/summer – monitor to detect outbreaks and assess control measures.
- Winter – herbicide, cultivate.
- Winter and spring – graze infested paddocks to between 1000-3500 kg/ha dry matter.
- Spring/summer – herbicide, chipping, and release biological control agents before seed set.

Follow up – if control hasn'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 more information on Onopordum thistles 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

MLA Tips and Tools: Managing scotch, nodding and spear thistles boosts pasture

www.mla.com.au

Ph: 1800 675 717 – option 3

3D Weed Management: Onopordum thistles Case Studies

available from AWI and MLA

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

Agfact P7.6.55 Scotch, Illyrian and stemless thistles (*Onopordum* spp)
Video – Control of weeds with goats
www.dpi.nsw.gov.au
Ph: 02 6391 3100

Department of Primary Industries Victoria

Landcare note LC0176 Scotch thistle

www.dpi.vic.gov.au

Ph: 136 186

CSIRO Entomology

www.csiro.au/weeds

Ph: 02 6246 4001