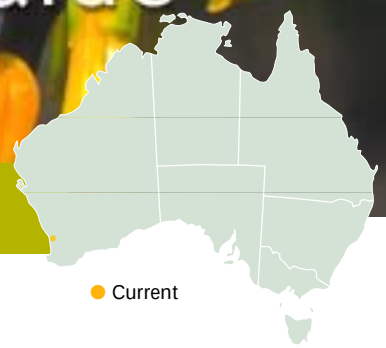
Weed Management Guide

Yellow soldier – *Lachenalia reflexa*



Yellow soldier (*Lachenalia reflexa*)

The problem

Yellow soldier is on the *Alert List for Environmental Weeds*, a list of 28 non-native plants that threaten biodiversity and cause other environmental damage. Although only in the early stages of establishment, these weeds have the potential to seriously degrade Australia's ecosystems.

Yellow soldier was first recorded as naturalised south of Perth, Western Australia, in 1957, probably after escaping from a garden planting. It has since become a problem weed and is spreading through tuart (*Eucalyptus gomphocephala*) and banksia woodlands on sandy calcareous soils. It is most common in the southwest of the state, a region renowned for its high biodiversity and unique aesthetic qualities.

It could become a significant environmental problem because it replaces native herbs and annuals in both disturbed and relatively intact bushland. Apart from causing a loss of plant biodiversity, which destroys habitat and resources for native animals, infestations of yellow soldier can reduce the recreational enjoyment of bushland by people.

The weed

Yellow soldier belongs to a group of South African plants, many of which are grown as garden ornamentals. Three other species of *Lachenalia* are weeds of Western Australia (see Box, p.3).

Yellow soldier has two strap-shaped leaves which are slightly V-shaped in cross-section.
Photo: Kate Brown

Yellow soldier has two strap-shaped leaves, 60–350 mm long and 15–25 mm wide, which grow upwards from the base. The leaves are slightly V-shaped in cross-section. The bright yellow flowers are 25 mm long and more or less tubular in shape but swollen in the middle. They grow on short stalks just 45–100 mm above the ground.

Yellow soldier stores food material for the next growing season in bulbs, which are short underground stems. Large healthy plants can produce up to ten yellow upright flowers. Plants flower particularly well following fire and set prolific amounts of seed. The smooth, shiny black seeds are about 2 mm long. The seed does not appear to remain viable in the soil for more than two or three years.

Key points

- Prevention and early intervention are the most cost-effective forms of weed control. Once established, yellow soldier is difficult to control so it is important to keep uninfested areas weed free.
- Yellow soldier produces a large number of viable seeds that germinate each year, leading to rapid expansion of populations.
- A number of species of *Lachenalia* are present in Australia but yellow soldier is considered the most widespread and invasive.
- Contact your state or territory weed management agency or local council if you find yellow soldier. Do not attempt control on your own.

Natural Heritage Trust
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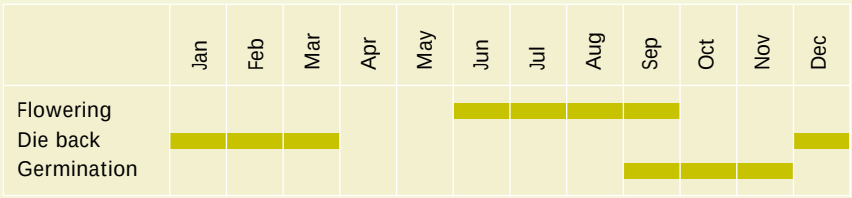
Growth calendar



Yellow soldier seeds germinate during spring and flower during the following winter and early spring. The above ground foliage dies off during summer.

Yellow soldier is considered the most widespread and invasive of the naturalised *Lachenalia* species in Australia. It occurs as a serious weed at a number of conservation reserves around Perth, Western Australia. It invades banksia/tuart woodlands and limestone scrub and heath around the Swan estuary, banksia/jarrah woodland to the south and west of Perth, and tuart woodland up to 40 km north of Perth.

How it spreads

With only a single annually renewed bulb, yellow soldier spreads mainly by seed. There are usually between one and ten flowers per plant and each flower produces a capsule that contains 40–60 seeds, potentially giving rise to infestations of more than 400 bulbs per square metre.

Experience in the Shenton bushland in Western Australia (see case study p. 5), where populations are quite discrete, suggests that seed is not easily spread over long distances. Water movement and human activity are the main causes of seed spread.

Yellow soldier seeds often germinate in response to fire, taking advantage of any bare ground and the reduction in competition from native species.

