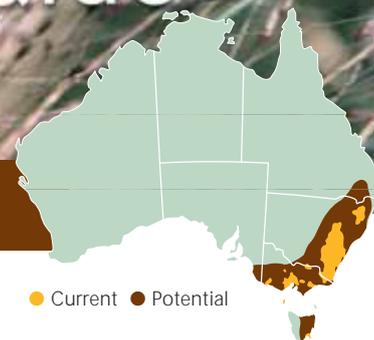


Weed Management Guide

Serrated tussock –
Nassella trichotoma



Serrated tussock (*Nassella trichotoma*)

The problem

Serrated tussock is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts.

It mainly causes problems in grazing lands with poor soil fertility and low rainfall where the benefits of control are marginal. Serrated tussock has no grazing value because of its high fibre and low protein content. Infestations result in a significant loss in livestock production, and dense infestations may completely dominate pasture, making large areas incapable of supporting livestock. Trials on heavily infested areas of New South Wales have shown a loss

of production of up to 95%. In native grasslands serrated tussock reduces biodiversity, and in urban areas it creates a fire hazard.

Serrated tussock has become a major agricultural weed because of the high costs associated with its spread. In New South Wales alone it has been estimated that the weed has cost more than \$40 million in lost production.

The weed

A perennial tussock-forming grass that can live for more than 20 years, serrated tussock has a deep fibrous root system. It grows to a height of 600 mm with a maximum diameter at its base of 150 mm. The leaves are thin

(0.5 mm diameter) and tightly rolled, with small easily felt serrations along their length.

Serrated tussock is similar to several native grasses in general appearance. The *ligule*, a small flap located at the junction of the leaf blade and the leaf sheath, is the key characteristic of serrated tussock. The ligule can be located by tracing a leaf down to where it joins the sheath and bending the leaf back at this point. Serrated tussock has a white hairless ligule about 1 mm long, whereas other grasses have ligules with different colours or hairs, or do not possess them at all.

See the information box (p.3) for help in identifying the tussock grasses.



Seed heads break off and are blown into obstacles, leading to large infestations along fencelines. Photo: David Boyle, Victorian Serrated Tussock Working Party

Key points

- Long-term management relies on the establishment and maintenance of a competitive pasture that outcompetes tussock seedlings and resists reinfestation.
- For successful control, progressively destroy the weed in manageable blocks and replace it with dense pastures, scrub or plantations.
- All control programs should aim to reduce the amount of seed produced.
- Herbicide treatment alone usually results in reinfestation of serrated tussock from seed in the soil, so it is important to incorporate other control methods in an integrated management strategy. Competition from desirable pasture plants is especially important.



Growth calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Pod formation												
Seed drop												
Bleaching due to frost												
Germination												

General growth pattern
 Growth pattern under suitable conditions

Serrated tussock is a perennial grass that reproduces from seed. It builds large seedbanks in the soil and although most seed dies within three years, some may stay viable for decades. Seeds germinate at any time of year but mostly in autumn and winter. Seedlings grow slowly and plants rarely flower in the first year; flowers and seeds are usually produced in the second summer. Flower stalks usually appear in spring, but in dry years plants flower earlier. By the time it flowers, serrated tussock leaves are long and drooping. The seed drops or is blown from the stems ten weeks after flowering commences. The plant mainly grows during spring and early summer and is bleached by frosts in winter and autumn.

How it spreads

Seeds are mainly spread by wind. Mature plants can produce more than 140,000 seeds per plant per year, and the very light seed head can be blown by wind over long distances (up to 20 km). It can also be spread by humans or animals. For example, it can catch on the fleece of sheep or be picked up in mud on the hooves of livestock; it can become attached to cultivating implements, in vehicle tyres, on slashing equipment or on firewood; or it may be transported by moving soil.



Seed is set in summer.
Photo: Jackie Miles

Seed buried by cultivation can remain dormant in the soil for several years and produce seedlings after subsequent soil disturbance. Serrated tussock seedlings are usually outcompeted by other plants, but become competitive under conditions of drought or overstocking when more favourable pasture species are consumed by stock, leaving the less palatable serrated tussock.

It is not known how serrated tussock was first introduced into Australia but it was recognised as a difficult problem in many areas before World War II.

Where it grows

Serrated tussock is a very invasive weed that is widespread in southeastern Australia, covering more than 1.1 million ha. The area of serrated tussock is increasing as control techniques have failed to contain its spread. Affected areas include roadsides, pastures and scrub. In Victoria the area covered has increased four-fold over the past 20 years. In Tasmania the weed is a problem in the southeastern part of the state. Smaller infestations are also recorded on King Island in Bass Strait.

