# best practice management guide

8

BEST PRACTICE MANAGEMENT GUIDE FOR ENVIRONMENTAL WEEDS

ISSN 1442-7192

# Horehound, *Marrubium vulgare*

Community involvement.
*Photo: K. Blood.*

Horehound spreads on tyres.
*Photo: K. Blood.*

Horehound plant.
*Photo: K. Blood.*

## Taxonomy and status

**Botanical name:** *Marrubium vulgare* L. - Family Lamiaceae (mint family).

**Standard common name:** horehound, white horehound.

**Relationship to other species in Australia:** There are no indigenous Australian species in the genus *Marrubium* or in the same tribe (Marrubieae). However, there are introduced plants in Australia which belong to the same subfamily, Lamioideae. These include *Ballota*, *Lamium*, *Leonotis*, *Leucas*, *Molucella* and *Stachys*.

**Legislation:** Horehound is declared noxious throughout southern Australia (NSW, Vic, SA, WA and Tas). Keep up to date with the latest legislation through local and State/Territory government weed agencies or on the web at www.weeds.org.au

## Description

**Habit/lifeform:** Horehound is an erect perennial herb *(Figure 1)*, or spreading bushy aromatic perennial herb (and has a similar shape and form to lavender).

**Figure 1.** Horehound plants with burrs.
*Photo: K.Blood.*

**Description:** Horehound has square stems (often woody near the base) densely covered with white hairs with leaves opposite each other. Leaves are hairy above, very hairy to woolly underneath, rounded with a crinkled surface and sharply aromatic when crushed. It has small white flowers in dense clusters above the nodes (where the leaves join the stem) around the upper sections of the stems *(Figure 2)*. Clusters of flowers dry to form brown burrs with small hooked spines. Each burr contains up to 4 small (1-2 mm long) spear-shaped seeds.

**Figure 2.** Horehound burrs are clustered around the leaf joins.
*Photo: J. Weiss.*

The plant is commonly 0.30 m high and 0.75 m wide but occasionally up to 0.6 m high and 0.9 m wide in favourable conditions. It is multi-stemmed with up to 200 individual stems.

## Origin and distribution

**Origin:** Horehound is native to temperate Eurasia, Europe, the Middle East and the Mediterranean region including North Africa.

**Introduction:** Horehound was possibly first introduced into Australia from Europe in a shipment of botanical specimens sent by Sir Joseph Banks. A record from Sir Joseph Bank's' diary states that *M. vulgare* was sent to NSW on board the ship *Porpoise* on 11 October, 1798. Horehound appears to have been introduced for use as a garden herb and for beer brewing purposes. It was first recorded as naturalised in the 1840s.

**Distribution:** Horehound is ideally suited to southern Australia's mediterranean climate and now occurs in both arid and high rainfall areas. Horehound prefers alkaline soils, is drought tolerant, and is widely distributed throughout south-eastern Australia occurring in areas receiving greater than 200 mm rainfall per annum. It covers over 26 million ha in Australia. The heaviest infestations are found in north western Victoria and south eastern South Australia where semi-arid conditions contribute to decreased vigour of competing plant species *(Figure 3)*.

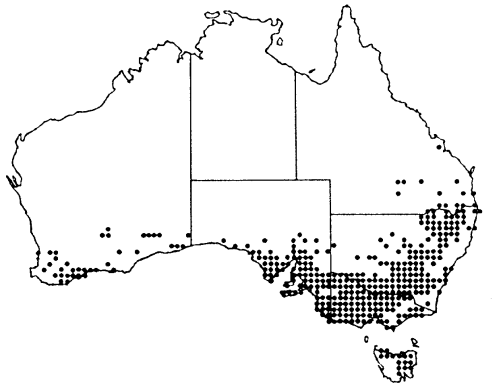

**Figure 3.** Distribution of horehound in Australia (Parsons and Cuthbertson 1992).

In 1980, the total infestation in Victoria was estimated at 6 million ha. In SA, 20 million ha are infested. Horehound also extends into Qld but is not important in that State. In WA it is widespread on some pastoral leases in Eastern Goldfields but is restricted to about 30 properties in the wheat areas and some coastal districts. Horehound is found throughout rural agricultural Tasmania but is most prevalent and troublesome in the grazing areas of the Midlands.

