Review

The biology of Australian weeds
44. *Asparagus asparagoides* (L.) Druce

Louise Morin[A,C,D], **Kathryn L. Batchelor**[B,C] **and John K. Scott**[B,C,D]
[A] CSIRO Entomology, GPO Box 1700, Canberra, ACT 2601, Australia.
[B] CSIRO Entomology, Private Bag 5, PO Wembley, Western Australia 6913, Australia.
[C] Cooperative Research Centre for Weed Management Systems, 1995–2002.
[D] Cooperative Research Centre for Australian Weed Management.

Name

Botanical name

Asparagus asparagoides (L.) Druce (synonyms: *Medeola asparagoides* L., *Myrsiphyllum asparagoides* (L.) Willd, *Asparagus medeoloides* (L.f.) Thunb., *Elide asparagoides* (L.) Kerguélen, *Dracaena medeoloides* L.f., *Elachanthera sewelliae* F.Muell., *Luzuriaga sewelliae* (F.Muell.) K.Krause) belongs to the family Asparagaceae. The species in this family were previously included in the Liliaceae *sensu lato* (Dahlgren *et al.* 1985).

Over the years, the higher taxonomy of the Asparagaceae has oscillated between one and three genera and varying numbers of sub-genera (Kleinjan and Edwards 1999). Obermeyer's (1984) revision of the family, which divided it into three genera, *Asparagus*, *Myrsiphyllum* and *Protasparagus* was widely accepted until recently. The latest Australian treatment of the Asparagaceae (Clifford and Conran 1987) included *A. asparagoides* in the genus *Myrsiphyllum* following Obermeyer's (1984) revision. In a subsequent revision, Malcomber and Demissew (1993) concluded that Asparagaceae contains only one genus, *Asparagus*, with two subgenera, *Asparagus* (which includes Obermeyer's *Protasparagus*) and *Myrsiphyllum*. More recently, Fellingham and Meyer (1995) upheld the decision that the family should comprise a single genus, but argued that the subgeneric status of *Asparagus* and *Myrsiphyllum* is not warranted. Fukuda *et al.* (2005) recently examined the molecular phylogeny of *Asparagus* as inferred from plastid *petB* intron and *petD-rpoA* intergenic spacer sequences. They found evidence that southern African species are potentially paraphyletic, supporting sub-division of *Asparagus* into more than three groups. In this molecular phylogeny *A. asparagoides* was the most different from all other *Asparagus* species.

Most recent scientific papers incorrectly credit authorship of *A. asparagoides* to W. Wight, perpetuating the mistake made by Fellingham and Meyer (1995) upon returning the genus *Myrsiphyllum* to *Asparagus*. *Asparagus asparagoides* (L.) Wight is illegitimate as Wight (1909) mentions the name under *Myrsiphyllum* without citing the name that it was based on, *Medeola asparagoides* L., or mentioning authorship of the combination *A. asparagoides* (Anon. 2006a). Druce (1914) was the first to legitimately publish the combination *A. asparagoides* (Obermeyer 1984, 1992, Anon. 2005a).

Two forms of *A. asparagoides* have recently been recognized in South Africa: a widespread form that corresponds to the most common form of the weed that occurs in Australia, and a form restricted to the south-western Cape (Kleinjan and Edwards 1999). The latter can be differentiated from the widespread form by rhizomes that grow primarily upwards towards the soil surface, larger tubers and cladodes (leaf-like stems) that are generally more waxy and elongated. However, above-ground growth in *A. asparagoides* is highly plastic and thus not a reliable factor for separation of the two forms (Kleinjan and Edwards 1999). Seedlings of the two forms are indistinguishable at the macroscopic level. Obermeyer's (1984) description of *A. asparagoides* is clearly that of the widespread form, but her distribution map is incorrect because it includes the south-western Cape form as well as some other broad-cladode *Asparagus* species (Kleinjan and Edwards 1999).

