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NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Nodding thistle

Agfact P7.6.28, second edition, March 2005
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The Problem

Nodding Thistle (*Carduus nutans* subsp. *nutans*) is a member of the family Asteraceae and is endemic to Europe, Asia Minor and North Africa.

It was introduced to Australia in the late 1940's as a seed contaminant and is now a declared noxious weed in many parts of NSW (See Map 1).

In Australia, nodding thistle has proven to be an aggressive competitor of pastures. It occurs in dense patches and is not readily grazed by most stock because of its spiny foliage. Its presence also discourages animals from grazing other neighbouring pasture plants and it can affect the movement of stock.

It is difficult to control because of: its long flowering season; prolific seed production; the longevity of its seed bank; a variable life cycle; and the ability to germinate at any time of the year provided there is moisture available.

Typical infestation of nodding thistle



Distribution

Because it requires a period of chilling (vernalisation), nodding thistle is confined to cool temperate areas in Australia. It infests about 1 million hectares of the tablelands of NSW and small areas in the ACT, Victoria and Tasmania.

It is usually found on soils of moderate to high fertility in areas with an annual rainfall of 500 to 900 mm.

A closely related species *Carduus thoermeri* occurs in south-east Queensland only.

The Plant

Nodding thistle is an erect annual or biennial herb growing to 1.6m high and commonly 80 to 120 cm in diameter.

The young plant first grows into a flat rosette. The rosette leaves are dark, shiny green and often have a whitish midvein. They eventually

A nodding thistle seedling



become deeply lobed and end in a rigid spine about 3 millimetres long.

Once the rosette is exposed to a sufficient period of low temperatures (vernalisation) it begins reproductive growth, resulting in stem production. In some high altitude locations this can occur at any time of the year.

Normally only one stem arises from a rosette and branches profusely 20 to 30 cm above the ground. However, if the crown is damaged, multiple stems are produced. The stems are slightly cobwebby with the wings extending to the flower heads.

Stem leaves are light green or yellowish in young plants and grey green, even dark green with a prominent white central vein in older plants. They vary in size and shape (lobing) depending on the age of the leaf and the position on the plant. The margins are spiny and each lobe is surrounded by rigid spines a few millimetres long.

The spectacular flowers are usually deep red but can be pink, purple, mauve or occasionally white. The individual flowers are tubular and have a musky fragrance – hence the name ‘musk thistle’ in some countries. They form in

A nodding thistle rosette



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The characteristic nodding head



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A rosette leaf



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A whole nodding thistle plant



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a large head, usually 1.2 to 4 cm in diameter, at the ends of main stems or branches and are surrounded by numerous often purplish bracts that also end in a spine. The head droops at right angles to the stem, hence the name – nodding thistle.

The main flowering season generally occurs from early November to late April, depending on the life cycle of the plant (See Figure 1). Odd plants may occasionally flower all year round, but once frosted they generally don't set viable seed.

The seed is grey to yellowish brown, 3 to 4 mm long and is topped by white, simple hairs (pappus) that detach readily from the mature seed. In Australia, the seed bank from nodding thistle can be 100 times greater than in Europe and the seed can survive in soil for several years depending on the habitat and the depth of burial.

Germination can occur at any time throughout the year after rain although the highest germination rates generally follow the autumn break. Young seedlings are particularly vulnerable and control programs should take advantage of this.

Nodding thistle can display a varied life cycle depending on the time of emergence relative to winter. It can exist as a biennial, winter annual

or summer annual so populations can contain plants of mixed ages (Figure 1).

Life cycle has a strong influence on the number of seeds produced by each plant with biennial plants producing more than winter annuals which produce more than summer annuals.

Dispersal

Nodding thistle can only reproduce by seed with most falling close to the parent. Long distance dispersal of viable seed by wind can occur, but is rare because the pappus detaches easily from the seed leaving it close to the source. Seed can also be dispersed in mud, agricultural seed and fodder and by water, vehicles, machinery and livestock.