Plants have also been observed to produce a prolific number of bulbils (small bulbs) around the base of stems left lying on the soil surface, but this does not appear to be a common method of reproduction or dispersal.

Where it grows

In its native range the genus *Lachenalia* extends mainly throughout western and southwestern Cape Province in South Africa, where it occurs in areas with winter rainfall, undergoing long dormant periods over the dry summers.

Yellow soldier is most common in the southwest of the state of Western Australia, a region renowned for its high biodiversity and unique aesthetic qualities

Yellow soldier produces a prolific amount of smooth, shiny, black seed.
Photo: Kate Brown

Why we need to be 'alert' to yellow soldier

Yellow soldier could spread over most of the Swan coastal plain in southwestern Western Australia. Based on climatic suitability, it could potentially spread to areas with sandy soils in South Australia and Victoria.

The infestation in the Shenton bushland has shown that yellow soldier does not need disturbance to establish, as many of the infestations occur in relatively intact bushland. This indicates that yellow soldier could become a major environmental weed and potentially have severe impacts in conservation areas, displacing more desirable native species and altering the ecological balance of these areas.

There are a number of difficulties associated with controlling bulbous weeds such as yellow soldier growing in native vegetation. See the case study (p. 5) for more information.

What to do about it

Prevention is better than the cure

As with all weed management, prevention is better and more cost-effective than control. The annual cost of weeds to agriculture in Australia, in terms of decreased productivity and management costs, is conservatively estimated at $4 billion. Environmental impacts are also significant and lead to

Other weedy naturalised species of *Lachenalia*

In recent years a number of *Lachenalia* species have become naturalised in southern Australia. *Lachenalia aloides* has been recorded as a weed in lowland grassland and grassy woodland in Victoria, while *L. aloides* and *L. bulbifera* have been recorded as garden escapees in South Australia. In southwestern Western Australia four species, *L. aloides* var. *aurea*, *L. bulbifera*, *L. mutabilis* and *L. reflexa*, have been recorded as weeds. Although these species are still very localised, they are spreading through woodlands in this region.

The various species of *Lachenalia* are similar looking, although there is some variation in plant size and flower colour. *L. aloides* grows 50–310 mm high and has flowers in a range of colours including orange, red, yellow and greenish blue. *L. bulbifera* grows 80–300 mm high and has orange to red flowers, with darker red or brown markings and green tips. *L. mutabilis* is the largest of the four species, growing 100–450 mm high, with pale blue and white flowers with yellow tips, and only one leaf. Yellow soldier (*L. reflexa*) is the smallest species (30–190 mm high) and has pure yellow flowers.

L. aloides has flowers in a range of colours including orange, red, yellow and greenish blue. Photo: Penny Hussey

a loss of biodiversity. To limit escalation of these impacts, it is vital to prevent further introduction of new weed species, such as yellow soldier, into uninfested natural ecosystems.

Yellow soldier flowers particularly well following fire and sets prolific amounts of seed

In the past various *Lachenalia* species have been offered for sale in nurseries around Australia, including in Western Australia, South Australia and Victoria. Notify the vendor or state or territory weed control contacts if you find *Lachenalia* for sale.

Early detection and eradication are also important to prevent infestations of yellow soldier. Small infestations can be easily eradicated if they are detected early but an ongoing commitment is needed to ensure new infestations do not establish.

The Alert List for Environmental Weeds

The Federal Government's *Alert List for Environmental Weeds* was declared in 2001. It consists of 28 weed species that currently have limited distributions but potentially could cause significant damage. The following weed species are therefore targeted for eradication:

Scientific name	Common name	Scientific name	Common name
Acacia catechu var. *sundra*	cutch tree	*Koelreuteria elegans* ssp. *formosana*	Chinese rain tree
Acacia karroo	Karroo thorn	*Lachenalia reflexa*	yellow soldier
Asystasia gangetica ssp. *micrantha*	Chinese violet	*Lagarosiphon major*	lagarosiphon
Barleria prionitis	barleria	*Nassella charruana*	lobed needle grass
Bassia scoparia	kochia	*Nassella hyalina*	cane needle grass
Calluna vulgaris	heather	*Pelargonium alchemilloides*	garden geranium
Chromolaena odorata	Siam weed	*Pereskia aculeata*	leaf cactus
Cynoglossum creticum	blue hound's tongue	*Piptochaetium montevidense*	Uruguayan rice grass
Cyperus teneristolon	cyperus	*Praxelis clematidea*	praxelis
Cytisus multiflorus	white Spanish broom	*Retama raetam*	white weeping broom
Dittrichia viscosa	false yellowhead	*Senecio glastifolius*	holly leaved senecio
Equisetum spp.	horsetail species	*Thunbergia laurifolia*	laurel clock vine
Gymnocoronis spilanthoides	Senegal tea plant	*Tipuana tipu*	rosewood
Hieracium aurantiacum	orange hawkweed	*Trianoptiles solitaria*	subterranean Cape sedge