The winter-rainfall region of the Western Cape Province is likely to be the geographic source of most founder populations of *A. asparagoides* in Australia, based on a comparison of DNA sequence data (non-coding internal transcribed spacer regions of the nuclear ribosomal DNA [ITS] and intron and intergenic spacer of the *trn*L-*trn*F region of the chloroplast genome) obtained from several populations (L. Morin unpublished results). However, two populations of *A. asparagoides*, with the same morphology as the south-western Cape form described by Kleinjan and Edwards (1999), were found at Donovan and Port McDonnell in south-eastern South Australia in July 2004 (K.L. Batchelor and P.J. Turner unpublished results). ITS sequences of these populations exactly matched that of South African populations of the south-western Cape form (from Princess Vlei and Silvermine in the Western Cape) (L. Morin unpublished results). The sequence of the south-western Cape form differed by 32 base pairs (5% difference) from that of the widespread form of *A. asparagoides* found in Australia. Based on recent surveys, this new form appears to be restricted to south-eastern South Australia and western Victoria (Coles *et al.* 2006). A molecular phylogeny of all southern African broad-leaved *Asparagus* species is required to determine if the two forms of *A. asparagoides* warrant separation at the species level.

Information provided hereafter refers only to the widespread form of *A. asparagoides* that occurs across southern Australia.

Common names

Asparagus asparagoides is commonly referred to as bridal creeper in Australia, most likely because its foliage was used in floral arrangements, particularly bridal bouquets (Scott 1995, Parsons and Cuthbertson 2001). It is also sometimes called smilax or florist's smilax for its resemblance to members of the Smilacaceae, although it is not related to that family. Bridal veil creeper is another name used in some States; however use of that name can be confusing because it also refers to another asparagus weed, *Asparagus declinatus* L. (Keighery 1996, Lawrie 2004). Parsons and Cuthbertson (2001) also list gnarboola, narbas and krulkransie (S. Africa) as common names. In the USA *A. asparagoides* is commonly referred to as African asparagus fern (Anon. 2005a). In contrast, in Australia asparagus fern refers to a range of asparagus weeds including *Asparagus africanus* Lam., *A. aethiopicus* L. and *A. scandens* Thunb. (Shepherd *et al.* 2001).

Description

The following description of bridal creeper (Figures 1, 2) was compiled mostly from Obermeyer (1984), Clifford and Conran (1987), Scott and Kleinjan (1991), Kleinjan and Edwards (1999) and Parsons and Cuthbertson (2001).

Habit

Bridal creeper is a geophyte with extensive, perennial, below-ground storage organs and above-ground parts that die back annually or when conditions are unfavourable (Humphries *et al*. 1991). It produces thin, wiry, twisting shoots, slightly woody at the base and up to 6 m long when offered support. Shoots emerging from the below-ground root system entwine with each other and surrounding vegetation, allowing them to climb understorey shrubs and small trees (Figure 1).

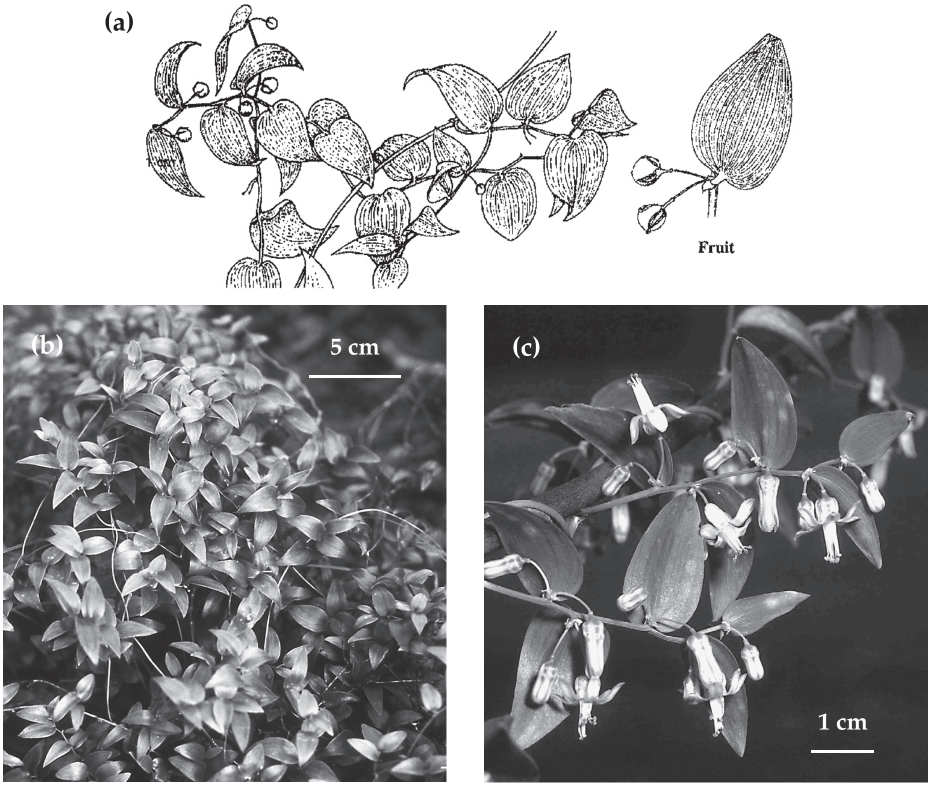
Leaves
The assimilating organs of bridal creeper are not true leaves but flattened, leaf-like stems called cladodes or phylloclades, arising in the axils of reduced, scale-like leaves (Arber 1924) (Figures 2a,b). The cladodes are stalkless, broadly ovate to lanceolate but sharply pointed with a smooth or minutely denticulate margin, 10–70 mm long, 4–30 mm wide, dark glossy-green when growing in shade, but dull and light green in exposed locations and have a delicate parallel venation with no prominent mid-vein. They are solitary and alternate along the stem, or borne in groups on short side branches.

