Section 3

Control methods

Choosing a control method

Identify the methods most suitable for your species in the table below. Then, read in the following pages about how to apply each method and compare their advantages before deciding.

Species	Hand pulling	Crowning[A]	Digging / grubbing[B]	Slashing stems / leaves*	Cut-paint / gouge-paint
Page	44	44	47	48	60
A. aethiopicus	Y	Y	N/A	Y	Y
A. africanus	Y	Y	N/A	Y	Y
A. plumosus	Y	Y	N/A	Y	Y
A. scandens	Y	Y	N/A	Y	Y
A. declinatus	Y	N/A	Y	Y	N
Bridal creeper	Y	N/A	Y	Y	N
WC bridal creeper	Y	N/A	Y	N	N
Infestation size	Small / Seedlings	Small / Dense (sensitive habitat)	Small / Dense (sensitive habitat)	Large / Dense	Small

Species	Basal bark spray	Foliar spot spraying	Fire*	Grazing*	Biological control
Page	62	62	65	65	65
A. aethiopicus	N	Y	+	Y	N/A
A. africanus	Y	Y	+	Y	N/A
A. plumosus	Y	Y	+	Y	N/A
A. scandens	N	Y	+	Y	N/A
A. declinatus	N	Y	+	Y	N/A
Bridal creeper	N	Y	Y	Y	Y
WC bridal creeper	N	Y	N	N	N/A
Infestation size	Medium / Large	Small / Large	Large	Large	Large

[A] Crowning involves removal of the central rhizome. [B] Grubbing involves removal of all branching rhizomes.

* Slashing, grazing or use of fire as a management technique will deplete but not kill the weed and must be integrated with other techniques.

Y = Yes. N = Not recommended.

+ Further research is needed to determine effectiveness of method.

Native species that can be confused with asparagus weeds

The list below was created from a combination of research literature and stakeholder consultation.

Asparagus racemosus – native asparagus is distinguished from A. africanus and A. plumosus by having red fruit when mature and longer leaflets (cladodes) (10–30 mm long). See A. racemosus distribution map on page 8.

Sheldon Navie

Asparagus racemosus (native asparagus)

Sheldon Navie

A. plumosus (left) and A. africanus (right); note short leaflets (to 15 mm)

Sheldon Navie

Asparagus racemosus: note long leaflets (to 30 mm) compared to A. plumosus and A. africanus in the photo above

Native species	Common name	Habit	Asparagus look-a-like
Adiantum aethiopicum	Common maidenhair	Small fern	*A. plumosus* (foliage)
Asparagus racemosus	Native asparagus fern	Vine / shrub	*A. africanus* and *A. plumosus*
Baloskion tetraphyllum	Plume rush, Australian reed	Rush	*A. aethiopicus* (foliage) *A. virgatus* (prior to formation of inflorescence)
Billardiera scandens	Common apple berry	Shrub	*A. asparagoides*
***Callitris* spp.**	Pines	Shrub / tree	*A. aethiopicus* (seedlings)
Clematis microphylla	Old mans beard	Vine	*A. asparagoides*
Eustrephus latifolius	Wombat berry	Vine	*A. asparagoides*
Geitonoplesium cymosum	Scrambling lily	Vine	*A. asparagoides* and *A. falcatus*
***Lycopodium* spp.**	Clubmoss	Small primitive plant	*A. africanus* (foliage)
Morinda jasminoides	Sweet morinda	Woody climber / scrambling shrub	*A. falcatus* (seedlings)
***Muehlenbeckia* spp.**			*A. asparagoides*
Podocarpus elatus	Plum pine	Tree	*A. falcatus* (seedlings)
Pteridium esculentum	Common bracken	Perennial fern	*A. plumosus* (foliage)
Selaginella uliginosa	Swamp selaginella	Small primitive plant	*A. africanus* (foliage)
***Smilax* spp.**		Climbers	*A. asparagoides*

Note: This list is not exhaustive and there may be other native species that resemble asparagus weeds – please use caution.

Detailed overview of control methods

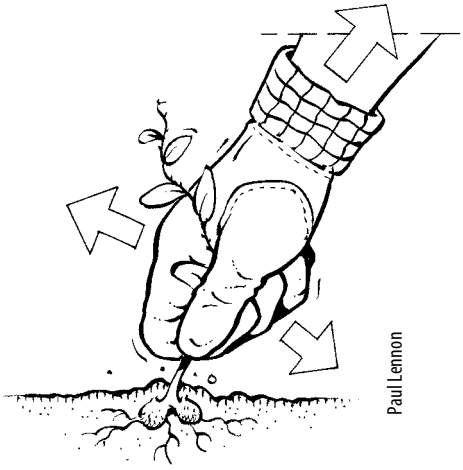
Manual control

Manual control methods use physical or mechanical means to remove plants, and may include the use of hand tools. Methods include hand pulling, digging / grubbing, crowning, and slashing. For asparagus weeds, these are only recommended for seedlings or small plants, in small to medium-sized infestations, or when working in high-value native vegetation or around cultural or geological assets.

Hand pulling

Applying the method:

- Hold the plant stem/s as close as possible to the base of the plant.



Hand pulling – grasp the stem close to the ground

- Gently tug the plant and rock from side to side. This will loosen the soil and allow the roots and tubers (if any) to come free.
- If the stems are breaking off from the rhizome, use a knife or trowel to help free the roots as they are being pulled out. The entire root system, including rhizome must be removed.
- Remove the roots and tubers shaking off any soil, bag them and dispose of properly.

Crowning

Crowning is the removal of the underground growing points (or the central crown) of the plant, thus preventing regeneration (see Section 1 – Biology and Threat for description of the root systems).

Applying the method:

- Grasp the base of the stems where they attach to the underground crown, so that the base of the plant is visible. Thick gloves (e.g. leather) are highly recommended due to thorns or prickles.
- Cut away large stems or foliage to gain access to the crown.
- Use a knife or sharp trowel to cut away all roots leading from the crown.
- Extract the crown by inserting a peter lever, mattock or trowel under the base of the crown and lever it up.
- Remove the crown, shaking and removing as much soil as possible, and dispose of in an appropriate manner (see 'Disposal' page 48). Taking excess soil from the site could: a) inadvertently remove native seeds that might

Hand pulling

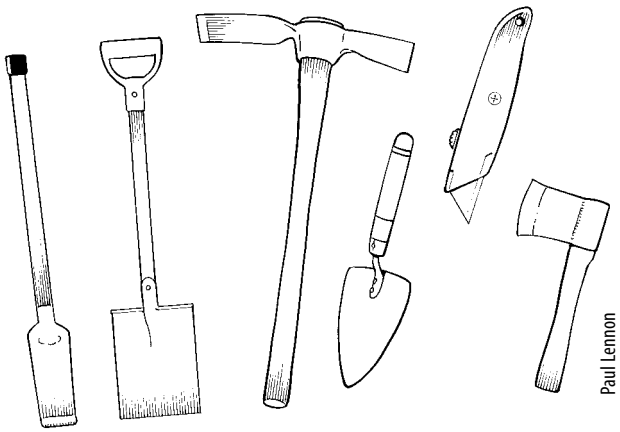
Recommended for:	Caution!	Advantages	Disadvantages	Timing
▪ Seedlings or small plants in light infestations or as a follow-up control option after mature plant control ▪ Soft soil, such as sand or loam ▪ Use on all asparagus weeds	▪ **If part of the crown is left in the soil, it will likely re-sprout** ▪ **Plants can regrow from any sections of rhizome that are left in the ground**	▪ Whole plant removed (no regrowth) ▪ No chemicals or equipment required ▪ Minimises risk of off-target damage to native flora	▪ Time consuming and labour intensive ▪ Not practical for extensive infestations or mature plants, as stems will break free of the crown ▪ Will not work in hard or compacted soils, such as dry clay	Anytime

otherwise naturally regenerate, and b) increase the amount of green waste that needs to be transported off-site.

- Remove and bag fruits or fruiting stems in areas of isolated infestations and/or low density to reduce the chance of reinfestation. In high density infestations, it is not necessary to remove fruits, as it is time consuming and any new seedlings can be controlled during follow-up.

Which tools to use?

For small crowns: Use a plaster cutter ('gyprock' saw), sharp knife or trowel. As knives and plaster cutters can go blunt quickly when used in soil, it is helpful to have one dedicated for use on asparagus crowns only.



Paul Lennon

Tools for manual control

Pittwater Council

Peter lever: can be used for crowning

For larger crowns: Use a peter lever, mattock or sharp spade. Hand mattocks are useful on large plants in open areas but are awkward for use in shrubby and rocky ground (e.g. coastal heath), where peter levers are more effective.