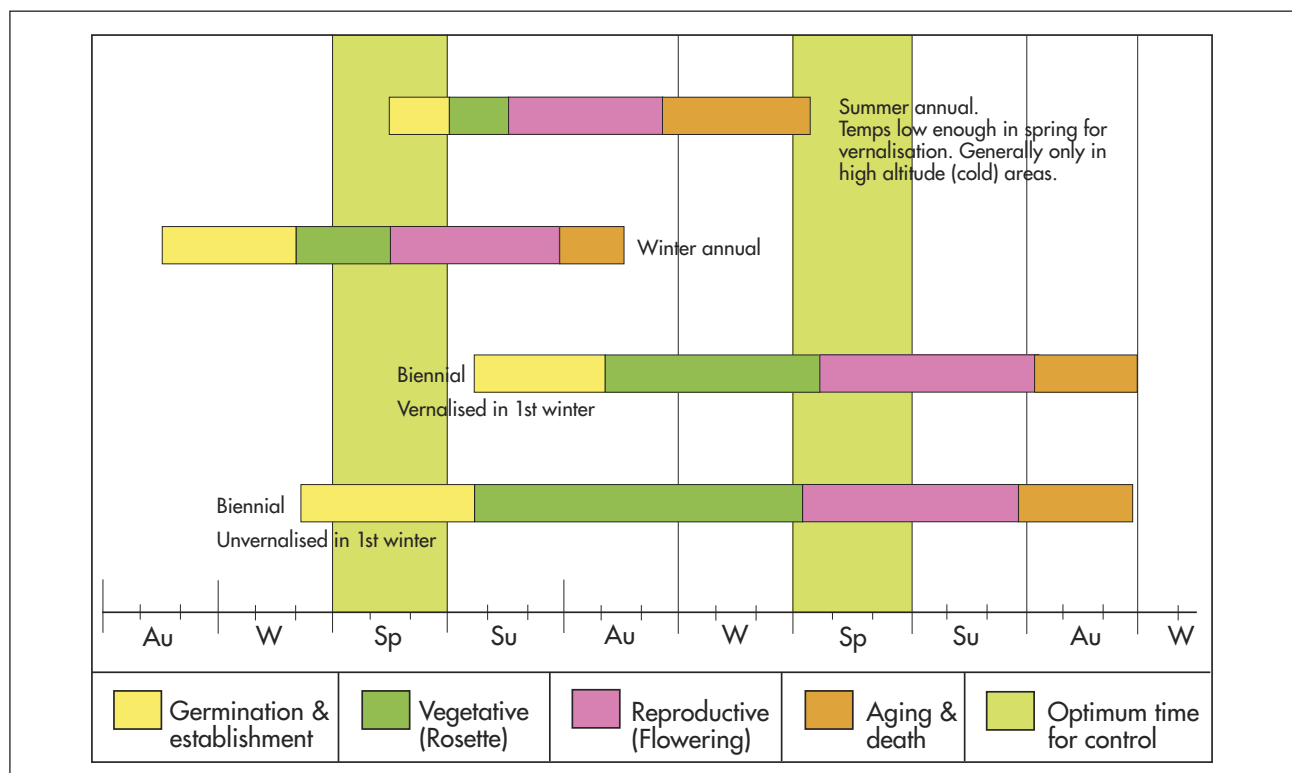
Methods of Control

Due to the longevity of the seed bank and varying life cycles in any plant population, nodding thistle requires a management plan persisting over a number of years. A plan should integrate all available methods of control including physical removal, cropping, perennial pasture management, grazing management, herbicide application, biological control, farm hygiene and regular surveillance.

Because the plant only reproduces from seed, the control effort should be directed at

Figure 1: Life cycles displayed by nodding thistle (J. Tarleton, 2003).

Adapted from: Medd R.W. (1986). *Carduus nutans – ingression through indifference towards weeds* In *The Ecology of Exotic Animals and Plants. Some Australian Case Histories*. Edited by R.L. Kitching.



preventing seed production. The existing seed bank of a nodding thistle infestation could take up to 13 years to deplete because they are large and persistent. Hence, the need for long-term, strategic control programs.

Physical and Mechanical Removal

For scattered plants, grubbing is effective. Because the plant has a strong fleshy taproot, always remove at least the top 10cm of the root system and invert the sod to expose the plant and prevent the development of viable seed.

If flower buds showing pink or reddish colouring or mature heads are present, these must be removed and disposed of (by incinerating or composting in a sealed bag) to prevent the dispersal of viable seed.