Flowers
Flowers are sweetly-scented, 8–9 mm wide and 5–6 mm long when fully expanded (Figure 2c). They are borne on 3–8 mm long and slightly bent pedicels, singly or in pairs in the axils of the reduced scale-like leaves. The six tepals (term used when petals and sepals are similar in appearance) are greenish-white, turned backward and fused into a tube in the lower half. The six stamens are connivent (touching but not fused) and slightly shorter than the tepals. Flowers develop in late winter and early spring.

Fruits
Bridal creeper produces globular berries, 6–10 mm wide, initially green and ripening red (Figure 2d). Mature berries are 2–4 mm wide and sticky. They contain 0–4 and rarely up to 14 black, shiny, spherical or ovoid seeds (K.L. Batchelor and J.K. Scott unpublished results). Fruits are produced in mid-spring, ripen in early summer and can be retained on senescing plants for several months.

Below-ground biomass
The below-ground biomass of bridal creeper consists of a cylindrical, slender (about 5 mm wide), branching rhizome (underground stem with shoot buds) growing parallel to the soil surface and bearing numerous, radially-arranged, spindle-shaped, fleshy tubers, 25–42 mm long and 8–20 mm wide, often continuing as roots (Figure 3). Rhizomes and tubers of large plants entwine, forming a dense mat about 5–10 cm thick just below the soil surface.

Figure 1. Bridal creeper climbing shrubs and trees in an infestation at Yanchep National Park in Western Australia. (Photo CSIRO, L. Morin).



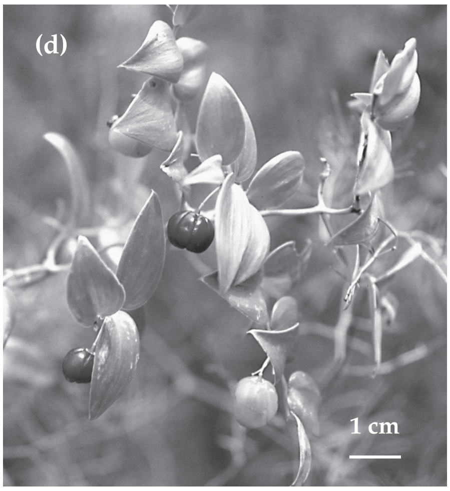


Figure 2. (approximate scale included). (a) Line drawings of bridal creeper cladodes (leaf-like stems) arising in the axils of reduced, scale-like leaves. From the Tamar Valley Weed Strategy (Anon. 2005b). (b) Bridal creeper foliage consisting of thin, wiry and twisting stems and cladodes (Photo CSIRO, J.K. Scott). (c) Bridal creeper flowers are borne on pedicels arising in the axils of leaves (Photo NSW Department of Primary Industries, J. Hosking). (d) Bridal creeper mature red berries (Photo CSIRO, L. Morin).