Note: ***There may be situations where removal of the entire underground root mat is desirable to allow native regeneration. For example, root mats of A. aethiopicus in temperate climates do not decompose rapidly therefore removal of the root mat may allow additional light penetration to assist germination from the native seed bank. This is only recommended when working in plant communities that have a resilient seed bank and where some level of soil disturbance is acceptable. Follow-up control will be necessary.***

Crowning

Recommended for:	Caution!	Advantages	Disadvantages	Timing
▪ Large, well-established asparagus weeds that do not form extensive rhizome networks under ground ▪ Weeds that grow from a central point at ground level or below the surface of the ground, including crown forming asparagus weeds e.g. *A. aethiopicus, A. africanus, A. plumosus, A. scandens* and *A. falcatus*	▪ **Do not leave the crown in contact with soil, as it can re-shoot** ▪ **The tubers and or thickened roots of the crown forming asparagus weeds are not reproductive and do not need to be removed from the soil** ▪ **Do not dig up entire root mats unnecessarily as it is labour intensive and creates a high level of disturbance**	▪ All reproductive parts removed via crown removal (no regrowth) ▪ No herbicides required ▪ Minimises risk to native flora if care taken ▪ Minimal soil disturbance ▪ Effective for plants of all sizes	▪ Time consuming and labour intensive ▪ May not be practical for extensive infestations ▪ Rhizomes must be completely removed ▪ Creates soil disturbance which may promote weed germination ▪ Not effective for *A. declinatus, A. virgatus* and *A. asparagoides*, as they form extensive, rhizomatous root mats (see Digging / grubbing method instead)	Anytime but pre-flowering / fruiting is best

Control methods

Should I remove all plant material off-site after 'crowning'?

Many people hang *A. aethiopicus* plants and root mats in tree forks, but be aware that if the tubers, which are water holding sacs, are still attached to the rhizome, plants can continue to grow, develop fruit and set seed. If the plant is fruiting, the fruits should be removed and disposed of properly.

Leaving crowns on-site is only used in:

- remote areas where removal of large amounts of refuse is a problem,
- large infestations, and
- areas where follow-up treatment will occur.

When crowning, leave the tubers and as much of the soil as possible in the ground. If you are leaving plant material on-site, leave the foliage attached to the crown to assist the plant in drying out.

Andrew Meiklejohn

Asparagus aethiopicus drying out in tree fork

Kerinne Harvey

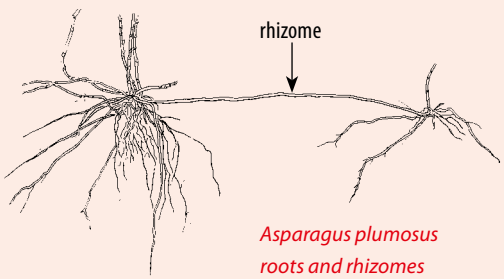
Asparagus africanus crown

Pittwater Council

Asparagus aethiopicus crown removal

Be careful of suckering and layering when crowning Asparagus plumosus

Asparagus plumosus crowns are capable of sending out creeping, underground stems or runners. These stems can be greater than 2 m long and produce more climbing stems from nodes along their length. Be aware, and search for creeping stems and new crowns that can form along these runners, particularly where infestations run under logs or other objects. Rooting from the nodes may also occur when climbing stems come in contact with the ground, such as when pulled down by a tree fall. These underground stems form new crowns, which must also be removed.



Asparagus plumosus roots and rhizomes

Digging out plants / grubbing

Digging, sometimes referred to as grubbing, involves the physical removal (by digging) of the entire root system including underground rhizomes. This contrasts with crowning, which only removes the central crown and not the rest of the root system.

Applying the method:

- Prepare the area by removing as much surrounding ground debris (e.g. mulch, leaves, etc.) as possible.
- Using a small trowel, dig a narrow channel next to and around the base of the stems until you reach the rhizomatous root mass. Dig out the root mass and remove from site, with any fruit or fruiting fronds/foliage. Shake as much soil off the roots as possible.
- Check the soil for any adjoining or loose rhizomes. Although the tubers do not regenerate in these species, the tubers are densely arranged along branching rhizomes. If a tuber breaks off from the rhizome, a small part of the rhizome may still be attached to the tuber and therefore regenerate. Best practice management is to remove both tubers and rhizomes in these species (i.e. non-crowning species).

Biosecurity SA

Tubers and branching rhizomes of A. declinatus (above) and Western Cape bridal creeper (below)

- After the plant is removed, it is best to replace soil and leaf litter to minimise the effect of disturbance.
- Remove plant material and dispose of in an appropriate manner (see 'Disposal' page 48).
- Follow-up control is required in subsequent years to treat seedlings that emerge after primary control.

Digging out plants / grubbing

Recommended for:	Caution!	Advantages	Disadvantages	Timing
▪ Isolated infestations or after several years of herbicide treatment on larger infestations ▪ Effective on species with extensive, rhizomatous root mats (*A. declinatus*, *A. asparagoides* and *A. virgatus*)	▪ **Once the rhizomes and roots have been removed, it is best to replace the soil and leaf litter to prevent erosion** ▪ **Rhizomes cannot be dug out separately; the whole root system needs to be removed from the soil, as vegetative growth can occur from broken off pieces of rhizomes**	▪ Whole plant removed (no regrowth) ▪ No herbicides required ▪ Very precise with potential for little or no off-target damage	▪ Time consuming and labour intensive ▪ Not practical for extensive infestations ▪ Rhizomes and tubers must be completely removed ▪ Creates extensive soil disturbance which may promote weed germination ▪ Not appropriate for *A. aethiopicus*, *A. africanus*, *A. plumosus*, *A. scandens* and *A. falcatus* (see Crowning method instead)	▪ Autumn and winter when soils are moist ▪ Pre-flowering / fruiting is best ▪ When plants have foliage on them

Slashing or pulling off above ground foliage

Slashing weeds involves the cutting back of above ground foliage to ground level. This can be done using either hand slashing or tractor drawn equipment on all asparagus weeds.

Slashing or pulling off above ground foliage

Recommended for:	Caution!	Advantages	Disadvantages	Time
▪ Dense infestation of asparagus weeds ▪ Will assist in improving access for follow up treatment ▪ Use on all asparagus weeds ▪ Not recommended for Western Cape bridal creeper because any infestations of this weed are to be eradicated or fully controlled	▪ **To prevent seed set, the foliage should be slashed before the plant flowers** ▪ **While slashing should usually be conducted six months prior to spraying, an established bridal creeper infestation that was slashed during flowering has been observed to re-sprout and flower again within just one month** ▪ **Green fruits can be viable and set seed even if stems are cut**	▪ May prevent fruit production and slowly deplete tubers of energy over time ▪ Improves access to dense infestations for further treatment ▪ New shoots easier to treat with herbicides	▪ Will not kill plants ▪ Not suitable in natural areas	▪ Pre-flowering, around six months prior to spraying ▪ When plants have sufficient foliage

Disposal

Off-site disposal

Shake as much soil off the roots as possible. Place plant material in a strong bag and remove from site. Rhizomes and other reproductive material should be disposed of in strong plastic bags and buried (>1 m depth) or disposed of at the tip. Do not include reproductive material in green waste.

Composting and mulching

If composting or mulching material on-site, be aware that crowns and rhizome fragments can re-shoot. Compost maintenance through routine turning, spot spraying and covering with black plastic is required to break the material down. Use compost bins that have an open bottom to allow soil organisms to assist in decomposition. Routine turning allows new material to be buried and aerates the pile, which further assists with decomposition. On occasion, spot spray re-shooting foliage prior to turning. When bins are full, a few months on average are required before new material can be added. Every 18–24 months, remove compost and leave in full sun on a hard surface to dry and lighten material before taking to landfill.

Peter Tuggart

Compost bins

Solarisation

Material can be transferred into a black plastic bag and left out in the sun to 'cook' (solarise) the tubers and rhizomes until they are no longer viable. This process takes about 2–3 months, depending on weather conditions, after which time the bag can be disposed of off-site or composted on-site.

Chemical control

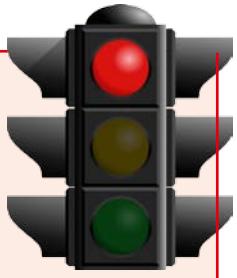
When used as part of an integrated management plan, the use of chemicals (herbicides) can be an efficient way of controlling asparagus weeds. Herbicide applications are recommended for medium to large infestations or where infestations are present on steep slopes where erosion may occur if roots and/or crowns are removed. To avoid off-target damage, care must be taken when applying herbicide in areas of native vegetation. Herbicide application on asparagus weeds is only effective with correct application methods and with appropriate chemicals. Herbicides should only be applied when plants are actively growing with sufficient above ground foliage. Plants may yellow off and re-sprout if treated with herbicide outside the active growing period or if the plant is stressed. Currently herbicide use is only registered for *A. asparagoides* but some herbicides are permitted under minor use (or off-label) permits for other asparagus weeds. Herbicide application methods used on asparagus weeds include:

- cut and paint or gouge and paint,
- basal bark spray, and
- foliar spot spraying.