Slashing or mowing is an effective short-term measure, however timing is critical (prior to seed production) and the treatment needs to be repeated often as plants can produce multiple shorter stems after slashing. Severed heads can still produce viable seed.

Cultivation can be effective for reducing the viability of the seed bank. Seed longevity is prolonged by burial therefore shallow cultivation to bring the seed closer to the surface assists in the rapid depletion of the seed bank. The subsequent fallow period should be as long as possible, to allow the control of emerging plants before sowing to a pasture or crop.

Crop Management

On arable land, a winter cropping phase of 1 to 2 seasons prior to the establishment of a vigorous perennial pasture can be effective in controlling nodding thistle. The crop provides competition initially to the emerging thistle seedlings reducing the population. In-crop weed control using selective herbicides assists in reducing the seed bank.

Consult your local agronomist for advice on the establishment and management of winter crops. Or refer to the NSW Department of Primary Industries publications, *Winter Crop Variety Sowing Guide* or *Productive Dual Purpose Wheats*. These can be obtained from www.dpi.nsw.gov.au or by contacting a NSW Department of Primary Industries office.

Pasture Management

Maintaining vigorous perennial pastures is critical to prevent nodding thistle invasion.

Seeding rates, appropriate species, fertiliser application and grazing should be managed to maximise the vigour of the pasture and competition for the thistle. Maintaining a strong, competitive perennial pasture is important as the development of bare patches, particularly during peak germination time, provides an ideal habitat for nodding thistle establishment.

Nodding thistle is intolerant of competition for light particularly during the germination stage. Pastures growing rapidly during the peak germination time (autumn) increase competition with the thistle seedlings, reducing the weed population density and ultimately seed production.

Using the 'Spraygraze' technique can also be effective in controlling nodding thistle. This is where sub-lethal applications of an appropriate herbicide are used in conjunction with short-term, heavy stocking rates to minimise the damage done to the legume component of the pasture. This technique relies on the presence of a competitive perennial pasture to replace the weed. See the NSW Department of Primary Industries publication *Weed Control in Lucerne and Pastures* for more information.

Consult your local agronomist or livestock officer for advice on pasture establishment and good pasture and grazing management. Or refer to the NSW Department of Primary Industries publications, *8 steps to successful perennial pasture establishment* (AgFact P2.2.6) or *Pastures for profitable crops – a weed management resource for farmers*. These can be obtained from www.dpi.nsw.gov.au or by contacting a NSW Department of Primary Industries office.

Chemical

Only a registered herbicide used according to the label directions should be used to control a weed. Refer to the NSW Department of Primary Industries publications *Noxious and Environmental Weed Control Handbook* or *Weed Control in Lucerne and Pastures* for the recommended chemicals to control nodding thistle.

As with many weeds, nodding thistles are most susceptible to herbicides at the early seedling stage or when passing from the seedling to the rosette stage. Whilst herbicides applied in autumn can be very effective, additional applications will be required to control new seedlings that can emerge after treatment.

Therefore, the most efficient time to apply herbicides is during early spring when plants have just begun to grow upright stems. This ensures viable seed is not produced and dispersed by the plant. New seedlings that subsequently establish are less likely to be vernalised and so will not flower before the following spring.

Herbicide application is less effective and more difficult on older plants often reducing plant growth but not preventing seed production.

The success of herbicide control relies on spraying with the most appropriate herbicide, at the correct time and during favourable seasonal conditions.

Herbicide resistance of nodding thistle has been recorded in New Zealand so herbicide management strategies to prevent resistance should be implemented.

Biological Control

The biological control of nodding thistle has been investigated in Australia since 1987. The present goal of the program is to limit seed production and eventually decrease thistle density in pastures by combining good pasture management with the introduction of the plants natural enemies.

Three biological control agents have been released in Australia for nodding thistle. These are now established throughout areas where nodding thistle is present.

The seed weevil (*Rhinocyllus conicus*) was the first agent released. Unfortunately, it competes with the seed fly (*Urophora solstitialis*) early in the flowering season and lowers their numbers later in the season when nodding thistle produces most of its seed. Because of this competition, the seed weevil has not been redistributed beyond the original release sites.

