

Scotch, Illyrian and stemless thistle

Weed Management Unit, NSW DPI

Introduction

There are four *Onopordum* species thistles present in Australia. Three are major weeds of pastures in some areas of New South Wales (NSW). These are

- Scotch thistle (*Onopordum acanthium*),
- Illyrian thistle (*Onopordum illyricum*) and
- Stemless thistle (*Onopordum acaulon*).

The fourth species, Taurian thistle (*Onopordum tauricum*), is recorded only in two isolated areas of Victoria.

An additional species, *Onopordum nervosum*, was detected in NSW. It was promoted as an 'cottage garden' plant and was purchased by mail order via the internet. Populations of this species were destroyed.

These thistles are all members of the Asteraceae (daisy) family and originate from Europe and Asia.

Distribution

In NSW, Scotch thistle and Illyrian thistle are major weeds of pastures on the Central and Southern Tablelands and the Central and South-West Slopes. They are also present to a much lesser extent on the coast, Northern Tablelands and North-West Slopes.



Figure 1. Illyrian thistle flower. Photo: J. Dellow.

Stemless thistle is a troublesome annual weed of pastoral areas of South-West Plains. It is the most widespread of the *Onopordum* species in Australia.

All three *Onopordum* species are still extending their range in NSW.

Habitat

Onopordum thistles grow well in the warm temperate regions. They are typically found in cultivated areas, on disturbed ground such as roadsides, rocky slopes and wasteland. They are often a problem on non-arable pastures. Thistles tend to favour the more fertile soils and those sown to introduced pastures.



Figure 2. Stemless thistle. Photo: J. Dellow.

Scotch and Illyrian thistle flourish on soils that are well drained and of moderate to high fertility and are particularly common on high fertile soils associated with introduced perennial pastures in the winter dominant rainfall zone. They prefer moderate to high rainfall. In contrast stemless thistle is found in areas of less than 450 mm of rainfall such as the pastoral areas of south-western NSW and can grow on a wide range of soils from sandy soils to the heavier, more fertile soils.

Impact

Thistles compete with pastures and reduce their carrying capacity. Rosette leaves smother desirable pasture species in spring reducing their early growth.

Dense stands of mature thistles create barriers that hinder livestock movement. Parts of the plant can break off causing vegetable fault and thus a loss in value for the wool. Thistles can cause injury to livestock and people handling the livestock or fleece.

Thistles are prolific seeders and can spread quickly if not controlled. Once established thistles are difficult and expensive to control. Dense thistle populations can reduce property values.

Description

Scotch and Illyrian thistles are often confused with each other and are sometimes identified as the same species.

There is a large variation within each species due to hybridisation between Scotch and Illyrian thistles. These two species have the same weediness and control methods.

The major differences between the three *Onopordum* species present in NSW are summarised in Table 1.

Scotch thistle

Onopordum acanthium is also known as heraldic thistle, cotton thistle and woolly thistle.

The plant has a whitish-grey appearance with woolly stems and leaves. The flower heads are purple and round with spiny bracts. These bracts, surrounding the flowers, are the main distinguishing feature. They are sharp, needle-like and less than 3 mm broad at the base, yellow in colour, and only the outer bracts are reflexed (bent sharply backwards). The plant can grow to over two metres in height.

Illyrian thistle

Onopordum illyricum is also known as Scotch thistle and woolly thistle.



Figure 3. Scotch thistle flower. Photo: J. Dellow.

It has the same whitish-grey, woolly appearance as Scotch thistle. Its main distinguishing feature is the configuration of the flower head. The flowers are purple and protrude slightly more from the head than they do with Scotch thistle. The bracts surrounding the flower are much broader than 3 mm at the base, are reddish-purple in colour and are all reflexed. The rosette leaves are more deeply lobed and the mature plant looks more skeletal and angular.



Figure 4. Mature Illyrian thistle. Photo: J. Dellow.

Stemless thistle

Onopordum acaulon is very similar to the other two species during the seedling and rosette stages. The rosette leaves are woolly, but are less lobed and broader than the other two species. The mature flowering plant is readily identified as it is stemless and prostrate with a 'wreath'-like appearance. It grows up to 60 cm in diameter and has the round flower heads in the centre of the rosette.