Serrated tussock is adapted to a wide range of climates and soil types and is



Serrated tussock has an extensive system of fibrous roots.
Photo: Environment Canterbury, NZ

spreading into metropolitan areas. Hot summer temperatures limit its distribution, as do salinity and waterlogging. It is tolerant to drought, fire and grazing and has few natural enemies in Australia, but does not survive repeated ploughing.

Potential distribution

Based on climate, serrated tussock could increase its range and spread throughout New South Wales, the Australian Capital Territory, Tasmania and, particularly, southwestern Victoria and southeastern South Australia. More than 30 million ha of southeastern Australia are classed as climatically suitable for the weed's invasion. Another model predicts it could also survive in southern and southwestern Western Australia.

What to do about it

Prevention of spread

Preventing the invasion of serrated tussock is the cheapest and most effective way of controlling it. Learn to identify the weed, regularly check for it and act immediately to remove it. Avoid purchasing hay or stock from contaminated areas. Stock grazed on seeding serrated tussock should be placed in a holding paddock for 7–10 days before moving them into a clean paddock.

Desirable vegetation can be used as a barrier to help reduce wind dispersal of the seeds. Rabbit proof fencing can also help to catch tumbling serrated tussock seed heads.

Pasture management

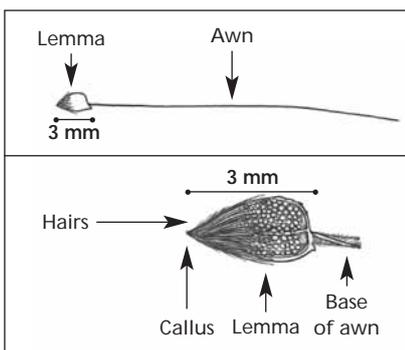
Competition from desirable species alone will not eliminate serrated tussock but will decrease seedling survival. For long-term control, vigorous improved pastures must be established to compete with serrated tussock and prevent reinvasion. Ploughing or spraying alone without pasture establishment is not effective because serrated tussock will regenerate from seed reserves in the soil (up to 1200 million seeds/ha in old infested areas).

When starting on a control program, it is best to start on the prevailing upwind side of a serrated tussock infestation to try and limit the amount of seed blowing into control areas.

Serrated tussock seeds generally travel small distances on flat ground because they get caught up in fences and other grasses. But in hilly country, the light seeds may blow many kilometres.

Small patches

If serrated tussock becomes established at more than a scattered low density, control becomes expensive and difficult. Search every paddock for serrated tussock each year and remove isolated or small patches of plants by spot spraying or chipping. Advice on suitable registered herbicides is available from your local council or state or territory weed management agency. Chip isolated plants with a mattock, preferably before the tussocks set seed. In wet conditions remove soil from the roots. Be careful chipping because any soil disturbance will cause germination of seeds.



Serrated tussock seed.
Image: David McLaren

Once serrated tussock has been removed, it is important to replace it with improved pasture. If the area is left bare, it will reinvade the site. It is important to monitor paddocks twice a year for several years to control young seedlings that germinate from the soil seedbank.

Herbicide treatment alone usually results in reinfestation of serrated tussock from seed in the soil, so it is important to incorporate other control methods in an integrated management strategy. Competition from desirable pasture plants is especially valuable.



If grazing were to continue, this medium density serrated tussock infestation would be favoured and quickly become uncontrollable.

Photo: Victorian Serrated Tussock Working Party

Identifying serrated tussock

The Tasmanian Department of Primary Industry, Water and Environment has developed the following checklist to help distinguish serrated tussock from other grasses.

1. The leaf bases are more tightly packed and more slender than other tussocks and are a whitish colour – never purple or blue-green.
2. In autumn, when most other grasses have dried off to a straw colour, young serrated tussock plants remain bright green except for the bleached tips.
3. At the junction of the leaf sheath and blade most grasses carry a small flap known as a ligule. The ligule is the most positive guide to identifying serrated tussock. To find the ligule, trace down a leaf to its junction with the leaf sheath. Bend the leaf back at this point, and a small, white hairless flap, 1 mm long, will protrude vertically. Other grasses will have different ligules, eg hairy, toothed or none at all.
4. The upward-pointing barbs on the leaf blade, which give them their rough or serrated texture, are minute and almost invisible to the naked eye. If the leaves appear at all hairy, the plant is not serrated tussock.
5. Serrated tussock leaves, when rolled between the index finger and thumb, roll smoothly – like a needle. Native grass species feel as though they have flat edges.
6. When cut in cross section, serrated tussock has a cylindrical appearance because the leaf is always tightly rolled. Other grasses form a 'V' or 'U' shape in cross section.
7. The seed head breaks off whole. If the previous year's seed heads remain on the plant, it is not serrated tussock.
8. Serrated tussock rarely grows in swampy areas.
9. Flower and seedling heads are dark purple due to the colour of the two 'glumes' surrounding the seed.
10. Serrated tussock seed is unlike the seed of any of the other tussock grasses. As shown in the diagram (*left*), the awn is 25–35 mm long and attaches obliquely to the lemma (seed).