Because of its invasive nature and early introduction horehound has most likely reached its maximum potential distribution but not its potential density in Australia.

Horehound is also a weed in the southern states of the USA, including California and Texas, South America (Argentina, Chile, Peru, Uruguay etc) and in New Zealand.

**Ecosystems invaded:** Initially horehound occupies roadsides, channel banks, sheep camps, rabbit warrens etc., from which it encroaches into bushland and adjoining farmland. In natural ecosystems, it invades open bushland such as red gum, dry coastal vegetation, mallee shrubland *(Figure 4)*, lowland grassy and grassy woodlands, black box woodlands, open grasslands and rocky outcrops especially if the areas have been disturbed, overgrazed or previously grazed by sheep. Horehound does not appear to be invasive in undisturbed native vegetation.

**Figure 4.** Infestation of horehound at Wyperfeld National Park, Vic. *Photo: J. Weiss.*

## Impacts

**Species and ecosystems at risk:** Two plant species at risk from horehound in Victoria are the endangered marble daisy bush, *Olearia astroloba* and the rare spiny lignum *Muehlenbeckia horrida*.

**Economic impact:** The total economic impact of Horehound on agriculture in Australia has not been calculated. However, a survey of Victorian parks in 1996 estimated that horehound infested 78 200 ha of public land and cost $19 000 in control costs and 1 900 work-hours per year.

In pastoral systems, significant losses occur due to reductions in wool values from vegetable fault caused by horehound.

## Dispersal and establishment

**Reproductive techniques:** Horehound spreads by seed. It is an opportunistic germinator with most seeds germinating in response to autumn rainfall, but germination also occurs throughout winter and spring whenever sufficient water is available. In low rainfall areas, however, there are rarely follow-up rains that allow for recruitment of seedlings. Most seedlings that germinate in spring and summer do not survive the first summer.

Horehound, as with most members of the Lamiaceae family, is primarily bee pollinated but there have been no studies, however, to indicate what the seeding potential of horehound would be without bees. There are no Australian native plants that are closely related to horehound, but overseas *M. vulgare* can hybridise with *M. supinum* is sometimes found in herb gardens in Australia but is not recorded as invasive here, but is in China.

**Vectors and dispersal mechanisms:** The fruit or burr is well adapted for spread because it readily attaches to tyres, wool, fur, clothing and similar material. Sheep, rabbits, kangaroos and emus can easily spread the burrs. Water is also an effective dispersing agent, as may be seen along water supply channels in many areas. Horses are known to eat and pass the seeds in a viable condition in faeces. As the seeds readily germinate whenever sufficient water is present, dispersal at any time will aid in the plants spread.

**Persistence:** Mature plants can produce in excess of 20 000 seeds per year, although the more numerous and smaller plants produce about half this number. Anecdotal evidence indicates that the seeds can survive in the soil for 7-10 years. Horehound does not establish in cultivated paddocks.

**Tolerances:** Horehound is drought and frost resistant. It will grow on very poor soil often being one of the first plants to colonise eroded areas. It prefers open areas but will grow under open canopy woodlands.

## Properties

**Health risks and other undesirable traits:** Horehound leaves contain marrubin, a bitter alkaloid that makes them unpalatable to grazing animals. The meat of animals which are forced to eat horehound is tainted by the plant's strong flavour. About 7 grazing days on clean pasture are required to lose this. Horehound burrs are a nuisance to people by catching in clothing and socks *(Figure 5)*, contaminating wool, and reducing fleece values.

**Figure 5.** Horehound burrs readily attach to clothing, shoes and laces. *Photo: K. Blood.*

**Cultural uses:** Horehound is used as a medicinal herb for sore throats and other ailments and as a substitute for hops in beer production.

## Biology and ecology

**Biological and ecological notes:** Horehound is often the first species to colonise infertile eroded areas although it rarely persists when faced with competition from other perennial species.

Due to horehound's bitter taste, grazing animals preferentially feed on surrounding plants, thereby reducing palatable competitive species and aiding in horehound's establishment and persistence.

Horehound is drought but not fire tolerant. Fire will kill all mature plants as well as reducing the soil seed bank by up to 80%.