These methods are discussed in detail later in this section.

Watch out!

Green fruits in asparagus weeds can be viable. Plants may still set seed after being sprayed with herbicide. Follow-up is important.



Stop and Think!

Site-specific management is important

Sites vary and what is appropriate for one site may not be suitable for another.

Follow-up, follow-up, follow-up!

Follow up is paramount for successful weed control and should be included as part of an integrated management plan (e.g. foliar spraying followed by hand removal and site monitoring). Although the seed bank for most asparagus weeds is thought to be relatively short-lived (approximately 3–5 years), many years of control may be required for dense infestations to be contained. It takes a minimum of 3 years per site, but more than 5 years at some sites, to control asparagus weed infestations.

Bird dispersal of asparagus weeds presents a considerable management challenge. Early detection and control of newly emerged populations is as important as post control site monitoring. See Section 2 for more information on planning.

Herbicide labels and legislation

The Australian Pesticides and Veterinary Medicines Authority (APVMA) controls and regulates the use of all pesticides (this includes herbicides). The APVMA approves the use of a herbicide to control a weed and sets the label recommendations. APVMA also issues permits for herbicide applications that are not otherwise registered and are referred to as 'off-label' permits. Various off-label permits for asparagus weed control are held by government departments and individuals and can be used by other individuals or groups with permission from the permit holder. As new chemical products are registered on a regular basis and existing chemicals are reviewed routinely,

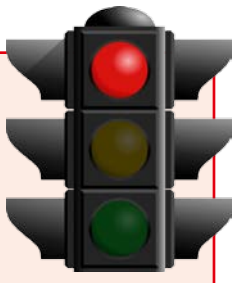
Weed control contacts

	Department	Phone	Email	Website
ACT	Environment and Sustainable Development Directorate	132 281	environment@act.gov.au	www.environment.act.gov.au/environment
NSW	Biosecurity NSW, NSW Dept. of Primary Industries	1800 680 244	weeds@dpi.nsw.gov.au	www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
NT	Dept. of Land Resource Management	(08) 8999 4567 Katherine and the Gulf (08) 8973 8857 Alice Springs (08) 8951 9210	weedinfo@nt.gov.au	www.lrm.nt.gov.au/weeds2
QLD	Biosecurity Queensland, Dept. of Agriculture, Fisheries and Forestry	132523	callweb@daff.qld.gov.au	www.daff.qld.gov.au/4790_8331.htm
SA	Biosecurity SA, Primary Industries and Regions SA	(08) 8303 9620	nrmbiosecurity@sa.gov.au	www.pir.sa.gov.au/biosecuritysa/nrm_biosecurity/weeds
TAS	Dept. of Primary Industries, Parks, Water and Environment	North (03) 6336 5429 North-west (03) 6421 7654 South (03) 6233 3650	invasivespecies@dpipwe.tas.gov.au	www.dpipwe.tas.gov.au/inter.nsf/ThemeNodes/SSKA-52J2K4?open
VIC	Dept. of Environment and Primary Industries	136 186	customer.service@dpi.vic.gov.au	www.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds/weeds
WA	Dept. of Agriculture and Food	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
National	Australian Pesticides and Veterinary Medicines Authority	(02) 6210 4701	contact@apvma.gov.au	www.apvma.gov.au

check the APVMA website (www.apvma.gov.au) each time you use a herbicide off-label to ensure you are not breaching any laws.

Herbicides must be stored in properly labelled containers, preferably in the original container and in a locked cabinet. Only chemicals that are registered for use in aquatic situations may be used in and around aquatic areas.

Stop and Think!



Be aware of legislation in your state regarding herbicide use. For example, some herbicides are restricted in certain states or in specific areas of the state.

For up-to-date registration details and current permits visit the Australian Pesticides and Veterinary Medicines Authority (APVMA) website: **www.apvma.gov.au** and refer to weed control contacts in your state (see table above).

Safety and training

Personal protective equipment (such as protective clothing, eye or face shields, and respiratory protection) must be used in accordance with the recommendations stated on the herbicide label or permit. **Herbicide use training is highly recommended** and is required for people using herbicides as part of their job or business. Training is recommended for community groups and may be required if working on public land. Training courses are run by ChemCert and TAFE in each state. Other training courses may be available through state agencies (e.g. AgTrain in Victoria, SMARTtrain in New South Wales, and AgForce in Queensland), local councils or non-government organisations. See Section 7 for contact information.

By law, you must read the label (or have it read to you) before using any herbicide product. Always follow the label instructions. The same applies for off-label permits.

Registered herbicides

Before using a herbicide it is important to check that each herbicide product is registered in *your* state or territory for the particular application method you are planning to use or that the use is allowed by a relevant permit. The use of certain chemicals off-label is permitted in specific circumstances in Victoria, as explained in the 'Guide to using Agricultural Chemicals in Victoria', which can be found at www.dpi.vic.gov.au/agriculture/farming-management/chemical-use/publications/a-guide-to-using-agricultural-chemicals-in-victoria.

It may be beneficial to choose herbicides that can treat multiple weeds at one time. For information on which herbicide may be most appropriate in your patch, contact your local weeds or biosecurity officer.

The most commonly used herbicides on asparagus weeds are glyphosate, metsulfuron-methyl, fluroxypyr, 2,4-D, picloram and triclopyr. Neat diesel is also registered in QLD only for use on environmental weeds. Some of these chemicals are used for all asparagus weeds, while others are species specific or used in combination. The characteristics of the most commonly used herbicides are described below. This information is not necessarily comprehensive and does not imply any recommendation of a specific herbicide. Individual site requirements must be considered when choosing a herbicide. See Section 6 – Case Studies for examples of where managers have considered their specific situation before applying chemicals. Many other herbicides containing these active ingredients, but not mentioned in this manual, may also be registered for use on asparagus weeds.

Glyphosate is a non-selective herbicide used against many annual and perennial broadleaf weeds and grasses. It is not residual, meaning it only kills existing plants and is inactivated on contact with the soil. Glyphosate enters a plant through its foliage and the speed of entry depends on the species and where it is applied to the plant. It is absorbed by the leaves and stems and is translocated throughout the plant and into the root system. Glyphosate inhibits an enzyme required for the production of amino acids used in protein synthesis, hence plant growth. On annual weeds, it may only take between 3 and 7 days to see visible impacts but, on perennial plants, it can take over 2 weeks. On asparagus weeds, it can take 3–4 weeks to see visible impacts. Visible effects of control may be delayed by cool or cloudy weather. Only healthy and actively growing weeds should be sprayed, as translocation is dependent upon the sugar transport system (phloem) within the plant being active. Most transportation within the phloem to the plant's growing points occurs within 4 hours and slows thereafter, stopping by 48 hours. Other factors such as plant stress, dust and extreme weather can affect glyphosate uptake in plants. Asparagus weeds often grow closely among native vegetation and the use of non-selective herbicides can lead to unacceptable off-target damage unless the application is very carefully targeted. For example, *Themeda* grasslands, a community commonly threatened by asparagus weeds, are particularly vulnerable to even low amounts of glyphosate.

Note: Do not use surfactants when working in an aquatic situation and only use herbicide formulations registered for use in aquatic situations.

Metsulfuron-methyl is a selective herbicide for use on broad-leaved plants and some annual grasses. The residual activity of this herbicide is dependent upon environmental conditions and can vary with soil type, soil pH, temperature, moisture and organic matter. Soil residual activity may be reduced in the presence of high carbon levels following fire. Half-life estimates for metsulfuron-methyl in soil are wide ranging from 14–180 days, with an overall average of 30 days. The residual activity dissipates faster in acidic soil and in soils with higher moisture contents, temperatures, and

increased microbial activity. Metsulfuron-methyl is absorbed both through roots and leaves, and is generally applied in solution to the leaves. It is transported through the plant rapidly, but can be slow acting. Metsulfuron-methyl blocks a key enzyme system required for the production of amino acids necessary for plant cell division.

Be aware of the importance of conducting small scale trials in your specific situation before broadscale spraying of residual herbicides. For example, the Narrawallee Foreshore and Reserves Bushcare Group in NSW conducted a small scale trial that found too much off-target damage from metsulfuron-methyl in their situation (see Narrawallee Beach Dunes case study on page 103). In contrast, the use of metsulfuron-methyl has worked effectively in a number of situations in SA (see South Australian Indigenous Flora case study on page 97).