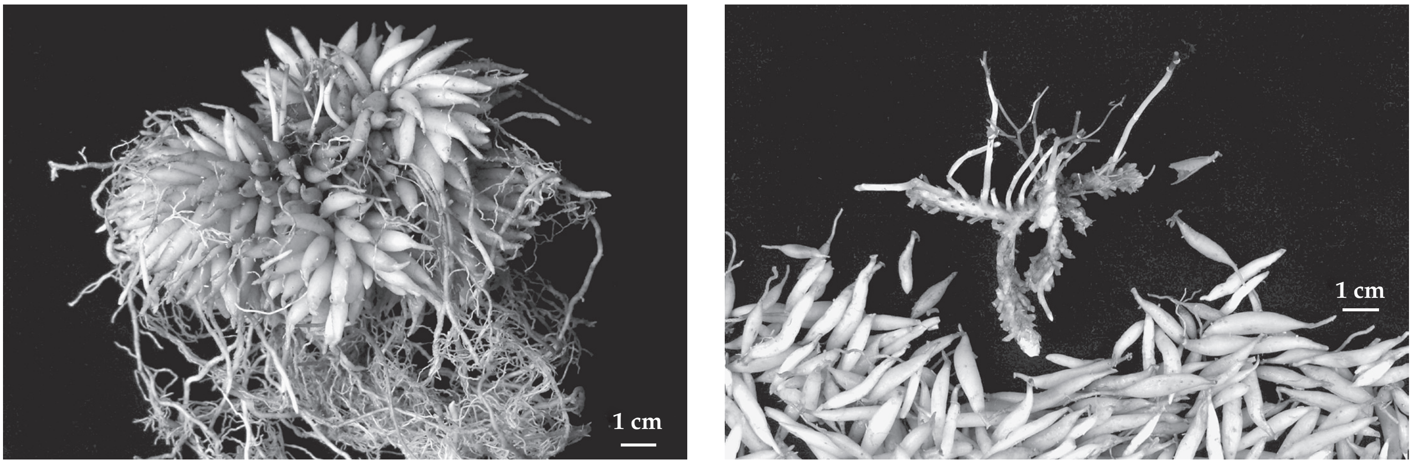


Figure 3. Below-ground biomass of bridal creeper (approximate scale included). (a) Mass of fleshy tubers with roots spirally attached to a central rhizome. (b) Branching rhizome separated from its tubers. (Photos CSIRO, A.J. Willis and C. Davies).

History

Bridal creeper, native to South Africa, was introduced to Australia as a garden ornamental possibly via Europe, where it was first used in horticulture (Jessop 1986, Scott 1995). The 1857 plant catalogue of William MacArthur, who supplied seeds to New South Wales, Victoria and South Australia, represents the earliest known record of bridal creeper being available for sale in Australia (Mulvaney 1991). It was also listed in other nursery catalogues in the 1870s and 1880s (Mulvaney 1991, Brookes and Barley 1992) and recorded as a plant growing in the Adelaide and Melbourne Botanic Gardens in 1871 and 1883, respectively (Scott 1995).

By the early 1900s, bridal creeper was widely used by florists for decoration and as greenery in bridal bouquets (Scott 1995). It was also extensively used as a garden ornamental at that time. Bridal creeper's popularity with florists and gardeners was short-lived and declined steadily during the first part of the twentieth century. It was first recorded as naturalized in Victoria in 1886 (Parsons and Cuthbertson 2001), although the first herbarium specimen of naturalized plants for that State was collected in 1943 (Clifford and Conran 1987). The earliest herbarium records of naturalized plants for South Australia and Western Australia were made in 1937 and 1960, respectively (Kloot 1986, Scott 1995).

Distribution

Australia

Bridal creeper is naturalized in all States, but not in the Northern Territory and the Australian Capital Territory. Its initial distribution was clearly linked to locations of early settlements (Carr 1996, Grant 1996, Pigott and Farrell 1996, Stansbury and Scott 1999). It is most prevalent in the temperate and Mediterranean regions of southern Australia (Scott and Kleinjan 1991). Localized infestations of bridal creeper have been present in South Australia since the 1950s, and bridal creeper is now widespread across southern South Australia, including Kangaroo Island and the Riverland (Robertson 1983, Cooke and Robertson 1990, Young 1995). Bridal creeper has also been reported throughout much of Victoria, with heaviest infestations found in coastal areas such as Port Phillip Bay and inland in the Horsham region, the north-east and along the Murray River (Beauglehole 1988, Conran 1994, Pritchard 2002). In south-western Western Australia, widespread but localized infestations were reported in the 1990s (Scott and Pigott 1993, Pigott and Farrell 1996, Pigott and Lund 1996).