In Europe, horehound is fed upon by many (greater than 40) insect species. Prior to 1994 only a few arthropods (mites, mealy bugs and one bug) fed on it. Two biological control agents have recently been released onto horehound, a defoliator, the horehound plume moth (*Wheeleria spilodactylus*) and a root borer, the horehound clearwing moth (*Chamaesphecia mysiniformis*).

**Growth calendar:** Low rainfall areas (<400 mm ): Germinates primarily in autumn, and can flower in the following spring (Sept - Oct) with dried seeds/ burrs produced in summer (Nov - Jan). The main growth periods are in early spring and autumn.

For higher rainfall areas (400+ mm): Germinates whenever sufficient rainfall occurs. It can flower throughout the year. Burrs and seed are produced predominantly in summer. The main growth period is in spring and autumn.

## Management

**Prevention:** It is important to keep uninfested areas clear of horehound. Identify and treat existing or potential sources of this plant before it invades.

Once an infestation is established, prevention of spread into surrounding areas should be a priority. The area may be quarantined to stop movement of seeds and burrs on vehicles and equipment (both management and recreational) *(Figure 6)*. Ensure stock are quarantined or clean of burrs prior to entry onto land. Managing rabbit and other pest animal populations will also help to reduce horehound spread. This may include the establishment of rabbit proof fencing around high priority land.

**Figure 6.** Horehound burrs are easily spread on vehicle tyres. *Photo: K. Blood.*

**Integrated management:** Weeds need to be treated as a symptom of larger land and water management issues. When treating horehound in a natural ecosystem, it is essential to consider its management in context of other management issues so that they can be integrated to get the best results. When using these guidelines, it is essential to realise their limitations and modify them in light of experience and local knowledge. Each situation should be considered individually.

Small isolated infestations should be removed to prevent expansion. Larger infestations require planning to efficiently reduce the population to an acceptable level. That level will be determined by the management objectives of the area and the resources available to tackle the problem.

Isolated plants or small infestations: Ensure that you have correctly identified the plant before removal. Isolated plants can be physically removed, preferably before they have seeded. Small infestations can be treated with herbicide. As infestations become larger, a strategically staged approach for removal is advisable to ensure that treated areas are not reinfested.

Larger infestations: Extensive infestations are best quarantined and tackled progressively as part of a comprehensive revegetation program.

Where controlled burning is compatible with other management objectives, an effective approach would include an autumn low-intensity fire in grasslands and open woodlands. Reduce the grazing pressure (introduced and indigenous) on competitive desirable plant species. Revegetate with perennial plant species and/or summer growing annuals (eg. indigenous grasses). Reduce other feral pest species such as rabbits. Where there are no biological control agents established, apply herbicide in autumn if compatible with the sensitivity of desirable plant species. This should be followed by the release of biological control agents (plume moths preferably in higher rainfall areas that do not regularly get above 35$^0$C in summer, and clearwing moths in areas regularly achieving over 30$^0$C in summer).

Where biological control agents are established or establishing and herbicide is to be used, consider measures to maintain enough live horehound for the agents to survive in reasonable numbers. If a high mortality of horehound after herbicide application is anticipated, then unsprayed reserves for the biological control agent(s) may be worthwhile.

To manage an infestation of horehound in open grassland and open woodlands in dryish (400 mm rainfall) areas with warm/ hot summers: establish biological control agents, ensure insects are established in infestations amongst open woodlands, carry out pest animal control programs, burn grasslands in autumn, apply herbicide to accessible parts of horehound infestations in woodlands in autumn, revegetate areas with preferred perennial and annual species, and monitor/ redistribute biological control agents into grasslands if natural dispersal is too slow.

**Treatment techniques:** There are a number of different treatment techniques that can be used but it is often better to combine a number of techniques for the best results. These should be coupled with good ecosystem management to give the best long term management of horehound.

Hand-pulling/grubbing: Manual removal is labour-intensive and needs to be repeated as new plants establish from seedlings. Very small patches are suitable for eradication by this technique, or it could be used as a containment measure to prevent spread from a larger infestation. Care is needed to ensure that hand pulling does not spread seeds to uninfested areas.

Slashing: If repeated at least annually slashing may restrict seed production, limit spread of established plants, and the regrowth may be more attractive to sheep. Slashing is unlikely to achieve rapid reduction of horehound infestations unless combined with other techniques and seed may be spread to uninfested areas on machinery.