Important notes on metsulfuron-methyl

- **Mixing metsulfuron-methyl with other chemicals:** before using any herbicide mixes, it is important to check that they are registered in *your* state or territory for the particular application method you are planning to use.
  - ***Penetrants (e.g. Pulse®) are required*** when using metsulfuron-methyl on asparagus weeds.
  - ***Spot-spraying metsulfuron-methyl + penetrant*** on asparagus weeds may take up to 12 months or more to see an effective kill. Asparagus weeds with crowns can have persistent, dormant crown 'buds' that can sprout even after other parts of the crown are dead, thus follow-up is required.
  - ***Spot spraying 'hotmix', a mixture of metsulfuron-methyl (600 g a.i./kg) + glyphosate (360 g a.i./L) + penetrant: Where hotmix is permitted or registered for use,*** 1.5 g metsulfuron-methyl + up to 200 mL glyphosate per 10 L water + label rates of penetrant is suggested to provide good kill of *A. aethiopicus*, *A. plumosus*, *A. scandens*, *A. declinatus* and *A. asparagoides*. This chemical mix is situation specific and can be used with a range of other weeds (e.g. weedy grasses like *Ehrharta erecta*). This mix should never be used for broadscale spraying – be careful to avoid off-target damage, particularly from glyphosate on native grasses.
  - ***Cut and paint or gouge-paint applications of 'hotmix'*** can be used on *A. aethiopicus, A. africanus, A. plumosus* and *A. scandens*.

- **Using lower rates:** some land managers have indicated that using lower rates of metsulfuron-methyl (i.e. 0.5 g per 10 L of water) may give a slower, but more effective kill of some asparagus weeds (e.g. *A. asparagoides, A. virgatus*). These lower rates, however, may limit the suite of other weeds that can be controlled at the same time. Further research is needed and this technique may be best suited only to certain asparagus weeds. Refer to the emerging asparagus weeds case study on page 106.

- **Off-target damage:** several native monocots, such as *Dianella* species, commonly co-exist with *A. aethiopicus* and are sensitive to off-target damage by metsulfuron-methyl. Do not apply where the roots of desirable non-target species are present. Similarly, *Eucalyptus* and *Leptospermum* species are particularly vulnerable to off-target damage from metsulfuron-methyl. Preparing an area for spraying is imperative to prevent off-target damage. Alternatively, manual control methods can be used in sensitive situations.

Herbicides and bridal creeper

From late autumn through winter, common bridal creeper is susceptible to very low rates (i.e. 0.5 g per 10 L of water) of metsulfuron-methyl + penetrant as a foliar spray, with little off-target damage to grasses, established trees and shrubs. When flowering (between mid-winter and early spring) glyphosate plus a penetrant is more commonly used. Be careful to avoid off-target damage when using glyphosate as a foliar spray. For greater selectivity when using glyphosate, wipe directly onto leaves using a stick type weed wiper, brush or sponge. Look for a weed wiper that has a narrow or controlled release reservoir. Wipe over leaves, working from the inner plants outwards. Apply yearly to prevent seed set and to exhaust the tubers.

2,4-D (present as dimethylamine and diethanolamine salts) is a selective, foliar-absorbed, translocated herbicide for use on broad-leaved plants. 2,4-D disrupts plant cell growth. Half-life estimates for 2,4-D in soil are approximately 6 days. 2,4-D can provide good control of asparagus seedlings, but may not be effective on mature asparagus plants. Like most herbicides detailed in this manual, it is useful for helping to defoliate asparagus weeds to assist with crown access in dense infestations.

2,4-D has been used successfully with concurrent management of *Ipomoea cairica* (see Boondall Wetlands case study on page 100).

Diesel is often mixed, in varying proportions, with various herbicides to facilitate their penetration into plant vascular tissue, thus allowing the movement of herbicide throughout the plant. It is a less desirable chemical for operators and for the environment than selective herbicides, due to possible off-target damage and petrochemical residue in the soil leading to long-term site contamination issues. It is usually only added for use when basal barking. However, neat diesel can give good control of some asparagus weeds if stems are cut near the ground and central crowns are sprayed or painted to the point of runoff (only permitted for use in QLD). Careful application will ensure minimal risk to adjacent non-target plants.

Fluroxypyr is a selective, foliar-absorbed, translocated herbicide used in the control of broad-leaved weeds. It has little residual activity. Fluroxypyr disrupts plant cell growth. It is an oil-soluble, water emulsifiable chemical. That is, it can mix with oil-based liquids (e.g. diesel), but isn't very soluble in water and turns a milky white colour. Fluroxypyr generally remains within the top 30 cm of soil if any reaches the ground, where it is then broken down by soil organisms.

Picloram is a selective herbicide targeted for use on broadleaf plants. It affects the synthesis of proteins and disrupts cell growth. It is absorbed through the roots and cut stems and translocates throughout the plant. While not widely used on asparagus weeds, it can be applied to rhizomatous plants as a thickened gel to cut stems or as a gouge and paint technique to the crowns. It is slow acting, signs of damage may take over 2 months and total death may take from 6 months to 2 growing seasons after application. The herbicide is highly residual and can remain active within the soil for more than a year and within the plant for up to 2 years.

Triclopyr is a systemic foliar-applied herbicide used to control a range of broadleaf weeds. It does not have a long residual activity in the soil. Half-life estimates for triclopyr range between 30 and 90 days. Once absorbed, it is rapidly transported throughout the plant. Triclopyr disrupts plant cell growth. While not widely used on asparagus weeds, it may be used as part of an integrated management program.

Herbicides for use on asparagus weeds

The herbicides listed in the next table are currently permitted to be used in the listed situations. Before using any herbicide, always read the label carefully. All herbicides must be applied strictly in accordance with the label directions and the conditions in the APVMA permit. This table is only a guide. Do not rely on it, only rely on current label or permit directions. Check permit or label before application to ensure it is still valid. Commercial products listed here are examples only, and many other products containing these active ingredients may be registered, visit www.apvma.gov.au/permits/search.php. To search registered chemical products visit services.apvma.gov.au/PubcrisWebClient/welcome.do.

Herbicides for use on asparagus weeds

	Application method	Active ingredient	**Commercial product/s** See additional information at PUBCRIS	Rate	**Situation as per label or permit** See additional information at PUBCRIS	Species suitability	**Label or Permit (APVMA) requirements (at June 2013)**	Comments
All states	Spot spray	Metsulfuron-methyl 600 g/kg	Please refer to PUBCRIS for labels Chemtura Metsulfuron 600 WG Herbicide FMC, Metsulfuron-methyl 600 Herbicide Rygel 600 Metsulfuron WG Agro-Essence Metsulfuron-methyl 600 Herbicide	5 g per 100 L	Native pastures, rights of way, commercial and industrial areas	*A. asparagoides*	As per label instructions	Apply from mid-June to late August. To achieve complete control follow-up applications over at least 2 seasons are required. To minimise damage to native vegetation, water volumes of 500–800 L/ha are recommended.
	Cut and paint or gouge and paint	Picloram 43 g/kg	Vigilant* Herbicide gel	Undiluted (gel form)	Native vegetation, conservation area, gullies, reserves and parks	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens*	As per label instructions	Avoid use over or near desirable plants, or in areas where their roots may extend or where the chemical may be washed or moved to their roots. Do not use if rain is likely to fall within 12 hours of application.
New South Wales	Spot spray	Glyphosate 360 g/L	All registered products	1 part glyphosate to 50 parts water + surfactant	Urban bushland and forests Coastal reserves	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11916 expires 31/3/2020	Do not allow spray to drift onto sensitive areas including but not limited to natural streams, rivers, wetland waterways and non-target species. The latter is particularly important when using a surfactant or penetrant
				1:75 + surfactant		*A. asparagoides*		August to September only
	Spot spray	Glyphosate 360 g/L	Roundup®, Weedmaster® Duo and Roundup® Biactive™	Up to 1 part glyphosate to 50 parts water	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens* *A. asparagoides*	PER9907 expires 31/3/2020	
	Spot Spray	Metsulfuron-methyl 600 g/kg	Brush-off®	5 g per 100 L of water + surfactant	Urban bushland and forests Coastal reserves	*A. asparagoides*	PER11916 expires 31/3/2020	Do not allow spray to drift onto sensitive areas including but not limited to natural streams, rivers, wetland waterways and non-target species. The latter is particularly important when using a surfactant or penetrant. August to September only

