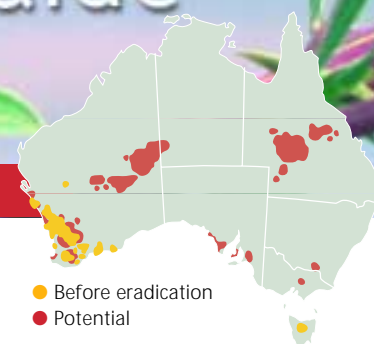


Weed Management Guide

Kochia – Bassia scoparia



Kochia (*Bassia scoparia*)

The problem

Kochia 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.

Kochia was originally planted in 1990 for forage and to rehabilitate salt-affected agricultural land in southwestern Western Australia. However, it soon spread out of control and was declared a weed in 1992.

Kochia is one of the fastest spreading of all weeds in the United States. Because it is extremely efficient at using water, it thrives in warm, low rainfall environments such as the cereal-growing regions of the southern mainland states of Australia. It can contaminate crops and suppress the growth of nearby plants by releasing chemicals into the soil.

Although palatable to stock, kochia may be toxic in large quantities. It can also alter fire regimes and reduce the abundance of native plants.

The weed

Kochia is a bushy annual, growing to 1.5 m tall and wide in good conditions. It has an erect main stem with many upwards-curving side branches. The stems and leaves are generally green,



Plants die off during autumn and are blown by winds as tumbleweeds.
Photo: R. Knox, WA Dept of Agriculture

but change to yellow, red and brown as the plant ages and dies. The many flat, elongated leaves grow up to 50 mm long and 8 mm wide and have no stalk. Leaves normally have three, but occasionally five, veins running along their length.

The flowers are the same colour as the leaves. Flowers occur singly or in pairs, in hairy spikes 5–10 mm long, along the upper parts of the shoots where the leaf and stem join. The single seeds are dull brown, 1.5 mm wide and contained in a star-shaped fruit. Kochia has a main taproot and a network of finer roots.

Dead plants break off at the base and are blown by the wind as tumbleweeds.

Key points

- Although originally planted for fodder and to help rehabilitate saline soils, kochia quickly became weedy.
- Kochia seed can spread up to several kilometres carried on dead plants blown by the wind as tumbleweeds.
- Preventing its spread will protect the cereal crops and pastures of much of temperate, semi-arid and subhumid Australia.
- Eradication efforts seem to have been successful.
- Any new outbreaks should be reported to local councils or state or territory weed management agencies. Do not attempt control on your own.

Growth calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flowering												
Seed formation												
Seed drop												
Dieback												
Germination												

■ General growth pattern ■ Growth pattern under suitable conditions

Kochia is a summer growing annual. Most seed germinates in spring and early summer although, if conditions allow (late summer rains), seeds can also germinate from March to May. The seedlings grow vigorously, outcompeting perennial species with their rapid growth. Vegetative growth occurs for several months before flowering and seed production begin. Most flowering occurs between February and April, although seedlings that germinate early or late in the season can flower at any time of the year. Plants die shortly after the seeds are formed, with most plants dying between March and May. Normally, the time between germination and death is six to seven months.

How it spreads

Kochia produces large numbers of seeds, many falling close to the parent plant. However, seeds can also be spread large distances from their original location when the dead parent plant breaks off at the base and is blown by the wind as a tumbleweed. Kochia can spread up to several kilometres in a single year in this way. Lines of seedlings indicate the path taken by the parent plants, which often end up clumped near fences.

The seeds are short lived. Most of the seedbank is exhausted after one year,

although a small percentage of seeds may remain viable for two to four years.

Kochia seed was deliberately planted in southwestern Western Australia in 1990 to supply forage and help rehabilitate salt-affected land. It was sown at 68 sites, covering a distance of almost 1000 km. By 1993 it had naturalised at 52 of these sites and spread to roadsides and pastures and other areas not affected by salt.

Kochia has also appeared in Tasmania on several occasions, introduced in contaminated carrot seed imported from the United States.



Kochia is a bushy plant with an erect main stem and numerous upwards-curving side branches. Photo: Larry Burrill, Oregon State University (USA)

Where it grows

Kochia grows well under conditions similar to those required by cereal crops in southern Australia, thriving in climates with hot, sunny summers. In the United States it is reported to grow in areas that receive as little as 150 mm annual rainfall. It invades disturbed sites such as roadsides, railways and eroded banks, and also grows in crops, pastures and rangelands. It tolerates saline soils and can flourish when irrigated with water of one-third the salinity of sea water.