In New South Wales, bridal creeper was listed in 1981 as present on the central coast, southern western slopes and western plains botanical regions and on Lord Howe Island (Jacobs and Pickard 1981). Indeed, it was first recorded on Lord Howe Island in 1962 (Le Cussan 2006). Until the mid-1990s bridal creeper was thought to be absent from Tasmania, but several small infestations have since been reported. These, as well as infestations occurring on Flinders Island, are currently targeted for eradication (Cooper and Warren 2006). Based on herbarium records, bridal creeper has also been found in the cooler areas of Queensland in the south-eastern Darling Downs, Warwick, Killarney and Toowoomba (R. J. Henderson personal communication).

Bridal creeper has spread considerably in the last two decades and is now widely distributed across southern Australia (Figure 4). The map of locations where bridal creeper biological control agents have been released, combined with herbarium records from Australia's Virtual Herbarium (Anon. 2006b), is currently the most accurate illustration of the national distribution of this weed. It underestimates, however, distribution in Tasmania, where agents have not been released extensively because of the bridal creeper eradication campaign (Cooper and Warren 2006). It also does not include infestations on Lord Howe Island.

Climate modelling to predict potential distribution of bridal creeper showed that slight northern expansions could be expected along the east and west coasts of the mainland (Scott 1995, Pheloung and Scott 1996, Scott and Batchelor 2006). Based on the model, bridal creeper also has the potential to spread extensively on the north and east coasts of Tasmania.

Other countries

The native range of bridal creeper is southern Africa, but it is also recorded from Namibia and further north in tropical Africa (Obermeyer 1984). Kleinjan and Edwards (1999), however, pointed out that the veracity of these northern herbarium records cannot be ascertained due to the absence of tubers on specimens and consequently additional collections are required to confirm these records.

Bridal creeper is not considered a weed in South Africa (Wells *et al.* 1986), although it is widely distributed and occurs in the three main rainfall zones (winter, summer and even rainfall) (Kleinjan and Edwards 1999). It does not, however, occur in the dry interior of the Western Cape and Northern Cape Provinces or the hot subtropical coast of KwaZulu-Natal.

Bridal creeper naturalized in New Zealand between 1900 and 1940 (Esler and Astridge 1987) and is now considered a weed in that country (Roy *et al.* 2004). It is also naturalized in some counties of California, USA, and although infestations are not large at this stage, managers have been alerted to its potential invasiveness (Anon. 2005a). Climate modelling showed that large areas of the Californian coast are suitable for bridal creeper establishment (Randall and Lloyd 2002). Bridal creeper is