Cultivation: Where feasible, deep cultivation will destroy existing plants especially if repeated in summer so that plants dry off. Reseeding pasture species will reduce horehound seedling establishment but controlled grazing and/or herbicide application will probably also be needed. Cultivation is not compatible with biological control agents unless carried out in a number of stages or adjacent to an uncultivated infestation so that some agents can survive in uncultivated areas and recolonise later.

Herbicide information: **When using chemicals always read the label and follow all instructions carefully. Consult a specialist for advice on registered chemicals in your particular State or Territory. Herbicide information is available at the National Registration Authority web site at** www.affa.gov.au/nra/pubcris.html

The following active constituents or combinations of active constituents are effective in different situations. Ensure that the herbicides are registered for your particular State/Territory: 2,4-D dimethylamine salt, 2,4-D isopropylamine salt, 2,4-D ethyl ester, triclopyr butoxyethyl ester, bromacil, bromacil + trichloracetic acid, bromacil + diuron, dicamba dimethylamine salt, dicamba dimethylamine salt + MCPA dimethylamine salt, diflufenican and MCPA 2-ethyl hexyl ester and metribuzin.

(i) Spot-spraying: Best effects are achieved in autumn when horehound is growing strongly. Small areas along creeks, tracks, fencelines or near rabbit warrens can be treated easily; it is more difficult to deal with widely scattered plants. Follow-up is needed to control seedlings and this technique is not compatible with biological control agents. Not all of the herbicides listed above are registered for spot spraying.

(ii) Boom-spraying, aerial spray or large-scale handgun application: Vehicle access is required for ground application. Spraying is likely to be considered too damaging to indigenous vegetation unless it is already very degraded. The plume moth biological control agent appears to be able to survive autumn herbicide application provided that live shoots remain on the horehound continuously until spring. Plume moth larvae may achieve useful further suppression of horehound that has been damaged by a herbicide treatment and the following generations of moths in spring are likely to at least delay recovery of the horehound population.

Where previous experience suggests that herbicide treatment will leave a substantial proportion of horehound plants (>10%) alive and green through winter, plume moths can probably survive at an effective density for the following spring. Survival of horehound will be higher if some plants are sheltered from spraying by stumps, rocks or tall grass or if application is made in less than ideal conditions. If 90% or more of horehound plants are expected to be killed by herbicide, then it may be necessary to leave some patches of mature horehound plants unsprayed as reserves for plume moths where they're active. Spraying strips in alternate years may achieve the same effect.


There is no information at present on whether herbicide application of any sort is compatible with the clearwing moth. Due to the slow rate of these moths and the fact that they primarily attack young horehound plants that are also likely to be killed by herbicide, chemical control is unsuitable in the presence of the clearwing moth unless substantial reserves of unsprayed horehound are maintained.

Burning: Burning is an effective means of killing larger plants but the large numbers of seedlings produced require follow-up treatment. The horehound seed bank is greatly reduced after fire due to large numbers of seeds being killed and the large numbers germinating immediately afterwards. Nevertheless, it seems unlikely that the seed bank could be decreased to the point where horehound seedlings would not rapidly reappear in suitable gaps, so fire should always be combined with other techniques. Regeneration of indigenous species may be aided by fire if the circumstances are right. Burning is not compatible with biological control agents unless reserves are left. Recolonisation and increases of biological control agent populations (especially clearwing moth) to effective densities will take several years unless reserves are relatively large and closely spaced.

Biological control: The horehound plume moth *(Figure 7)*, was first released in 1994 and is now established at over 100 localities throughout south eastern Australia (SA, Vic, Tas and NSW). This insect is specific to horehound; the caterpillars (larvae) feed on the growing tips of the plants and then work their way down the shoot, progressively defoliating the stem. This weakens the plant and reduces the number of seeds and flowers produced. It is essentially a cost-free technique after the initial establishment. Feeding by the larvae at a sufficient density will reduce the size and shorten the life of established plants. Once present for 4+ years at a particular location densities of at least one (in areas <400 mm rainfall) or two (in areas with >400 mm rainfall) per shoot ndicate plume moths are having or will have some impact on the infestation.