Figure 5. Mature stemless thistle. Photo: J. Dellow.



Figure 6. Seedlings of Scotch thistle (left), stemless thistle (centre) and Illyrian thistle (right). Photos: J. Dellow.

Table 1. Comparison of *Onopordum* species thistles

	Scotch thistle <i>O. acanthium</i>	Illyrian thistle <i>O. illyricum</i>	Stemless thistle <i>O. acaulon</i>
Lifecycle	Annual to biennial	Annual to biennial	Annual
Seeds	species similar – rectangular, 4–5 mm long, greyish-brown		
Seedlings	cotyledons and seedlings all very similar (see Figure 6)		
Colour and texture	whitish-grey with woolly stems and leaves	whitish-grey with woolly stems and leaves (less woolly than Scotch and stemless thistles)	whitish-grey with woolly leaves
Rosette leaves	lobed with spiny margins	deeply lobed to main rib (more deeply lobed than scotch and stemless thistles)	lobed with spiny margins (broader than Scotch and Illyrian thistles)
Stems	erect with spiny wings extending from leaves	erect with spiny wings extending from leaves (more skeletal, angular appearance than scotch thistle)	stemless and prostrate
Flower heads	purple, globular with long, slender bracts less than 3 mm with only outer bracts reflexed	purple, globular with broad bracts wider than 3 mm, bracts reddish-purple and all reflexed (flowers protrude more from head than scotch thistle)	white to purple clusters of globular heads in centre of rosette, sharp bracts
Flowering time	August–December	December–February	October–December
Distribution in NSW	mainly Central and Southern Tablelands and Slopes	mainly Central and Southern Tablelands and Slopes	mainly south-western pastoral areas but scattered populations are present on the Northern Tablelands



Figure 7. Rosette leaves of Scotch (left), stemless (centre) and Illyrian thistle (right). Photo: J. Dellow.

Life cycle

Scotch and Illyrian thistles are annual or biennial but can behave as short-lived perennials when stressed (e.g. during drought or when they are slashed or mowed prior to flowering). Stemless thistle is mostly an annual plant.

Seeds can germinate at any time of year, however rain in summer and autumn often result in establishment events. Seedling survival is highest when there is little ground cover or competition from other pasture plants. Plant growth is dependent on rainfall.

Thistles form rosettes in their first year and develop a thick tap root that supports the development of an erect flowering stem one to two metres (rarely to three metres) in height later in the lifecycle. Stemless thistle has no stems.

Plants that germinate in autumn can flower in the following spring or summer and then die (annuals). Plants that germinate later in winter or spring/summer can be biennials, that is, if the summer is favourable the plants remain as rosettes until the following spring and then flower. This is because the plants need a winter chilling period before they flower. A proportion of the thistle population may persist in the rosette stage for several years before flowering as a response to stress (perennial).

The variable germination and biennial growth habit increases the difficulty in controlling these thistles as there is always a mixed age population, from seedlings through to mature plants.

Thistle seed production can vary from a few hundred per plant in a poor season to over 10 000 per square metre in a good season. Seed is long-lived and can remain viable in the soil for more than eight years.

Spread

The main form of spread is by seed. The seeds have fine hairs which can easily attach to stock and clothing. The seed is often spread in hay, on machinery or vehicles. The seed can also survive the digestive tract of sheep.

The seed of stemless and Illyrian thistles are well suited for wind and water dispersal. The Scotch thistle seeds are poorly spread by wind except when the seed head breaks off the plant and is blown about by strong winds.

Scotch thistle may be spread when root fragments are moved by cultivation equipment. This is rare as plants will only survive if the fragments are fresh and the ground is moist and soft.



Figure 8. Scotch thistles grow to two metres. Dense infestations can prevent movement of vehicles or stock. Photo: J. Dellow.

Control and management

The control and management of all three species is similar.

Integrated weed management

An integrated management program is the key to successful thistle management. The use of a range of tools such as the maintenance of a strong perennial pasture, strategic herbicide application, chipping by hand and use of biological control agents where appropriate is the best strategy for long term control.

The key to managing thistles is control of seed set. By preventing plants from ripening seed the following year's population will be greatly reduced. Dense populations of thistles may have to be controlled in stages.