	Application method	Active ingredient	**Commercial product/s** See additional information at PUBCRIS	Rate	**Situation as per label or permit** See additional information at PUBCRIS	Species suitability	**Label or Permit (APVMA) requirements (at June 2013)**	Comments
New South Wales continued	Spot spray	Metsulfuron-methyl 600 g/kg	Associate®, Brush-off®, Bushwacker®	10–20 g per 100 L water plus surfactant	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens* *A. asparagoides*	PER9907 expires 31/3/2020	
	Spot spray	Glyphosate 360 g/L and metsulfuron-methyl 600 g/kg	All registered products	Tank mix of up to 2 L glyphosate + 15 g metsulfuron-methyl per 100 L water	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens* *A. asparagoides*	PER9907 expires 31/3/2020	
	Spot spray	Fluroxypyr 333 g/L	Starane Advanced	300–600 mL per 100 L water; or 3–6 L per ha; or label rate for specific weed	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens* *A. asparagoides*	PER9907 expires 31/3/2020	
		Fluroxypyr 200 g/L	Nufarm Comet 200	500 mL per 100 L water; or 5–10 L per ha; or label rate for specific weed				
	Splatter gun	Glyphosate 360 g/L	Roundup®	Rates of up to 1:9 with water	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* Needs further investigation	PER9907 expires 31/3/2020	
	Wipe onto leaves	Glyphosate 360 g/L	Roundup®	1:20 with water to undiluted herbicide	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. asparagoides*	PER9907 expires 31/3/2020	
	Cut stump	Glyphosate 360 g/L	All registered products	Undiluted	Urban bushland and forests, coastal reserves	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11916 expires 31/3/2020	Do not allow spray to drift onto sensitive areas including but not limited to natural streams, rivers, wetland waterways and non-target species. The latter is particularly important when using a surfactant or penetrant

	Application method	Active ingredient	Commercial product/s See additional information at PUBCRIS	Rate	Situation as per label or permit See additional information at PUBCRIS	Species suitability	Label or Permit (APVMA) requirements (at June 2013)	Comments
New South Wales continued	Cut stump, basal bark spray or cut and paint	Glyphosate 360 g/L	All registered products	1:1.5 with water to undiluted herbicide	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens*	PER9907 expires 31/3/2020	
	Cut and paint	Glyphosate 360 g/L and metsulfuron-methyl 600 g/kg	All registered products	Tank mix of 1:1.5 glyphosate + 1 g metsulfuron-methyl per 1 L water	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. aethiopicus* *A. africanus* *A. plumosus* *A. scandens*	PER9907 expires 31/3/2020	
	Basal bark spray	Fluroxypyr 333 g/L	Starane Advanced	21 mL per 1 L diesel/ kerosene	Areas of native vegetation (e.g. subtropical rainforest remnants, littoral rainforest and other bushland reserves) Lands controlled by the Botanic Gardens Trust Non cropland areas	*A. africanus* *A. plumosus*	PER9907 expires 31/3/2020	
Queensland	Spot spray	Glyphosate 360 g/L Products registered for use in aquatic situations	Roundup® Biactive™, Weedmaster Duo	1 L per 100 L water; or 10 L per ha. Boom or label rate for specific weed	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	Spot spray in aquatic and wetland areas
	Spot spray	Glyphosate 360 g/L	Roundup®	1 L per 100 L water; or 10 L per ha. Boom or label rate for specific weed	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	Spot spray in dry land areas
	Spot spray	Metsulfuron-methyl 600 g/kg	Brush-off®, Alley	10 g per 100 L water plus wetting agent; or 100 g per ha plus wetting agent	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	
	Spot spray	Fluroxypyr 200 g/L	Starane 200	500 mL to 1 L per 100 L water; or 5–10 L per ha; or label rate for specific weed	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	

	Application method	Active ingredient	**Commercial product/s** See additional information at PUBCRIS	Rate	**Situation as per label or permit** See additional information at PUBCRIS	Species suitability	**Label or Permit (APVMA) requirements (at June 2013)**	Comments
Queensland continued	Spot spray	2,4-D 625 g/L	Amicide® 625	3 mL per 1 L water; or 3 L per ha	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	
	Spot spray	Triclopyr 600 g/L	Garlon™ 600	33 mL per 10 L water Or label rate for specific weed	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. plumosus* Needs further investigation	PER11463, expires 30/6/2014	
	Paint or spot spray crowns	Diesel	All registered products	Neat	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. aethiopicus* *A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	
	Cut stump	Glyphosate 360 g/L	Roundup®	1 part product to 2 parts water (e.g. 10 mL in 20 mL water)	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	
	Basal bark spray	Fluroxypyr 200 g/L	Starane 200	35 mL per 1 L diesel/ kerosene	Non-agricultural areas, bushland, forests, wetlands, coastal and adjacent areas	*A. africanus* *A. plumosus*	PER11463, expires 30/6/2014	
Western Australia	Spot spray	Glyphosate 360 g/L	Roundup®	1 L per 100 L water; or 10 L per ha; or label rate for specific weed	Non-agricultural areas bushland and forests, wetlands, roadsides, industrial areas	*A. aethiopicus* *A. plumosus* *A. scandens* *A. declinatus* *A. asparagoides*	PER1333 expires 31/3/2017	Spot spraying in dry land areas
	Spot spray	Glyphosate 360 g/L where product has an aquatic registration	Roundup® Biactive™	1 L per 100 L water; or 10 L per ha; or label rate for specific weed	Non-agricultural areas bushland and forests, wetlands, roadsides, industrial areas	*A. aethiopicus* *A. plumosus* *A. scandens* *A. declinatus* *A. asparagoides*	PER1333 expires 31/3/2017	Spot spraying in aquatic and wetland areas
	Spot spray	Metsulfuron-methyl 600 g/kg	Brush-off®, Alley	10 g per 100 L plus wetting agent or spray oil; or 100 g per ha plus wetting agent or spray oil; or label rate for specific weed	Non-agricultural areas bushland and forests, wetlands, roadsides, industrial areas	*A. aethiopicus* *A. plumosus* *A. scandens* *A. declinatus* *A. asparagoides*	PER1333 expires 31/3/2017	
	Mister or hand held spray	Metsulfuron-methyl 600 g/kg	All registered products	0.5 g per 10 L of water registered + wetting agent e.g. Pulse at 2 mL per L	Crop and non-crop areas as specified on the label. Apply up to maximum registered label rates in accordance with Dept of Ag WA advice for the control of Declared Plants	*A. asparagoides*	PER13236 expires 31/12/2016	Lower rates are also recommended for bushland treatment (see permit) Mid-June to late August Follow-up treatment required for a couple of seasons.

Herbicides for use on asparagus weeds continued

	Application method	Active ingredient	Commercial product/s See additional information at PUBCRIS	Rate	Situation as per label or permit See additional information at PUBCRIS	Species suitability	Label or Permit (APVMA) requirements (at June 2013)	Comments
Western Australia continued	Spot spray	Metsulfuron-methyl 600 g/kg	Apparent Metsulfuron 600 WG	5 g per 100 L	Native pastures, rights of way, commercial and industrial areas – ground application	*A. asparagoides*	As per label instructions	Apply during mid-June to late August. Follow-up applications over at least 2 seasons will be required for complete control. Water volumes of 500–800 L/ha are recommended to minimise the risk of damage to native vegetation.
	Wipe onto leaves	Glyphosate 360 g/L	Roundup®	Undiluted to 1 L per 5 L water	Non-agricultural areas bushland and forests, wetlands, roadsides, industrial areas	*A. asparagoides*	PER1333 expires 31/3/2017	Apply directly to plant using a sponge glove. Retreatment necessary.
			All registered products	1:2 parts with water	Crop and non-crop areas as specified for WA on the approved label. Apply up to maximum registered label rates and in accordance with Dept of Ag WA advice for the control of Declared Plants		PER13236 expires 31/12/2016	
South Australia	Spot spray	Glyphosate 360 g/L	Roundup®, Roundup® Biactive™	1 L per 100 L water surfactant or spray oil may be added	Non-crop areas, rights of way, roadsides and easements, forest and conservation areas	*A. aethiopicus* *A. plumosus* *A. scandens* *A. declinatus* *A. asparagoides*	PER13371 expires 31/3/2017	
	Spot spray	Metsulfuron-methyl 600 g/kg	Brush-off®	10 g per 100 L water + surfactant	Non-crop areas, rights of way, roadsides and easements, forest and conservation areas	*A. aethiopicus* *A. plumosus* *A. scandens* *A. declinatus*	PER13371 expires 31/3/2017	
	Spot spray	Glyphosate 360 g/L and metsulfuron-methyl 600 g/kg	Weedmaster® Duo Roundup® Biactive™ Brush-off®	(Roundup 1 L + Brush-off 3 g) per 100 L water + surfactant	Non-crop areas, rights of way, roadsides and easements, forest and conservation areas	*A. aethiopicus* *A. declinatus* *A. asparagoides*	PER13371 expires 31/3/2017	
	Spot spray	Metsulfuron-methyl 600 g/kg	Please refer to PUBCRIS for labels	5 g per 100L water	Native pastures, rights of way, commercial and industrial areas – ground application	*A. asparagoides*	As per label instructions	Apply during mid-June to late August. Follow-up applications over at least 2 seasons will be required for complete control. Water volumes of 500–800 L/ha are recommended to minimise the risk of damage to native vegetation.
			Brush-off®	1.5 g per 100 L water + surfactant	Non-crop areas, rights of way, roadsides and easements, Forest and conservation areas		PER13371 expires 31/3/2017	