**Figure 7.** Horehound plume moth is a biocontrol agent for horehound well established in Australia. *Photo: J. Weiss.*

Larval densities should be assessed between late autumn and early spring when the whole population is present as larvae. Year-to-year variation in densities is to be expected. Unless the infestation is an immediate and severe problem, assessment of effectiveness should take place over several years before techniques that are incompatible with biological control agents are introduced. The presence of horehound plants stripped of all leaves is a sure indication of a substantial effect. The final horehound population at equilibrium with plume moths cannot yet be predicted and will probably vary according to individual site characteristics. Should plume moths alone not appear to be providing acceptable control, other techniques could be used either as alternatives or in combination with the plume moth.

The horehound clearwing moth, was first released in March 1997. Larvae feed within the growing tissue of the root and lower stems. Larval activity affects the flow of water and nutrients through the plant, weakens it, reduces growth and increases the likelihood of the plant dying (especially when water stressed). Clearwing moths primarily attack young horehound plants, killing them completely and thus reducing the ability of the weed to replace losses of older plants or invade new gaps. The clearwing moth should work well in combination with the plume moth which suppresses larger plants. Population increase of clearwing moth will be slower than plume moth and its presence is more difficult to assess because the larvae are hidden in the roots. With only one generation per year, the clearwing moth is likely to be more vulnerable than the plume moth to herbicides, fire or heavy grazing. Introductions of clearwing moth would be most appropriate in large infestations unlikely to be controlled by other means and in lower rainfall areas. Success with this agent may be restricted to sites where maximum summer temperatures often exceed $30^0$C.

The native brightly coloured orange and black horehound bug, *Agonoscelis rutila*, is often seen on horehound in great numbers but does not provide any worthwhile control.

Biological control is a long term program which is best used on large, chronic infestations with a low priority of control due to inaccessibility, remoteness or low threat of spread.

Additional biological control agents are under investigation. Research into horehound has been supported by the Victorian Department of Natural Resources and Environment, South Australian Animal and Plant Control Commission, The Woolmark Company, and the Weeds CRC.

Grazing (sheep): Sheep generally avoid horehound due to the bitter taste but may eat it when other feed is scarce or when lush shoots are produced in spring. Temporary tainting of meat will result from feeding on horehound. Grazing often favours horehound by creating gaps in which horehound seedlings can later establish without competition from other pasture species. Heavy grazing pressure will do little to suppress large horehound plants but can be effective on seedlings or short new shoots produced following slashing, burning, herbicide application or cultivation. Using low rates of phenoxy herbicide can make horehound more palatable to sheep which are subsequently stocked at high rates for a short time (spray-grazing). Spray-grazing of horehound does not seem to be widely applied and no herbicides registered for spray-grazing specifically mention horehound, but it could be successful and is included on some herbicide labels under the designation “other broadleaf weeds”. Light or moderate grazing is probably compatible with biological control agents, but heavy grazing in spring is likely to severely reduce populations of both biological control agents. Delaying spring grazing until adult plume moths have emerged could be helpful.

Grazing (rabbits): Rabbits may reduce horehound seedlings in the same circumstances as sheep but are probably more likely to avoid small horehound plants. Feeding and digging by rabbits create gaps for horehound seedling establishment and rabbits also transport horehound seeds. Control of rabbits assists horehound management and re-establishment of pasture or natural vegetation.

Reseeding: Dense vegetation cover, especially in autumn, will reduce establishment of horehound seedlings. Any treatment technique that produces bare ground may usefully be followed by reseeding with appropriate pasture or indigenous species, unless the seed bank of desirable species is already adequate. Variable establishment and later disturbances will inevitably create gaps in which horehound seedlings can grow, so removal of horehound and reseeding may not achieve more than a temporary reduction in horehound unless followed by some other treatment(s). Reseeding combined with biological control agents may restrict recovery of the horehound after clearance of existing plants and maintain an acceptably low horehound density.

**Disposal:** Horehound plants do not recover after hand pulling or grubbing and can be left on site with their roots exposed. Any flowering stems or seed heads should be bagged, removed and later burnt or disposed of through local government tip facilities. Cover trailers and ensure seeds and flowering stems are not dropped in transit. Ensure local tip facilities are following Australian standards for composting and transfer station or tip management best practice guidelines.