Consistency of control is also important. Trials show that preventing seed set for five years reduced a large thistle population, however plant numbers returned to pre-trial levels after only two years when no control was undertaken.

Preventing spread

Control isolated patches before they have a chance to spread. If transporting hay from areas where these weeds occur, monitor the area where the hay was spread out for thistle seedlings and kill them before they set seed

Quarantine sheep in holding paddocks if moving from infested to uninfested areas to allow seed to pass through the digestive tract. A minimum of five days is recommended. Monitor and kill any thistles before they set seed in quarantine paddocks.

Pasture management

The most important part of any thistle control program is maintaining a dense, vigorous and competitive pasture. A vigorous perennial grass pasture provides competition for germinating thistles reducing seedling establishment.

Gaps in the pasture result in an increase in thistle germination and seedling survival so maintaining excellent ground cover at all times is desirable. Maintenance of adequate ground cover especially in summer and early autumn is essential to reduce the potential for the establishment of thistles.

Establishing a new pasture

Establishing introduced perennial pastures is expensive so thorough preparation and research into suitable species and varieties is required. The establishment of adequate plant numbers is the first step to a successful pasture. Seek advice from your agronomist on the best pasture establishment steps for your situation. Some perennial grasses, particularly

phalaris, compete strongly with Scotch and Illyrian thistles. Lucerne competes well with stemless thistle.

Sown perennial pastures also require regular maintenance fertiliser applications (as dictated by a soil test) to maintain their vigour and competitiveness. Grazing management and ground cover is a critical factor to the maintenance of adequate perennial plant density in the years following pasture establishment.

Maintaining the current pasture

Management of existing native and naturalised pastures should aim to maintain perennial grass content and ground cover. Identify the species present, their growth cycles and their response to grazing, and fertiliser to formulate a management regime that is most suitable to maximising their competitive behaviour. The addition or dominance of too many legumes, combined with fertiliser and a trend towards an annual pasture system can lead to instability in the pasture and potential for thistle invasion.

While thistles respond to increases in soil fertility (and in particular nitrogen), management of all pasture types should aim to maintain pastures that have a good balance of perennial grass to legume content.

Fertilisers

Fertiliser application (as determined by a soil test) will improve the vigour of annual and perennial introduced grasses, increasing ground cover and reducing future thistle establishment.

Grazing management

Thistles are generally avoided by stock. However goats eat thistles at both the rosette and flowering stage as well as post-flowering. Horses, and sometimes cattle graze the flower which can reduce the amount of seed. The amount eaten depends on the grazing pressure and the amount of other feed available.

Physical removal

Isolated plants should be removed using a hoe or mattock (chipping or grubbing). Remove as much of the taproot as possible so that regrowth does not occur.

Cultivation is effective on seedlings or young rosettes if they are uprooted. Older rosettes are damaged by cultivation but are able to regrow, especially if the soil is moist.

Slashing or mowing is not usually effective as plants develop new growth from the base. Immature seed heads that are cut and left lying on the ground can contain viable seed.

Herbicides

Herbicide control can be very effective and is an essential part of the overall management of these thistles. When there is a low density of thistles, spot spraying or chipping is preferred.



Figure 9. Illyrian thistle grazing trial. Goats eat thistles at the rosette and flowering stages. Photo: NSW DPI.

Onopordum thistles can be difficult to kill, and a number of critical factors should be taken into consideration when using herbicides. These include:

- Correct rate and timing of application – herbicides are most effective on seedlings and young rosettes however once plants begin stem elongation herbicides may be less effective.
- The hairy leaves of the thistles can reduce herbicide effectiveness through reduced absorption. Therefore it is important to follow the herbicide label and use the recommended rate, application volume and adjuvant.
- Control will be reduced if plants are stressed.

Always read the herbicide label prior to applying herbicides.

For populations of thistles where there is a mixture of sizes, spray in the spring before the flowering stem develops. If there is a flush of seedlings in the autumn an early spray can prevent the rosettes from colonising the ground and competing with the pasture.