	Application method	Active ingredient	Commercial product/s See additional information at PUBCRIS	Rate	Situation as per label or permit See additional information at PUBCRIS	Species suitability	Label or Permit (APVMA) requirements (at June 2013)	Comments
South Australia continued	Spot spray	Triclopyr 75 g/L and metsulfuron-methyl 28 g/L	Ultimate Brush Weed Herbicide	125 mL per 100 L water + surfactant	Native pastures, rights of way, commercial and industrial areas	*A. asparagoides*	As per label instructions	Spray from mid-June to late August. One spray is unlikely to give complete control and follow-up sprays will be necessary. Avoid excessive wetting and run-off to minimize damage to native vegetation.
	Cut and swab	Glyphosate 360 g/L	Nufarm Weedmaster® Duo	10–50 mL per L water	Non-crop areas, rights of way, roadsides and easements. Forest and conservation areas	*A. plumosus* *A. scandens*	PER13371 expires 31/31/2017	
	Weed wiper sponge or brush	Glyphosate 360 g/L	Roundup®, Roundup® Biactive™	1 L per 3 L water surfactant may be added	Non-crop areas, rights of way, roadsides and easements. Forest and conservation areas	*A. asparagoides*	PER13371 expires 31/31/2017	
Tasmania	Spot spray	Glyphosate 360 g/L where product has an aquatic registration	Roundup® Biactive™	10–13 mL per L plus adjuvants ONLY in accordance with label as required	Non-cropping and bushland (native vegetation both forested and non forest, including urban bushland reserves)	*A. scandens* *A. asparagoides*	PER13160 expires 31/3/2017	
	Spot spray	Glyphosate 360 g/L where product has an aquatic registration	Sickle™ 540 plus other registered herbicides	7 mL per L plus adjuvants ONLY in accordance with label as required	Non-cropping and bushland (native vegetation both forested and non forest, including urban bushland reserves)	*A. scandens* *A. asparagoides*	PER13160 expires 31/3/2017	
	Spot spray	Metsulfuron-methyl 600 g/kg	Nufarm Associate®, Brush-off®, Lynx WG	As per existing registrations or if weed not recorded on label 10–15 g per 100 L	Non-cropping and bushland (native vegetation both forested and non forest, including urban bushland reserves)	*A. scandens* *A. asparagoides*	PER13160 expires 31/31/2017	

Note: Starane 200 (Fluroxypyr 200 g/L) has/will be phased out and be replaced by Starane Advanced (Fluroxypyr 333 g/L). There are a number of companies that produce a generic formulation of Fluroxypyr 200 g/L, namely Fluroxypyr, Fluroxypyr 200, Floxor 200EC, Restrain 200, Neon 200, Rockstar 200, Acclaim, Dozer, Prostar, Flagship 200, Staroxy 200, Trample 200 and Uni-Rane 200. APVMA permits will be updated to reflect changes upon their expiry.

Products may be registered for use on asparagus weeds in all states and territories (shown as 'All') or only in the specific states and territories listed.

Please note that this is not a full list of herbicides and applications for use on asparagus weeds. Seek further advise from APVMA or your local weed authority.

Application methods

Cut and paint / gouge and paint

Cut and paint (also known as cut-stump, cut-swab or snip and drip) and gouge and paint are treatments used to apply herbicide to the stems and/or crowns of asparagus weeds.

Applying the method

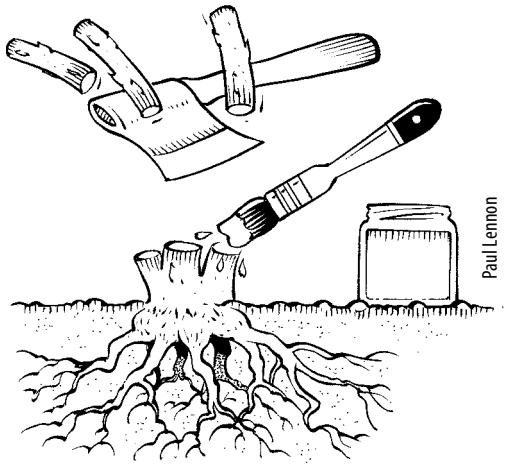
For stem treatments: cut the stem close to the ground and apply herbicide immediately (within 10 seconds) to the cut surface.

For crown treatments: gouge out sections of the fleshy base (crown) with a knife (cut the stems to improve access) and apply herbicide immediately with a low-pressure sprayer, paint brush or applicator bottle.

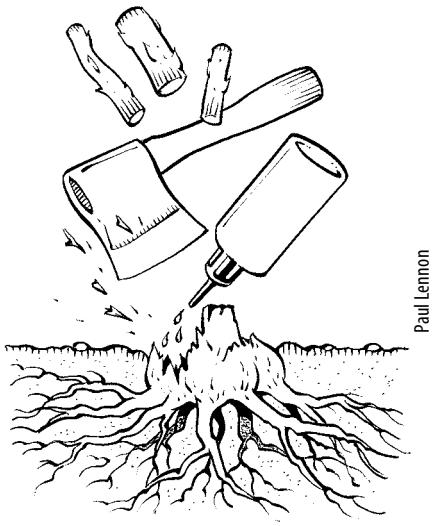
For the canopy climbers: a tomahawk is a handy tool to gouge into *A. africanus* after the canes are cut. Paint herbicide to gouged section of the crown immediately.

For *A. plumosus*: use the same technique as above but, as the crowns are generally smaller, loppers or secateurs can be used to gouge into the crown.

Be aware that bringing down climbing asparagus foliage is a lot of work and can potentially damage trees.



Cut and paint method



Gouge and paint method

Cut and paint / gouge and paint

Recommended for:	Caution!	Advantages	Disadvantages	Timing
▪ Asparagus weeds that do not form extensive rhizome networks underground ▪ Suitable for *A. aethiopicus, A. africanus, A. plumosus* and *A. scandens*	**It is imperative that the herbicide is applied as soon as possible after the stem is severed or crown is gouged (within 10 seconds)**	▪ Stem and crown treatments can minimize off-target damage ▪ Less labour intensive than manual methods ▪ Useful when crowns are difficult to dig out (e.g. in hard and rocky ground) ▪ Limits soil disturbance	▪ More labour intensive than foliar spray	▪ When plants are actively growing, as herbicide is rapidly transported through the plant ▪ Immediately after cutting

Case study

Dealing with hazardous weedy climbers in Queensland rainforests

Alan Carter, *Strategic Weed Control and Vegetation Management, Queensland*

Climbing vines can be a hazard when doing weed control. A pole hedge trimmer is a useful tool to cut vines away from trees and is much faster than using a machete or secateurs. Low branches or other obstructing vegetation can be trimmed back quickly to give safe access to your site and reduce the number of anchor points available for climbers to attach to.

Cut vines as high as possible and let long vines drop to the ground for later spraying. In the case of climbing asparagus weeds, the crowns can then be readily accessed and treated by gouge and paint methods or basal barking. For other weedy vines, follow-up using a selective herbicide to help ferns, grasses, sedges, palms and other monocots re-establish while you continue to control any regrowth. Plants including *Commelina diffusa*, *Poa labillardieri* and species of *Oplismenus* and *Ottochloa* establish readily and keep some annual weeds at bay between follow-up treatments.

Techniques for glyphosate that can reduce off-target damage include:

- trimming the trigger on the spray bottle to prevent it getting caught on things and squirting accidently, and
- applying thread tape to the nozzle screw, preventing drips onto the trigger. This also allows a nice straight laminar jet that can reach the crown or stump without having to get on your hands and knees. But always squirt gently, as close as possible and using only as much chemical as the stump or crown will absorb.

This technique can also be readily used for all other woody weeds that are encountered on a site.

For most vines (except Madeira vine *Anredera cordifolia*), laboriously cutting and treating large individual stems with herbicide is usually less work in the long run rather than repeatedly spraying regrowth of untreated cut stems.

Alan Carter

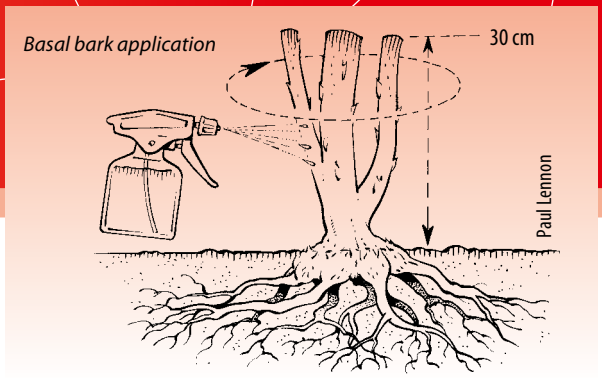
Cutting back vines using a pole hedge trimmer

'I nearly always carry hand secateurs and a modified 500 mL trigger spray on a belt holster when I'm working.'