An unaffected rosette



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The seed-fly (*Urophora solstitialis*) was released in 1991. Eggs are laid into the developing flower and larvae feed on the cell that contains the embryonic seed. This reduces the potential seed set by inducing the plant to divert nutrients, intended for seed production, into forming a casing or gall around the larvae. It is expected that as the seed-fly becomes more synchronised with the life cycle of the thistle, seed set each year will be reduced significantly.

Plants being attacked by the seed fly can be recognised by an obvious woody gall in the seed heads. These can be seen from a distance later in the season due to the retained pappus (ring of fine hairs) on the seed head (See photograph below).

The head on the right has been attacked by the seed fly. Note the retained pappus



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The rosette weevil (*Trichosirocalus mortadelo*) was released in 1993 and it attacks the crown region of the rosette. The larvae feed on the central growing point and either kill the plant or prevent it from running to head and producing seed.

Plants being attacked by the rosette weevil will have a black discharge coming from the central

A rosette after attack by the rosette weevil.



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crown area of the rosette (See photographs on page 5).

The seed fly and the rosette weevil work together by reducing the vigour of the plant and the eventual seed set.

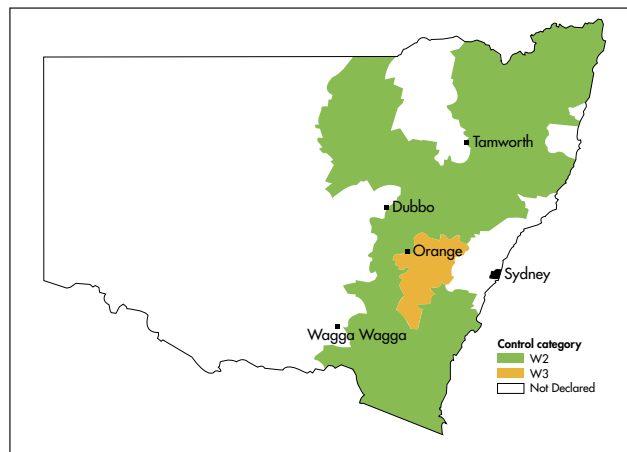
Some aspects of integrating biological control agents with other control methods still need to be explored. For example, the rosette weevil increases the palatability of nodding thistle to stock, so the survival of the weevil population may be dependent on the effect of grazing pressure. Also, the timing of herbicide application to the rosette stage of the plant may have an effect on the feeding rosette weevil populations.

Landholders need to consider these things in the management of nodding thistle if populations of the agents are present on their property. However, there are no guidelines available at present.

Who is Responsible for the Control of a Noxious Plant?

Nodding thistle is a declared noxious weed in many areas of NSW. See www.dpi.nsw.gov.au/noxweed for a complete list of declared noxious weeds for each control area in NSW.

Map 1: Areas of NSW where nodding thistle is declared a noxious weed, January 2003 (Alan Maguire).



It has a W2 or W3 Weed Control Category depending on the infestation and control area. A W2 weed poses a threat to agriculture, the environment or the community and has the ability to spread to other areas. Infestations must be continually suppressed and destroyed. A W3 weed is the same but is also so widespread that total suppression or destruction is impractical.

The *Noxious Weeds Act, 1993* is enforced by the local control authority, usually local government.

The responsibility for control of noxious plants and appropriate disposal of weed plant material on private land rests with the owner or occupier of the land. Failure to do so could result in the local control authority issuing a weed control notice, court action and a fine.

Local control authorities must control noxious weeds on public land adequately to prevent the infestation of adjoining land. Community members can assist the control of this weed by notifying the local control authority of any known infestation of nodding thistle on public land.

Acknowledgements

Information for this Agfact was taken from:

- *Nodding thistle*. 1st Edition. Agfact P7.6.28.
- Parsons W.T. and Cuthbertson E.G. (2001). *Noxious Weeds of Australia*. 2nd Edition.
- Popay A.I. and Medd R.W. (1995). *Carduus nutans L. ssp. nutans* In *The Biology of Australian Weeds*. Vol 1.
- *Biological control of nodding thistle* (1997). CSIRO. Brochure.

The authors would like to acknowledge the comments made by Royce Holtkamp, Bruce Clements and Todd Andrews regarding the technical content of this publication and Jennifer Tarleton for preparation of the graphics.

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NSW Department of Primary Industries
ISSN 0725-7759

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