Take care in selecting the herbicide product, as many registered and effective herbicides for control will damage pasture legumes leaving room for other weeds to establish. Regular herbicide use affects the long term composition of the pasture. For lists of herbicides registered for these thistles see the *Noxious and Environmental Weed Control Handbook*, *Weed Control in Lucerne and Pastures* or *Weed Control in Winter Crops* available from NSW DPI or www.dpi.nsw.gov.au/weeds

Resistance

In New Zealand the total reliance on 2,4-D ester (MOA Group I) for the control of nodding and slender thistles for many years has led to the development of herbicide resistance, however this has not yet been recorded in Australia.

Dense thistle populations with large seed banks are a higher risk to develop resistance compared with sparse weed populations.

Herbicides should only be used as part of an overall management strategy.



Figure 10. Illyrian thistle infestation. Photo: J. Dellow.

Spray grazing

Spray grazing is the use of a sub-lethal rate of herbicide to 'sweeten' the weeds, making them palatable to livestock. Only use this method when there are low levels of the weeds present and there is plenty of alternative feed available. Weeds must be in the early rosette stage. For spray grazing to be effective sheep stocking rates must be increased to 8–10 times the normal rate. Grazing should be continued until the weeds have had the growing points eaten but not to the point where the pasture species are at risk. Spray grazing is only effective if there is a competitive pasture to replace the weed.

Observe the stock health warnings on the herbicide label when using the spray grazing technique. There is a risk of stock poisoning if a large proportion of the pasture consists of other weeds such as Paterson's curse (*Echium plantagineum*) or variegated thistle (*Silybum marianum*).

Biological control

Biological control of thistles is a long term tactic and should only be seen as part of an effective integrated weed program.

Up to ten insect species were trialled for release for the biological control of *Onopordum* thistles. The successfully established species shown below were released several years ago and are now present in most areas affected by *Onopordum* thistles. There should be no need for redistribution of these species.

These biological control agents have a direct impact on the seed set of thistles. This is important for the long term control of thistles.

Seed-head weevil

The seed-head weevil, *Larinus latus*, was released in spring 1992. The adult weevil is up to 25 mm long, 10 mm wide and is black with a yellow waxy coating. Adults hibernate over winter until mid to late spring when they become active and mate. Each lay up to 30 eggs on the thistle flower head. Larvae hatch and tunnel into the flower head where they feed on the tissue supporting developing seeds. After feeding for about six weeks the larvae pupate.

A single larva is capable of destroying all the seed in a flower head of 3 cm diameter or less and more than one larva may develop in larger heads. This weevil has only one generation per year so it has taken a number of years for populations to grow large enough to destroy most of the seed in a flower head. At some NSW sites this insect has reduced seed production by more than 80 per cent.



Figure 11. Clockwise from top left. The crown moth (*Eublemma amoena*). The rosette weevil (*Trichosirocalus briesei*). The seed-head weevil (*Larinus latus*) attacking Illyrian thistle. The stem-boring weevil (*Lixus cardui*). Photos: CSIRO Entomology.

Stem-boring weevil

The stem-boring weevil, *Lixus cardui*, was first released in November 1993 and is now widely established. Adults grow up to 15 mm long and are brown in colour. They emerge from stems in early spring and chew holes in the leaves of thistle rosettes. Females lay eggs into the flowering stems then larvae bore into the plant. Adults continue to feed on the leaves. Combined heavy adult and larval feeding can reduce plant growth and subsequent seed production.

The stem-boring weevil is not capable of killing *Onopordum* thistles. Its activity weakens the plant, makes it less competitive and reduces seed production. This action allows insects such as the seed head weevil to have a greater impact on the plant.

Crown moth

The crown moth, *Eublemma amoena*, was first released in 1998. Adult moths are mottled, light brown and white and up to 15 mm in length. There are three adult generations per year, commencing in spring when adults emerge from pupal cells in thistle rosettes. Females lay eggs on leaves and larvae feed in the leaf petioles, causing leaves to shrivel and die. Larvae can also bore into the crown and root of the plant. This may lead to the death of smaller plants. Larvae of subsequent generations feed in the leaves of stems, causing similar leaf shrivelling, reducing plant vigour.

Rosette weevil

The rosette weevil, *Trichosirocalus briesei*, was first released in 1997. It is now established in many areas and is starting to have an impact on thistle populations. Adults are 3–5 mm long and a mottled brown colour. There is one generation per year. Adults emerge from a summer dormancy period following autumn rains and commence feeding on rosette leaves. Females lay eggs near the base of the rosette leaves. After hatching, larvae destroy the growing point of the rosette either killing the plant or severely reducing its vigour.