Kochia is native to eastern Europe and western Asia. It has been introduced as an ornamental and become naturalised throughout most of Europe, Argentina, Canada, United States, Africa, New Zealand and parts of temperate Asia including China and Japan.

Why we need to be 'alert' to kochia

Although kochia was deliberately introduced, it was declared an eradicable weed only two years later. The decision to attempt eradication of kochia was based on its behaviour, including its:

- very fast spread from the original plantings
- invasion of crops and pastures and threat to agricultural production
- invasion of areas where it was a nuisance (eg firebreaks, tracks, roadsides, fencelines) and potential to affect fire regimes and natural ecosystems.



Fences catch the tumbleweeds and can be sites of large infestations. Photo: Steve Dewey, Utah State University (USA)

Kochia gives itself a competitive advantage by producing chemicals that reduce the growth and germination of other more desirable plants, further reducing agricultural production.

Additionally, kochia contains high levels of oxalates, alkaloids and nitrates that can be toxic to a variety of grazing animals if large amounts are consumed.

Much of central and southern Australia is climatically suitable for kochia. This includes parts of all states and territories, extending from semi-arid and temperate pastoral country to subhumid areas.



Kochia seedlings grow very fast and can flower after only a few months.

Photo: Larry Burrill, Oregon State University (USA)

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

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

Quarantine to prevent further introductions

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 kochia. 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

Because of the eradication campaign currently being undertaken in Western Australia (see case study, p.5), public awareness of the weed and its potential impacts should be increased. The public should know how to identify kochia and what to do if they find it.

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

Features to aid identification of kochia include: hairy flowers located at the top of the stem where the leaf meets the stem; star-shaped fruit and leaves with, in most cases, three parallel veins along their length; and the tendency for the plants to break off at the base and roll as tumbleweeds when they die off during autumn.

New infestations of kochia

Because there are relatively few kochia 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 kochia

without their expert assistance. Control effort that is poorly performed or not followed up can actually help spread the weed and worsen the problem.

Herbicide tolerance

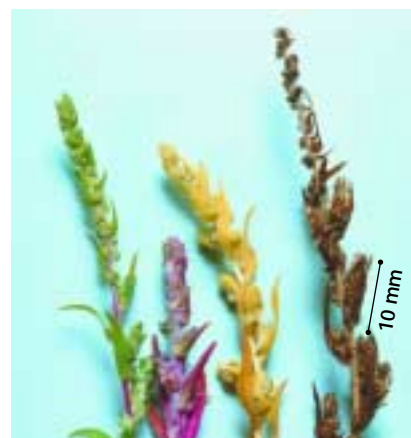
Overseas, kochia has shown that it can become resistant to herbicides, which means that plants survive treatment with a herbicide that would normally kill them. The resistance of kochia to two groups of herbicides, the sulfonylureas and triazines, has been well documented in the United States and Canada. Herbicide resistance is one of the reasons why kochia was so quickly targeted for eradication.

Ornamental form

Kochia exists in both a weedy and an ornamental form. The ornamental form (*Bassia scoparia* forma *trichophylla* (hort. ex Voss)) is a different subspecies to the weedy form (*Bassia scoparia* ssp. *densiflora*). The bright red autumn foliage of the ornamental form is appreciated by gardeners. It has been recorded as a weed in South Australia and Western Australia and is a declared noxious weed in some states. Do not plant the ornamental form of kochia, and replace any existing specimens with more desirable species. Check with your local council or state or territory government agency about the latest requirements for controlling the ornamental form.



Kochia stems are striped, and the leaves have virtually no stalk.
Photo: Steve Dewey, Utah State University (USA)



As the plant ages the stems, leaves and flowers turn from green to red to yellow to brown.
Photo: R. Knox, WA Dept of Agriculture



Program to eradicate kochia from Western Australia is on track

Both the biology of kochia and several important aspects of the Western Australian infestation made eradication a realistic goal. These aspects include the following:

- kochia only reproduces by seed, which is short lived
- it is highly visible and flowers and seeds are produced late in the season
- it is palatable to stock when lightly grazed
- the precise location of each of the original plantings was known
- the sites were easy to locate and access
- many sites were well fenced, which reduced the distance tumbleweeds could spread
- control often commenced within 12 months of the seed being sown
- there was no risk of reinfestation from elsewhere in Australia.