Weed control contacts

State / Territory	Department	Phone	Email	Website
ACT	Environment ACT	(02) 6207 9777	EnvironmentACT@act.gov.au	www.environment.act.gov.au
NSW	NSW Agriculture	1800 680 244	weeds@agric.nsw.gov.au	www.agric.nsw.gov.au
NT	Dept of Natural Resources, Environment and the Arts	(08) 8999 4567	weedinfo.nreta@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.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@dpiwe.tas.gov.au	www.dpiwe.tas.gov.au
Vic	Dept of Primary Industries/Dept of Sustainability and Environment	136 186	customer.service@dpi.vic.gov.au	www.dpi.vic.gov.au www.dse.vic.gov.au
WA	Dept of Agriculture	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au

The above contacts can offer advice on weed control in your state or territory. If 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.

Yellow soldier is the smallest *Lachenalia* species and has pure yellow flowers.
Photo: Greg Keighery

Quarantine to prevent further introductions

Although on the Alert List, yellow soldier is currently a permitted import. However, importation of yellow soldier to Australia is not encouraged due to its potential to be a serious environmental weed.

Do not buy seeds via the internet or from mail order catalogues unless you check with quarantine first and can be sure that they are free of weeds like yellow soldier. Call 1800 803 006 or see the Australian Quarantine and Inspection Service (AQIS) import conditions database <www.aqis.gov.au/icon>. Also, take care when travelling overseas that you do not choose souvenirs made from or containing seeds, or bring back seeds attached to hiking or camping equipment. Report any breaches of quarantine you see to AQIS.

Raising community awareness

Some 65% of weeds, including yellow soldier, which have recently established in Australia have escaped from plantings in gardens and parks. The detrimental impacts of these weeds far outweigh any potential horticultural benefits. The public should be made more aware of these impacts, and other issues such as how to identify yellow soldier and what to do if they find it.

Yellow soldier causes loss of plant biodiversity, destroys habitat and resources for native animals and can reduce the recreational enjoyment of bushland

Yellow soldier can be identified by its two opposite leaves, which are broadest at the base and V-shaped in cross-section. Between June and September, it bears bright yellow flowers on short stalks which emerge from the centre of the plant.

New infestations of yellow soldier

Because there are relatively few yellow soldier infestations, and it can potentially be eradicated before it becomes established, any new outbreaks should be reported immediately to your state or territory weed management agency or local council. Do not try to control yellow soldier without their expert assistance. Control effort that is poorly performed or not followed up can actually help spread the weed and worsen the problem.

...case study

Managing the spread of yellow soldier in a banksia woodland near Perth, Western Australia

At the Shenton bushland, a 21 ha remnant of banksia woodland west of Perth, Kate Brown, Project Officer with the Environmental Weeds Action Network, has run a three-year trial on methods of controlling yellow soldier. The project was funded through the Natural Heritage Trust Bushcare Program.

Trials in the banksia/jarrah woodland commenced in 1998 and measured the impact of three different control methods on the abundance of yellow soldier: hand removal, wiping the weeds with herbicide, and spot spraying with a different herbicide. The amount of cover provided by native vegetation was also measured, to test for off-target impacts of the control methods.

Hand removal over two seasons left all native species intact but was very labour intensive (up to six hours for 4 m^2), reducing cover of yellow soldier by only 44%. It also triggered germination of annual weeds.

Wiping the leaves with herbicide was not effective and was also very labour intensive.

Spot spraying reduced the cover of yellow soldier by 65% in one season and appeared to have no significant impact on native shrubs or herbs. Where no control was carried out, yellow soldier increased in cover by more than 30% between 1998 and 2000.

The herbicide treatments did not significantly affect native shrubs or perennial herbs. After two years of treatment, yellow soldier still comprised 12% of cover the following year, indicating that any broad-scale application would need to be carefully followed up for a number of years to prevent the weed reinvading the area. Indigenous species are being allowed to recolonise treated sites unassisted.

Preventing spread into undisturbed areas is the main aim of the control program. Understanding the current distribution of the weed allows any new infestations to be recognised, recorded and targeted for control.