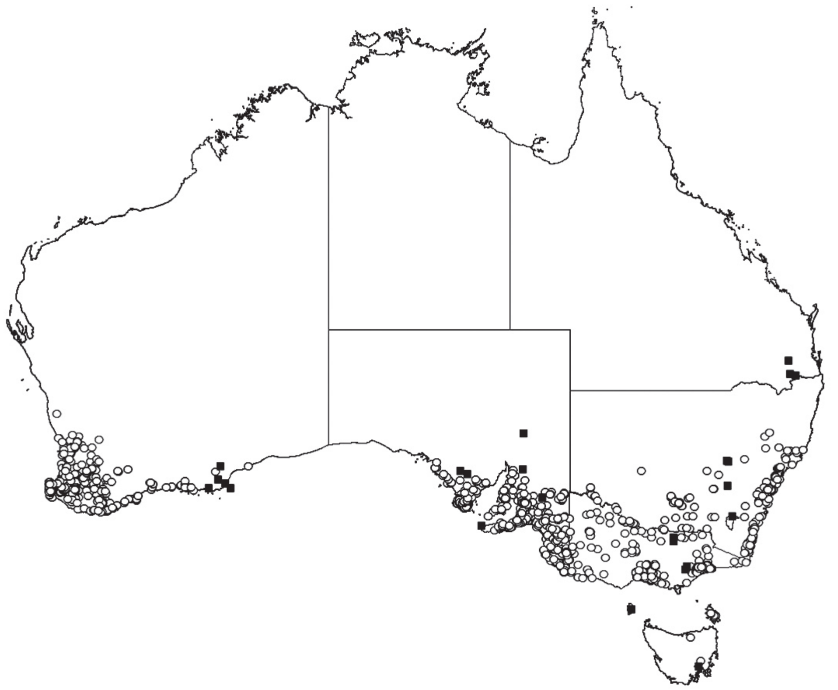


Figure 4. National distribution of bridal creeper based on locations of sites where biological control agents have been released since 1999 (open circles; based on information currently found in the CSIRO database; http://www.ento.csiro.au/weeds/bridalcreeper/project.html) with additional locations included based on herbarium records from Australia's Virtual Herbarium (solid squares; Anon. 2006b). A herbarium specimen of *Elachanthera sewelliae*, a synonym of *A. asparagoides*, collected in 1886 at Nickol Bay in the Pilbara Region of northern Western Australia is not included in this map because bridal creeper was not found in that area during a survey in the 1970s (Scott and Kleinjan 1991).

recorded as locally naturalized but not invasive in the Azores, Canary Islands, Portugal and Sicily (Valdés 1980, Obermeyer 1984, Anon. 2006a).

Habitat

Bridal creeper is capable of invading a variety of habitats in warm temperate climates. In contrast to most other environmental weeds, bridal creeper's invasion of new sites appears unrelated to disturbance events (Hobbs 1991, Raymond 1995, 1999, Siderov *et al.* 2005). Stansbury and Scott (1999), however, found via a questionnaire distributed to landholders that there was a weak association between properties that had a long history of disturbance through clearing of native vegetation and the presence of bridal creeper. Bridal creeper prefers shaded or part-shaded habitat (Meney *et al.* 2002). It does grow in hind dunes on exposed beaches in South Australia, coastal cliffs and amongst shrubs closer to shoreline in sheltered bays (J. Virtue personal communication).

Climatic requirements

Bridal creeper's ability to alter its phenology enables it to survive in different rainfall zones of South Africa, which receive between 400 and 750 mm of annual rainfall either in the winter, summer or aseasonally (Kleinjan and Edwards 1999). Recent South African surveys and examination of herbarium specimens revealed that it cannot survive in arid or hot subtropical areas, and prefers the cool climate of high altitudes in north-eastern regions of South Africa (Kleinjan and Edwards 1999).

In Western Australia, bridal creeper is associated with regions that receive more than 350 mm of annual rainfall (Stansbury and Scott 1999). Cooke and Robertson (1990) reported a similar finding for South Australia, where bridal creeper was not recorded in areas with less than 300 mm annual rainfall. Bridal creeper can grow in areas where rainfall is sub-optimal providing it is irrigated (e.g. private gardens or citrus orchards) (Young 1995), or in close proximity to watercourses or in moist gullies (Pigott and Farrell 1996, Stansbury and Scott 1999).

Substratum

Bridal creeper is able to grow on a wide range of soils, but prefers light-textured sandy and loam soils (Cooke and Robertson 1990, Grant 1996, Yates 1997, Stansbury 1999a,b). It is particularly vigorous in soils with high moisture content (Meney *et al.* 2002) and areas high in nutrients such as drainage lines (Pigott and Farrell 1996). It favours limestone outcrops in Yanchep National Park, Western Australia, which retain water and are well insulated from summer heat (Pike 1996). Stansbury (1999a,b) found that it grew best at sites with higher levels of available nitrates, potassium and iron. A recent study in south-western Western Australia has shown that soils where bridal creeper dominates have higher levels of available phosphorus than nearby weed-free areas (P.J. Turner personal communication). It is unknown at this stage whether bridal creeper originally invaded phosphorus-rich areas or if it is modifying the soil environment.

Bridal creeper has been recorded growing in soils between pH 5.8 and 8.5 (Yates 1997, Stansbury 1999a,b, Raymond 1999, P.J. Turner and K. Siderov personal communications).