Weed control contacts

State / Territory	Department	Phone	Email	Website
ACT	Territory and Municipal Services	(02) 6207 5111	www.contact.act.gov.au/	www.tams.act.gov.au/live/environment
NSW	Dept of Primary Industries	1800 680 244	weeds@dpi.nsw.gov.au	www.dpi.nsw.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9500	apc@saugov.sa.gov.au	www.dwlbc.sa.gov.au
Tas.	Dept of Primary Industries, Water and Environment	1300 368 550	Weeds.Enquiries@dpiw.tas.gov.au	www.dpiw.tas.gov.au
Vic.	Dept of Primary Industries / Dept of Sustainability and Environment	136186	customer.service@dpi.vic.gov.au	www.dpi.vic.gov.au www.dse.vic.gov.au
Qld	Dept of Primary Industries	(07) 3404 6999	callweb@dpi.qld.gov.au	www.dpi.qld.gov.au
WA	Dept of Agriculture and Food	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6210 470	contact@apvma.gov.au	www.apvma.gov.au

For up-to-date information on which herbicides are registered to control serrated tussock and the best application methods and dosages, contact your state or territory weed management agency or local council. This information varies from state to state and from time to time. Contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory environment protection authorities may be required if herbicides are to be sprayed on riverbanks.

Large infestations

On arable land serrated tussock can be successfully controlled with a program of cultivation, cropping and pasture improvement. This will reduce the seed reserves of serrated tussock available to germinate because seeds buried below 20 mm tend not to germinate.

In Tasmania experience has shown that burning in winter and ploughing soon after to a depth of 100 mm is effective. Leave the paddock fallow and cultivate again in summer to remove any new tussocks. Crop for two years before sowing pasture to reduce the reserve of tussock seed in the soil. Seek advice on the suitability of these cultivating techniques for areas of land in a high risk category for soil erosion.



The ability of farm forestry to provide long-term control of serrated tussock is currently being investigated.

Photo: Victorian Serrated Tussock Working Party

Herbicides have also proven to be effective in controlling large infestations. There are several different registered herbicides available for use in different ways. Contact your agricultural chemical reseller, council or state/territory weed management agency for relevant local advice. Note that some herbicides will also kill annual grasses and some native grasses, making re-seeding necessary.

Revegetation in agricultural pastures

Control needs to focus on preventing the re-establishment of seedlings as well as the eradication of adult plants. This means establishing an alternative groundcover.



Isolated plants can be hand chipped but soil disturbance should be minimised.

Photo: Environment Canterbury, NZ

After cultivation or spraying, an improved perennial pasture must be planted back to provide long-term control of serrated tussock. The young tussock seedlings are weak and slow to establish, and vigorous grasses can outcompete them.

Sow pasture seed in late autumn or early winter, one week after controlling annual weeds with a knockdown herbicide. Phalaris and cocksfoot, two deep-rooted, drought tolerant perennial species, are recommended for use in cool temperate regions but may not be suitable in other areas. Contact your council, state/territory weed management agency or local seed merchant for relevant local advice.

Allowing the pasture to become dominant with clover in the first year will smother any new tussock seedlings in the short term and make nitrogen available to the improved grasses. The nitrogen will then help the pasture to become grass dominant, which will provide long-term control of serrated tussock.

Dense tree plantings which provide good shade can kill serrated tussock, eg commercial pine plantations used in a control program in New South Wales. Windbreaks also play a role in trapping the seed and preventing it from blowing any further.



Grazing management

Serrated tussock can germinate in response to rain at any time so it is vital to keep good pasture cover (at least 80%) and avoid overgrazing to prevent the weed taking hold.

One way to encourage the competition of native grasses, which grow actively in summer, is to introduce a rotational grazing system where areas with serrated tussock problems are not grazed as heavily over summer. The aim of this method is to reduce seedling establishment, although it does not affect established adult tussocks.

Revegetation in native grasslands

Serrated tussock is a difficult weed to manage in native grasslands. To minimise damage to native vegetation, early detection is essential and careful physical removal of isolated plants is recommended. Revegetation with indigenous species is needed to prevent reinfestation. Larger infestations need to be contained using a combination of available methods to minimise the spread of serrated tussock into native grasslands.

Fire

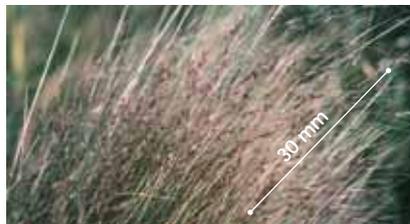
In areas of low rainfall and low soil fertility with a high infestation of serrated tussock, burning may help control the weed. Burning will not kill serrated

tussock but, if carried out in winter, will stop most plants from setting seed and therefore spreading. It will also reduce the fire hazard over summer. However, it also leaves bare areas so should only be done where the weed is at a high density. Permits may be required to light fires – check with your local council or state or territory weed management agency.