The Friends of Shenton Bushland used the results of the trial to secure funding to implement control of yellow soldier across the whole infested area. An experienced contractor carried out the work. With a total of only about 1 ha invaded, the cost of control is relatively low. The local government authority is expected to continue to fund follow-up work until the populations require only occasional hand removal.

This case study was adapted from Brown, K. & Brooks, K. 2002. 'Bushland weeds: A practical guide to their management.' Environmental Weeds Action Network.

Methods to control yellow soldier

Any control of yellow soldier should be undertaken cooperatively with your state or territory weed management agency or local council.

Hand removal of yellow soldier is very labour intensive – up to 6 hours for 4 m^2 – and triggers germination of other annual weeds.
Photo: Kate Brown

Removal by hand

In sandy soils bulbs can be removed by hand in late August – early September by cutting the roots with a knife and pulling them out with the bulb.

However, hand removal is difficult and time consuming, and can cause major soil disturbance which may encourage other weeds. It is often impractical on a larger scale, especially given the high density at which these bulbous weeds often occur.

Fire is not recommended for control

Yellow soldier appears to be tolerant of fire and regenerates soon after bushfire. Plants appear to flower particularly well following fire, setting prolific amounts of seed. In addition, fire reduces competition from native vegetation and creates bare areas where seed can germinate. However, fire can create opportunities for land managers to prevent further spread and establishment. After fire, yellow soldier's flowers are clearly visible, and the reduced cover of native vegetation makes the resprouting flowering bulbs easy targets for herbicide control.

Legislation

There is no legislation to control yellow soldier but, as part of the *Alert List for Environmental Weeds*, it is marked for eradication and should not be imported into Australia or further spread.

Acknowledgments

Information and guide revision: Kate Brown (Environmental Weeds Action Network), Greg Keighery (CALM WA), Sandy Lloyd (Agriculture WA/Weeds CRC) and John Thorp (National Weeds Management Facilitator).

Map: Base data used in the compilation of distribution map provided by Australian herbaria via Australia's Virtual Herbarium.

If you find a plant that may be yellow soldier

Quick reference guide

Identification

You will first need to confirm its identity. Contact your state or territory weed management agency for help in identifying the plant. You will need to take note of the characteristics of the plant in order to accurately describe it. The most striking characteristic of yellow soldier is its upright, yellow flower stalk containing from one to ten flowers and its two strap-shaped leaves emerging from the base.

Reporting occurrences

Once identified, new occurrences of yellow soldier should be reported to the relevant state or territory weed management agency or local council, who will offer advice and assistance on its control. Because yellow soldier poses such a serious threat, its control should be undertaken with the appropriate expertise and adequate resources.

Follow-up work will be required

Once the initial infestation is controlled, follow-up monitoring and control will be required to ensure that reinfestation does not occur.

Yellow soldier appears to be tolerant of fire and regenerates soon after bushfires.
Photo: Kate Brown

Collecting specimens

State or territory herbaria can also identify plants from good specimens. These organisations can provide advice on how to collect and preserve specimens.

State/Territory	Postal Address	Phone	Web
Australian National Herbarium	GPO Box 1600 Canberra, ACT, 2601	(02) 6246 5108	www.anbg.gov.au/cpbr/herbarium/index.html
National Herbarium of New South Wales	Mrs Macquaries Rd Sydney, NSW, 2000	(02) 9231 8111	www.rbgsyd.nsw.gov.au
National Herbarium of Victoria	Private Bag 2000 Birdwood Avenue South Yarra, Vic, 3141	(03) 9252 2300	www.rbg.vic.gov.au/biodiversity/herbarium.html
Northern Territory Herbarium	PO Box 496 Palmerston, NT, 0831	(08) 8999 4516	http://www.nt.gov.au/ipe/pwcnt/
Queensland Herbarium	c/- Brisbane Botanic Gardens Mt Coot-tha Rd Toowong, Qld, 4066	(07) 3896 9326	www.env.qld.gov.au/environment/science/herbarium
South Australian Plant Biodiversity Centre	PO Box 2732 Kent Town, SA, 5071	(08) 8222 9311	www.flora.sa.gov.au/index.html
Tasmanian Herbarium	Private Bag 4 Hobart, Tas, 7000	(03) 6226 2635	www.tmag.tas.gov.au/Herbarium/Herbarium2.htm
Western Australian Herbarium	Locked Bag 104 Bentley DC, WA, 6983	(08) 9334 0500	http://science.calm.wa.gov.au/herbarium/

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