Plant associations

Bridal creeper is found in a wide range of habitats including coastal heath on sandy dunes, eucalyptus and banksia woodlands or forests, creek and river banks, swamps, dry coastal vegetation, mallee shrubland, dry and damp sclerophyll open-forest, and littoral rainforest (Cooke and Robertson 1990, Scott and Kleinjan 1991, Carr 1996, Grant 1996, Pigott and Farrell 1996, Yates 1997, Williams and Gerrand 1998, Raymond 1999, Stansbury 1999a,b). Bridal creeper-infested vegetation on roadsides and along tracks is believed to act as a source of infestation for surrounding areas (Young 1995, Siderov and Ainsworth 2004, Horlock 2005, Siderov *et al.* 2006). Bridal creeper is also one of the most serious weeds of citrus orchards in the Riverina, Sunraysia and Riverland irrigation areas of New South Wales, Victoria and South Australia (Cooke and Robertson 1990, Kwong *et al.* 2002, Kwong and Holland-Clift 2004). However, it does not persist in other agricultural ecosystems, particularly pastures, as plants are readily grazed (Siderov and Ainsworth 2004, Siderov *et al.* 2006). Bridal creeper invades pine plantations, but it is not perceived to have a significant impact on tree growth (J. Virtue personal communication). In South Africa, bridal creeper mainly occurs as a minor understorey species (Kleinjan and Edwards 1999).

Growth and development

Morphology

Bridal creeper seedlings have a single cotyledon and their above-ground parts develop slowly until the root system is established (Parsons and Cuthbertson 2001). Cooke and Robertson (1990) recorded the first tuberous root at nine weeks after emergence, and found that some seedlings were capable of surviving their first summer with this limited reserve. In Western Australia, seedlings produced an average of

1.3–2.4 tubers over six months, depending on habitat (Stansbury 1999a,b). Robertson (1983) observed that young plants generally had several stems and approximately 20 tubers before a distinct short rhizome was produced. The rhizome develops into several branches comprising meristematic buds (growing points) and numerous, fleshy tuberous roots (Figure 3).

Mature plants are characterized by their extensive below-ground mat of rhizomes and tubers that make up more than 87% of the plant's total biomass (Raymond 1995, 1996, 1999) (Figure 3). Raymond (1995, 1996, 1999) recorded an average dry weight of rhizome and tuber mats of 0.83 kg m^{-2} at one of her study sites in Victoria (corresponding to approximately 6000 tubers m^{-2}), while at Western Australian sites the dry weight of rhizome and tuber mat ranged between 2.3 and 3.7 kg m^{-2} (P.J. Turner personal communication). New shoots arise from meristematic buds on the rhizomes and not from tubers (Cooke and Robertson 1990). Plants can be generated from sections of rhizome as long as they bear at least one growing tip and a few tubers (Kleinjan *et al.* 2004a). Individual plants cannot be distinguished in dense infestations.

Plants produce shoots early in the growing season that can extend several metres by climbing over vegetation or other kinds of support. The climbing, intertwining shoots can create columns or curtains of foliage, smothering surrounding vegetation (Figure 1). Mature plants typically flower only after several years of vegetative growth (Robertson 1983).

Perennation

Perennation is achieved by the persistence of the extensive below-ground storage organs and the production of adventitious buds on rhizomes. With these characteristics, bridal creeper fits perfectly the classification of a geophytic life form (Raunkiaer 1934). Its storage reserves not only provide energy for shoot growth, but also buffer plants against adverse conditions, thereby ensuring persistence over many years (Raymond 1996, 1999). In winter-dominant rainfall areas, bridal creeper senesces at the onset of warm weather in late spring and relies on its below-ground biomass to survive hot, dry summer months.

Bridal creeper is a long-lived perennial plant. Presence of dark and shrivelled tubers indicates that an infestation is more than three years old (Siderov and Ainsworth 2004). Raymond (1999) estimated that the infestation at her main study site was at least 15 to 20 years old, based on an approximate average increase of 18.3 g dry mass m^{-2} of new tubers per year. The tuber and rhizome mass has also been found to persist for over eight years after bridal creeper had been killed by glyphosate (Turner and Virtue 2006).