Alan Carter

Trigger spray and belt holder

Control methods



Basal bark spray

This method involves mixing an oil-soluble herbicide in diesel or other carriers and spraying (or painting) the circumference of the plant stems and or crown. Diesel enables the penetration of the vascular tissue of the plant, allowing the movement of herbicide throughout the plant.

Applying the method:

- Basal barking can be done with plants entire (vertical stems not chopped) or chop stems out of the way to avoid prickles and entanglement.
- Prepare herbicide mix as per label directions.
- Apply herbicide mix to the outer tissue of the base of the crown and remaining stems (to a height of 10–30 cm) with either a paint brush or a hand-held sprayer, ensuring that the whole circumference of every stem is saturated.
- Refer to the product label for further information. Check that the herbicide and application is listed for use in your state and seek advice from local weed authorities.

Basal barking

Recommended for:	Caution!	Advantages	Disadvantages	Timing
Canopy climbers (i.e. *A. africanus* or *A. plumosus*) when foliar spraying cannot get effective cover and or when the weed is intertwined with native host plants	**To achieve maximum efficiency, ensure that the full circumference of every stem arising from the ground (to a height up to 30 cm) is saturated including the crown**	Saves on 'hands and knees' time required for primary control compared with physically removing the crown	Labour intensive	Only when stems are dry and free of charring from fire – stems that are wet with rain or dew repel the oil-based spray and charcoal deactivates the chemical

Foliar spot spraying

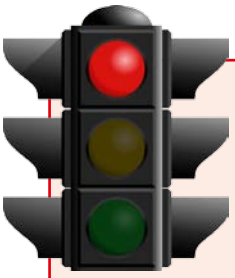
Foliar spot spraying is the use of herbicide diluted with water (or other carrier) at a specific rate and applied to the leaves and stems of a plant in the form of a fine spray. A range of other chemicals may be added (e.g. penetrants, adjuvants, surfactants, wetting agents).

Applying the method:

- Effective foliar spraying requires that **all** foliage be wetted with herbicide.
- There are several techniques available and the choice of which technique to use depends on the plant size and growth form, density of infestation, habitat, site specifications and the availability of resources, including trained contractors.
- The application rate, volume and concentration of herbicide in water vary with the application used. Foliar spray application techniques used to control asparagus weeds include:
  - Backpack/knapsack – for low pressure spraying and used for spot spraying large or small infestations.
  - Hand held spray bottles – for small areas or around native vegetation.
  - Vehicle-based sprayers – for high pressure spraying using a hose with handgun.

Foliar spot spraying

Recommended for:	Caution!	Advantages	Disadvantages	Timing
▪ All asparagus weeds ▪ Large infestations	▪ **Follow-up control is required to treat subsequent seedlings that emerge after primary control** ▪ **Herbicides should not be applied when the plant is under stress or during hot, dry conditions**	▪ Efficiency ▪ Can cover large areas	▪ Potential for spray drift and off-target damage ▪ Several asparagus weeds have fine or waxy foliage that may impede herbicide uptake ▪ All foliage must be wetted with herbicide to be effective	When plants are actively growing and prior to fruit set – ideally when plants are just starting to flower



Stop and Think!

Site-specific management: minimising spray drift and off-target damage

In areas where there is a good ground cover of native plants, some land managers have found that some off-target damage may be prevented and herbicide coverage improved if they bundle up and tie asparagus stems prior to foliar spraying.

Wendy Midgley

Asparagus aethiopicus bundled prior to spraying

Alternatively, if asparagus is growing over native shrubs, the climbing branches can be quickly cut off to get the asparagus foliage onto the ground for spraying. This assists in targeting herbicide spray to asparagus foliage and saves time in untangling asparagus from native plants.

Foliar spot spraying of A. plumosus regrowth after initially cutting vines has been used effectively in Iluka Nature Reserve (see case study on page 93).

***Asparagus declinatus* does not readily absorb sprayed herbicide due to its waxy foliage. To overcome this problem, practitioners should add a penetrant or spray oil to their spray mixture. Best results for spot spraying occur when the plant is flowering in late winter. Follow-up control is required to treat subsequent seedlings that emerge after primary control.**

Splatter gun

Splatter guns are not widely used on asparagus weeds, but may be effective, so this technique warrants further investigation. This technique is widely used on lantana and bitou bush. The method involves applying a low volume of concentrated herbicide mix to foliage. A specialized nozzle produces a solid stream of large droplets of herbicide that can be applied from a distance of 6–10 m away. Only a small portion of the foliage needs to be sprayed, thus non-target damage can be minimized. This technique is useful in difficult to access areas and for specifically targeting the herbicide to the plant. The use of a marker dye is recommended to identify treated plants.

Hillary Cherry

Splatter gun equipment

Case study

A potential new technique for treating *Asparagus aethiopicus* in hard-to-access locations

Sue Bower, Lord Howe Island Board and Stuart McDonald, Byron Shire Council, NSW

Weed managers on Lord Howe Island are faced with controlling infestations of *Asparagus aethiopicus* growing in remote, hard to access cliff locations. They are currently trialling the splatter gun to control mature stands of *A. aethiopicus*, with some success.

The splatter gun is a relatively new tool that is commonly used on lantana and bitou bush. Herbicide concentrations for splatter guns differ from that of normal foliar spray guns, and technique is extremely important. Further information on splatter guns can be found at your local weeds authority or rural supplies store (or in the lantana and bitou bush management manuals at www.weeds.org.au).

***'Trial the technique in an accessible location first as you want to make sure you get it right before you use it remotely.'* Sue Bower, Lord Howe Island Board.**

For *A. aethiopicus*, the trick is to be sure that each 'frond' gets a good 'splatter' of herbicide. Weed managers are using a 'cross hatch' pattern or linear splat that ensures that each frond gets an appropriate cover of herbicide (for further information and contact details, see Section 7).

Suitability of method

- Use on mature and dense *A. aethiopicus* stands of similar age.
- Apply at least a 20% herbicide cover on each plant.
- Ensure a good 'splat' of herbicide hits each asparagus frond (stem).
- Apply herbicide in a cross-hatch pattern by using long arching strips, or a strip along each frond for individual plants.
- Apply when the weed is actively growing and not under stress.

Sue Bower

Hayden Denmeade from The Good Bush People demonstrating the use of the splatter gun – as you traverse a cliff, it is best to spray down from above, or from the side

Splatter gun

Advantages	Disadvantages
▪ Great for use in hard to access locations with low weed density (e.g. cliff faces, areas of low water availability). ▪ Splatter gun is lightweight and portable. ▪ Requires minimal use of water. ▪ Good response with mature age stands (i.e. thick, mature ground cover of asparagus). ▪ Can achieve targeted control. ▪ Minimal soil disturbance.	▪ Only suitable for use in dense, mature-aged stands (e.g. monocultures). ▪ If used in the wrong way, off-target damage can be amplified because of the concentrated nature of this technique. ▪ If you are using the technique in hard to access locations, you want to make sure your technique is right! Consult with others who have experience using the splatter gun. ▪ Not recommended for use on multi-aged stands of asparagus (i.e. where there are young plants that may not be exposed to herbicide; or where there is a high concentration of seedlings).

For an example of how a community group is effectively using a splatter gun in coastal environments please refer to Pittwater Eco Warriors YouTube videos, e.g. 'The how and why of splatter guns' www.youtube.com/watch?v=LozAyJcghck.

Other methods

Fire

Using fire as a tool to manage asparagus weeds has only been investigated for bridal creeper, and further research is required to determine the feasibility of fire to manage other asparagus weeds. Fire can be used in bridal creeper management but must be part of an integrated control strategy. Fire assists with removing understorey vegetation to improve access and promote weed regrowth for later herbicide treatment. Fire is not likely to kill bridal creeper, but has the potential to help deplete the seed bank and the dense, rhizomatous root mat. Burning must be followed up with other control methods, including physical removal or herbicide application.

Pre-planning is paramount to a successful integrated asparagus weed management plan that utilises fire. Asparagus weeds will usually re-sprout from the rhizome unless the fire is very intense and the rhizomes are shallow (less than 5 cm deep) or over rock. As high intensity fires in planned burns are not desirable, best practice management is to treat asparagus weeds with herbicide prior to a prescribed burn. All weeds that are unlikely to be killed by fire and/or that may be fire resistant should be considered for treatment in the months prior to the burn. Crowned rhizomes or rhizomes that have been dug out can be left suspended in the low shrub or herb layer. Retaining the foliage on the hanging rhizome assists in removing moisture from the rhizome and adds to the fuel load. Foliage that has been sprayed prior to fire also adds to the fuel load. Untreated asparagus weeds have a high moisture content, making burning difficult.