The program began in early 1992 and had apparently achieved good results by early 1996. At this stage, kochia had been eliminated from 46 of the 52 known infestation sites; however, an unknown

infestation of thousands of plants was discovered in May 1996. This required an additional significant control effort because it had been allowed to spread uncontrolled for about five years.

When control commenced, most of the infestations covered areas of less than 10 ha, although a few were 100 ha or greater. Seedlings were present at virtually all sites that had contained mature plants in the previous autumn, often at very high densities of several thousand per square metre.

The control program involved the use of herbicides, 'crash' grazing, grubbing and flaming. Herbicides were delivered from the ground and, for larger infestations, aerially. High densities of sheep were used to provide extreme grazing pressure that caused defoliation of large plants and destruction of seedlings. Grubbing, the physical removal of plants from the ground, was also conducted where appropriate. Flaming, where plants are burnt by a flamethrower or similar, was used on mature, seeding plants to kill the seeds.

No kochia plants have been found since 2000. Complete eradication of kochia has not been claimed, as a few plants were discovered at a site that had previously been clear for five years. If no more plants are discovered, the eradication program will be judged as successful in 2005.

The eradication program was allocated \$200,000, with contributions from the Commonwealth Government and all of the states. Each state's contribution was proportional to the value of its wheat industry, the sector most at risk from kochia. These funds were used to cover operating and overhead costs, mainly the provision of herbicides. In-kind labour contributions (eg monitoring and control activities) throughout the project were estimated to be worth over \$300,000.

In addition to being well funded, the program was well coordinated and involved experienced agricultural officers who had good local knowledge and productive relationships with affected farmers. Farmers were consulted early in the program, were highly cooperative and provided significant resources that assisted the eradication efforts.

The Tasmanian experience

Kochia was found in Tasmania in 1995, 1997 and 1998, when seeds were discovered as a contaminant of imported carrot seed. Infestations in carrot crops

near Deloraine and Devonport have been eradicated. Hand pulling was used to remove all plants, which numbered less than 50 in each of the infestations. Although some plants set seed at some sites, no seedlings were found, possibly because of the herbicides used to control other weeds. The sites continue to be monitored.

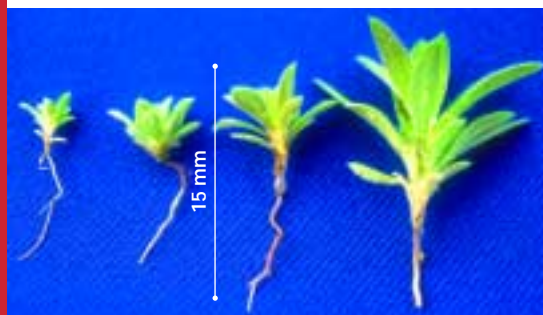
Legislation

Kochia has been declared a weed across Australia except in the Northern Territory and Victoria. Landholders are required by law to control any declared weeds occurring on their property.

Acknowledgments

Information and guide revision: John Moore (WA Agriculture/Weeds CRC), John Dodd (WA Agriculture), Sandy Lloyd (WA Agriculture/Weeds CRC), Cindy Hanson (Tasmania DPIWE), Tony Grice (CSIRO/Weeds CRC) and John Thorpe (National Weeds Management Facilitator).

Maps: Data used in the compilation of actual and potential distribution maps provided by Australian herbaria via Australia's Virtual Herbarium and the Australian Weeds Committee, respectively.



The leaves and stems of kochia seedlings are particularly hairy.
Photo: Steve Dewey, Utah State University (USA)

If you find a plant that may be kochia

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. Some important features of kochia are:

- stems, leaves and flowers that range in colour from green to yellow to red to brown as the plant ages
- long, flat leaves with no stalk and three parallel veins, occurring alternately on the stem

- single seeds, 1.5 mm wide, in a star-shaped fruit
- plants that break off and roll as tumbleweeds when dead.

Reporting occurrences

Once identified, new occurrences of kochia 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 kochia spreads so quickly and 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.

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/

© 2003 Information which appears in this guide may be reproduced without written permission provided the source of the information is acknowledged.
Printed on 100% recycled paper.

ISBN 1-920932-35-6

Disclaimer

While every care is taken to ensure the accuracy of the information in this publication, the CRC for Australian Weed Management and the Commonwealth Department of the Environment and Heritage take no responsibility for its contents, nor for any loss, damage or consequence for any person or body relying on the information, or any error or omission in this publication.