Legislation

In some areas of NSW Scotch thistle, stemless thistle, Illyrian thistle and Taurian thistle are declared as Class 4 noxious weeds under the *NSW Noxious Weeds Act 1993* (Figure 12).

Class 4 control requirements are that 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the Local Control Authority.'

The responsibility for control of noxious weeds on private land rest with the landowner or occupier of the land.

A full list of noxious weeds and requirements under the Noxious Weeds Act can be found at www.dpi.nsw.gov.au/weeds

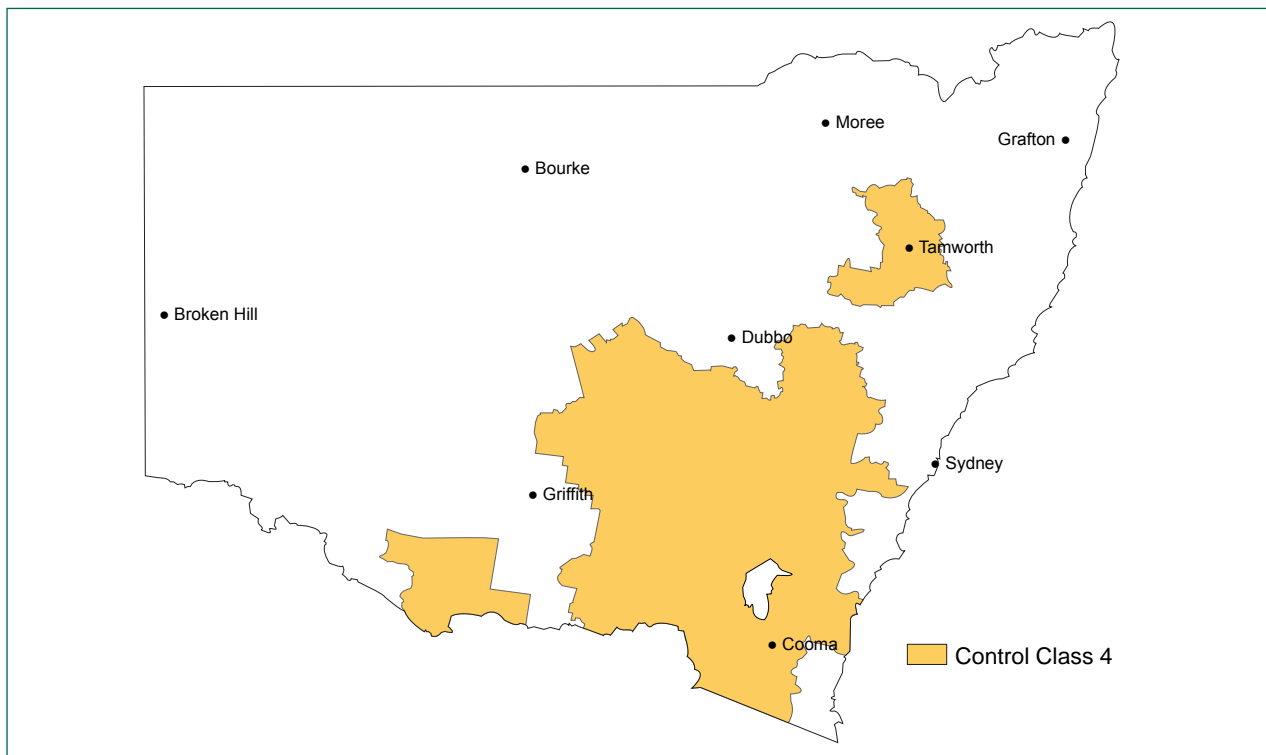


Figure 12. Areas of NSW where *Onopordum* species are declared a Class 4 noxious weed.

Acknowledgements

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Warnings: Pasture improvement may be associated with an increase in the incidence of certain livestock health disorders. Livestock and production losses from some disorders are possible. Management may need to be modified to minimise risk. Consult your veterinarian or adviser when planning pasture improvement.

Legislation covering conservation of native vegetation may regulate some pasture improvement practices where existing pasture contains native species. Contact your Catchment Management Authority office for further information.

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