**Community awareness:** A number of Landcare groups and one National Park in Victoria are involved in the management of nursery sites for biological control agents, the redistribution of agents and the monitoring of their establishment and dispersal. There are a number of nursery sites set up for redistribution of plume moths in SA, NSW and Tas. Contact the relevant State departments for further information.

Consider running activities as part of national Weedbuster Week in October each year to increase local community awareness of the problem. See the web site at www.weedbusterweek.info.au for more information.

**Follow-up:** As horehound rarely persists with competition from perennial species, revegetation/promotion of desirable species must be the long term goal of any management program for horehound. Once an area has been treated it is necessary to monitor the area for many years and destroy new plants.

**Management calendar:** Rabbit ripping programs are conducted in spring. Hand pull and/or cultivate prior to flowering in early spring. Monitor previous plume moth release sites in early-mid spring. Release/redistribute plume moths in spring (Sept-Oct) and release clearwing moth from January to March. Apply herbicide and conduct control burns in autumn. Bait rabbits and start revegetation in autumn.

**Replacement plants:** It is best to seek the advice of local flora and revegetation experts for suitable indigenous plants of local provenance for revegetation. It is best to revegetate with a mixture of perennial and annual plants to compete with both horehound seedlings and any mature plants that become established. There are no recommended replacement medicinal or herbal plants although *Marrubium supinum* may have some of the same properties.

**WeedWatch:** Legislation prevents the sale of horehound in a number of areas. If it is being sold, then the garden centre or nursery and local weed management authority should be informed. Let garden centre staff know how weedy it is and the damage it is doing locally. Encourage them to provide safer alternatives.

Where plants are found in the bush they should be reported to those managing the area so that infestations can be treated where feasible. If you are uncertain about identification, send a specimen to the State or Territory Herbarium with details on where and when it was found and the contact details of the person who sent the specimen (see the *White Pages* or the *Weed Navigator* for address details of herbaria).

## Further reading


**Anon.** (1998) Landcare note PP0008, Horehound. Department of Natural Resources and Environment, Keith Turnbull Research Institute, Vic.

**Carter, R.J.** (1990) Biology and control of horehound, *Marrubium vulgare*. Proceedings of the Ninth Australian Weeds Conference, pp. 382-6.

**Parsons, W.T. and Cuthbertson E.G.** (1992) Noxious weeds of Australia. Inkata Press, Melbourne.

**Weiss, J. and Sagliocco, J-L.** (1994) Horehound, *Marrubium vulgare* - A global perspective. Fourth Biennial Proclaimed Animal and Plant State Conference. Animal and Plant Control Commission, SA, pp. 39-43.

**Weiss, J.** (1996) Control of Horehound, *Marrubium vulgare* L., in Wyperfeld National Park, Victoria. Eleventh Australian Weeds Conference Proceedings, pp. 417 - 419.


Further horehound information is available on the internet at http://www.nre.vic.gov.au/agvic/profiles/ktri.htm. There are a number of management guides on different weeds being published by the Weeds CRC (see contact details below). Other CRC weed publications include the *Weed Navigator* (lists many weed publications, information resources and contacts in Australia and New Zealand), workshop proceedings, field and management guides, brochures and posters.

**Further contacts:** Many people interested in environmental weeds communicate regularly through the *Enviroweeds* email discussion group established in Australia. If you would like to join this group free of charge, send this email message <subscribe> to the following email address: enviroweeds@majordomo.nre.vic.gov.au


**Acknowledgements:** Emma Wills, Mike Keller, Craig Clarke and John Ireson are thanked for comments on an earlier draft of this guide. Editing by Richard Groves, Kate Blood and Rick Roush. Design and layout by Kirsty Villis and Kelly Scott



**Authors: J. Weiss**, **N. Ainsworth** (Weeds CRC) and **I. Faithfull** (Weeds CRC), Keith Turnbull Research Institute, PO Box 48, Frankston, Vic, Australia 3199.



Publication date: September 2000. Printed on recycled paper.





More copies available from the Cooperative Research Centre for Weed Management Systems (Weeds CRC) at University of Adelaide, PMB1 Glen Osmond, South Australia, Australia 5064, ph 08/8303 6590, fx 08/8303 7125, email: crcweeds@waite.adelaide.edu.au web: www.waite.adelaide.edu.au/CRCWMS