Biological control

Three biological control agents against serrated tussock are being investigated for release into Australia. These are a rust, *Puccinia nassellae*, a smut, *Ustilago* sp., and a fungus. The impact of the rust appears to be highly dependent on environmental conditions, reducing its effectiveness as a biological control agent in drier areas. The smut is known to infect other *Nassella* species, but little is known about the host specificity or life cycle of the fungus at this stage.

A fungus that occurs naturally on native



Mature serrated tussock plants produce an extremely large amount of seed which germinates over many years.
Photo: Kate Blood

Austrostipa spp. has also been observed to attack serrated tussock in the field.

Legislation

All *Nassella* species are prohibited from entering Australia. Regulations apply to control of serrated tussock in all states and territories. Check with your local council or state/territory government agency about the latest requirements for serrated tussock control.

Acknowledgments

Information and guide revision: David McLaren (DPI Vic/Weeds CRC), David Boyle (DPI Vic), Cindy Hanson (DPIWE Tas), Sherryl Wright (Upper Lachlan Landcare network), Linda Iaconis (DPI Vic), Richard Carter (NSW DPI/Weeds CRC), Bob Trounce (NSW DPI/Weeds CRC) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee.



On arable land serrated tussock can be successfully controlled with a program of cultivation, cropping and pasture improvement.
Photo: Weeds CRC

...case study

Breaking the serrated tussock cycle in the Upper Lachlan NSW Tablelands

In the Southern and Central Tablelands of New South Wales, landholders are trying to develop improved control strategies for serrated tussock and other perennial grass weeds. This approach includes optimising the use of herbicides, grazing management and pasture establishment. The potential use of forestry is also being assessed.

The area around Crookwell in the Central Tablelands is severely affected by serrated tussock. More than 60% of the area is infested, 10% severely (ie greater than 80% cover).

With the help of Natural Heritage Trust funding from the Commonwealth Government, the Upper Lachlan Landcare network is trying to break the cycle of spraying/reinfestation. They have negotiated control programs with landholders in the district to change their management practices and suppress serrated tussock by re-establishing competitive vegetation.

On one heavily infested 200 ha site on the side of a steep hill, helicopter spraying will be used to reduce the

level of tussock grass seed which blows all over the district. The site will then be aerial seeded with a mixture of phalaris, cocksfoot and clover, species recommended by local agronomists. These persist in hot dry summers, outcompete serrated tussock and establish well by aerial seeding.

In some places native trees and bushes will also be planted as windbreaks to reduce the amount of seed blown along the ground.

case study

How to control serrated tussock

Quick reference guide

Identifying serrated tussock

There are a number of ways to identify serrated tussock (see information box p. 3). Learn to identify it, regularly check for it and act immediately to remove it.

Preventing spread

Avoid purchasing seed, hay or stock from contaminated areas. Spot spray with a registered herbicide or chip with a mattock before tussocks set seed to control light and scattered infestations.



Planting tree belts along boundaries with infested properties helps to reduce the amount of seed blowing in.
Photo: Victorian Serrated Tussock Working Party

Integrated management

Herbicide treatment alone will not give long-term control so vigorous improved pastures must be established to compete with serrated tussock and prevent reinvasion.

Reduce invasion from wind-blown seeds by planting windbreaks or sowing perennial pastures such as phalaris.

Monitor paddocks twice a year for 5–10 years to control young seedlings that

germinate from the soil seedbank in the soil.

On arable land serrated tussock can be successfully controlled with a program of ploughing, cropping and pasture improvement.

Control options

Type of infestation	Chemical	Grazing management	Physical	Mechanical
Scattered light infestation, good coverage of perennial grasses	Spot spray with a registered herbicide.	Spell pastures to let native grasses seed.	Remove by chipping.	Not suitable.
Arable land, moderate to heavy infestation, little or no perennial grass coverage	Not suitable.	Not suitable.	Not suitable.	Plough in preparation for autumn sowing. Consider pre-plough burning. Cultivate and sow pasture species.
Non-arable land, moderate to heavy infestation, little or no perennial grass coverage	Aerial spray with registered herbicide. Different herbicides are recommended for different times of the year.	Graze hard in summer and autumn; spell pasture over winter and spring.	Not suitable.	Not suitable.

Table adapted from Taylor, U. & Sindel, B. 2000. 'The Pasture Weed Management Kit'. CRC for Weed Management Systems.
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Reprinted 2008
Printed in Australia on 100% recycled paper.
ISBN 1-920932-17-8. 2008 reprint.

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