Great care is needed when using fire. Appropriate conditions, equipment and experienced personnel are essential. The landowner is responsible for ensuring that all planned burning is conducted in a safe manner. Prior to undertaking any planned burn, the landowner must inform all relevant authorities and obtain all relevant permits.

Consultation with vegetation specialists is also recommended as fire can have both positive and negative effects on native vegetation. For example, fire raises soil pH and can increase the persistence of herbicides used after fire, so there may be greater off-target damage.

Follow-up actions are required after sites are burned. Infestations post-fire should be monitored regularly and over several years because of the high probability of regrowth from remnants of the root system. New seedlings or regrowth need to be carefully removed or treated with herbicide to limit above ground growth and further reduce the stored root reserves. For new or small infestations, hand digging of roots may be an appropriate follow-up technique.

Grazing

Grazing may assist in exhausting the tubers and may assist in managing some asparagus weeds. Tamar wallabies on Garden Island in Western Australia have been found to eat bridal creeper. Similarly, sheep are known to eat bridal creeper and *A. declinatus*, keeping the plants at low levels in grazed areas. As sheep grazing can also damage native understorey plants and tree seedlings, it is not suitable for conservation reserves. Do not allow grazing when asparagus weeds are fruiting, as seed can be consumed and spread by animals.

Bridal creeper biological control

Three natural enemies specific to bridal creeper have been released in Australia: the bridal creeper leafhopper (an undescribed Erythroneurini formerly referred to as *Zygina* sp.) was first released in 1999, the rust fungus (*Puccinia myrsiphylli*) in 2000 and a leaf beetle (*Crioceris* sp.) in 2002. The rust fungus and leafhopper have caused the most impacts. In good years, these agents can stop plants flowering and fruiting. Many more years of impacts by the agents are required to deplete the nutrient reserves stored in underground tubers and stop regrowth.

Control methods

Since they were introduced, the leafhopper and rust fungus have been widely released across southern Australia. They have most likely colonised all areas suitable for their development. Redistribution of these agents is mainly done to accelerate development at specific sites in some years by increasing their population at the beginning of the growing season.

The leaf beetle has established poorly, so there is currently no scope to redistribute it.

Note: The Western Cape form of bridal creeper, which is found in limited areas of South Australia and south-west Victoria, is not impacted by the bridal creeper rust fungus.

Shauna Potter, Biosecurity SA

Western Cape bridal creeper (left) stands out among rust infected common bridal creeper (right)

Bridal creeper biocontrol agents

Agent	Appearance	Damage	Life cycle	Status
Leafhopper	White, 2–3 mm long, living on underside of bridal creeper leaves.	Sap-sucking insect that feeds on the photosynthetic leaf cells (visible as silver patterning on the leaves). Adults and juvenile stages feed on the leaves, causing them to turn white and, in severe cases, fall off. Continued damage over several years reduces new tuber production, making bridal creeper less competitive.	Lays about 200 eggs over 6 weeks, and has multiple generations each year.	Widely established across Australia. By 2008, released at close to 900 sites. Used in Weed Warriors program as educational tool (see page 67).
Rust fungus	Yellow pustules surrounded by yellowing tissue on the underside of leaves.	Attacks leaves and stems, diverting nutrients away from healthy plant tissue. Can have a major impact on the level of reserves normally stored in tuber. In severe cases, leaves die off.	Complicated, with 5 spore stages including one that survives over summer when bridal creeper has senesced. Many generations per year, and produces large amounts of wind-dispersed spores.	Widely established across Australia. By 2008, released at more than 2100 sites. Spreads within and between bridal creeper infestations efficiently.
Leaf beetle		Adults and larvae feed exclusively on bridal creeper's young, expanding tissues. Larvae strip shoots and leaves and prevent plants from climbing, thereby reducing fruit production.	Active in autumn and early winter (February to July) and does not compete directly with above agents for resources. From early winter, adult females lay eggs on expanding shoots and leaves, either singly or in groups of up to 10.	Poorly established. By 2008, released at 82 sites across southern Australia (except TAS) but confirmed established at only three sites, possibly due to predation or parasitism.

Redistribution of the leafhopper and rust fungus

The leafhopper and rust fungus can be sourced from sites where they have been released and have established.

- For a list of sites where the leafhopper and rust fungus had been released up to 2008 see: www.csiro.au/en/Outcomes/Safeguarding-Australia/Agent-Release-Sites.aspx.
- For a list of some sites where they are established see: www.root.ala.org.au/bdrs-core/wbiocont/home.htm. If bridal creeper rust is established at sites in your area please consider adding location details for these sites to this national website.
- For regionally specific information on bridal creeper biocontrol redistribution, contact your local weeds officer.
- Search the web for information related to the Weed Warriors program which engages school children in the rearing and release of biocontrol agents (see Section 7 – Further Information).

Leafhopper redistribution method

University of Adelaide

Bridal creeper leafhopper

Harvest:

- Cut a large bunch of heavily infested foliage and put into large plastic bag. Seal bag and keep it out of the sun. Do this in the early morning when cool.

Redistribute:

1. Tease apart foliage and spread thinly over resident bridal creeper infestations while pushing infected foliage into infestation.
2. Invert bag and shake out any insects into common bridal creeper infestations.

For more detail see:
www.csiro.au/Outcomes/Safeguarding-Australia/BridalCreeperLeafhopper.aspx#a3.

More information can also be found by searching the internet for 'Weed Warriors'.

Rust fungus redistribution methods

Louise Morin

Rust pustules on common bridal creeper

The rust spores are not toxic but may cause irritation to people who are hypersensitive to pollens. As a precaution when handling rust-infected foliage, wear safety equipment, including:

- goggles,
- a respiratory mask, and
- gloves.

The rust fungus does not spread internally throughout the plant and must reinfect bridal creeper every growing season to be effective.

There are two methods currently available for the redistribution of the rust fungus (see page 68).

First signs of rust appear in autumn. Redistribution is more effective when spore production is at its peak, usually between July and September when plants are flowering and fruiting. Infection is dependent upon seasonal conditions.

See 'A guide to weed biological control in South Australia' for more photos and information on bridal creeper agents: www.pir.sa.gov.au/biosecuritySA/nrm_biosecurity/weeds.

Rust fungus redistribution methods

Method 1 (developed by CSIRO to establish nursery sites)

1. Cut approximately a dozen, 30 cm long, infected stems of bridal creeper that have well-developed sporulating pustules and place in a paper bag to move to the new release site.
2. A dozen infected stems are required to inoculate a one to two metre square bridal creeper infestation on either the ground, or the equivalent amount of foliage climbing up a bush or tree.
3. Releases should be made at the end of the day to avoid hot temperatures.
4. Rub infected foliage onto healthy foliage in the field by sliding infected foliage back and forth to dislodge spores from pustules to be deposited on the under surface of healthy leaves.
5. After inoculation, mist inoculated field plants with water.
6. Cover the area with a sheet of clear plastic held in place with sticky tape, rocks or pegs to provide a humid environment for 16–24 hours, or overnight.
7. If the site is in full sun, the plastic sheet should be removed the next morning to prevent plants heating up or burning.

For more detail see: www.csiro.au/Outcomes/Safeguarding-Australia/Bridal-Creeper-Rust-Fungus.aspx

Method 2 – **'spore water' method** (developed by a community group on Kangaroo Island, SA)

1. Rinse rust-infected bridal creeper leaves in rainwater. One plastic shopping bag of infected leaves makes approximately 15 L of spore water or use 4 kg of leaf to 100 L of rainwater. Water should turn brown.
2. Strain spore water from bucket into a clean spray unit (e.g. quick spray or backpack sprayer).
3. Using a fine mist, spray out resulting slurry as soon as possible by starting at top of infestation and work downwards. Spray until run-off, paying particular attention to underside of leaves. Try to keep solution agitated while in tank to minimise spores sticking to tank. There is no threat of off-target damage.
4. Spray spore water solution as soon as possible after mixing, as the spores will die the longer they are kept in solution.

- **Note:** It is important to use rainwater only, as mains water and minerals in bore water may adversely affect the rust spores. Clean spray units, and a clean spray gun must be used.

Following up after spraying spore water

Follow-up monitoring of the release sites should take place a month after initial spraying with spore water. If no sign of the rust is seen within two months, another dose of spore water will be required.

Please remember that the spore water technique does not work in all areas. Repeated failure to establish the rust fungus may indicate that a different application technique is required for the area or that conditions are unsuitable for rust establishment. Monitoring and recording activities at the spray site is important so that work is not unnecessarily duplicated.

For more detail: on how to make spore water view the Power Point file www.weeds.org.au/docs/BC_How_to_make_spore_water.ppt