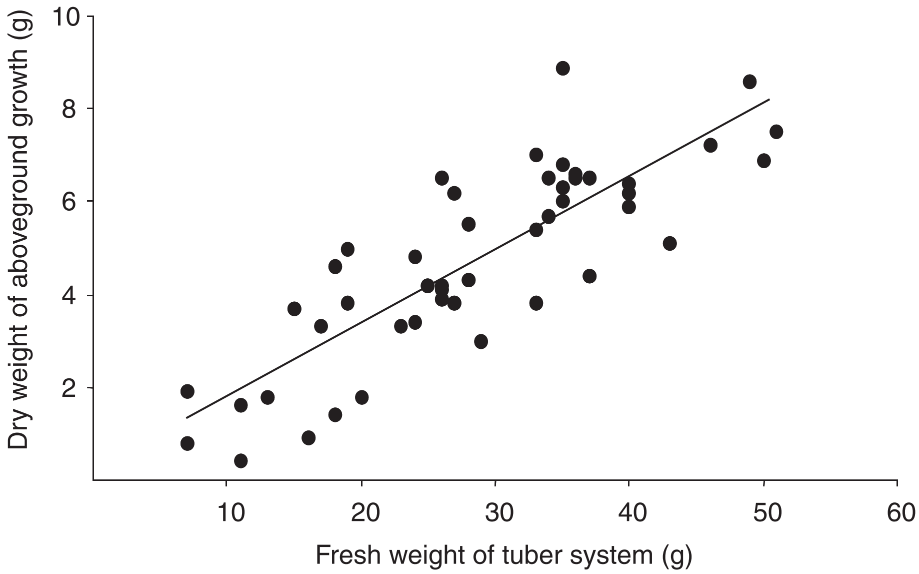


Figure 5. Correlation between above-ground and below-ground biomass of bridal creeper. Reprinted from *Biological Control*, Vol. 30, Kleinjan, C.A., Edwards, P.B. and Hoffmann, J.H., Impact of foliage feeding by *Zygina* sp. on tuber biomass and reproduction of *Asparagus asparagoides* (L.): relevance to biological control in Australia, pp. 36-41, Copyright 2004, with permission from Elsevier.

Physiology

No detailed studies have been carried out on bridal creeper's evapotranspiration and photosynthetic and translocation capacity.

Bridal creeper's preference for shaded or part-shaded habitats is an indication that it can photosynthesize effectively under low light intensities. Maximum growth of stems has been recorded at low light intensities in laboratory conditions (Courtot 1965). Following rapid growth and establishment of shoots at the beginning of the growing season in late summer and early autumn, bridal creeper diverts some of its photosynthates towards tuber production. Raymond (1996, 1999) estimated that new tubers account for a maximum of only 8% of the below-ground biomass each year. This, however, may be an underestimate because new tubers gradually change colour during the season and become difficult to distinguish from previous years' tubers.

The above-ground biomass of bridal creeper is positively correlated to its below-ground biomass (Turner 2003, Kleinjan *et al.* 2004a) (Figure 5). Raymond (1999) noted that bridal creeper's use of its below-ground reserves to support foliage growth is likely to be minimal due to the absence of any decrease in tuber biomass over her two year study. Bridal creeper's tuber reserves are not easily depleted, as shown in experiments where bridal creeper was mechanically defoliated at regular intervals (Raymond 1999, L. Morin and A.J. Willis unpublished results). Only the most severe and regular defoliation treatment (100% every fortnight for 20 weeks) completely exhausted tuber reserves of some plants and prevented regrowth after the last defoliation (L. Morin and A.J. Willis unpublished results).

Once plants establish extensive below-ground reserves they can produce shoots at the onset of cooler temperatures, even in the absence of available external moisture (Kleinjan and Edwards 1999, Raymond 1999). This can be attributed to fleshy tubers retaining high moisture content over several months. In the absence of rain, foliage growth is largely restricted to stems with small and slender cladodes, but it returns to normal as soon as rainfall resumes.

Daily growth rates of bridal creeper's seedlings and above- and below-ground biomass of established plants have not been measured. Nevertheless, the relative growth rate of above-ground biomass (dry weight) of young plants has been shown, in a glasshouse experiment, to follow the same trend as that of other species (Turner 2003). Following initial exponential growth, bridal creeper's relative growth rate reached a plateau and then declined as plants matured. In contrast, the relative growth rate of tuber biomass peaked in the middle of the experiment after bridal creeper had developed extensive foliage.

Mature plants can tolerate fire (Yates 1997, Willis *et al.* 2003). Hot summer fires can destroy a large proportion of tubers lying near the soil surface, but generally fire does not affect below-ground reserves located deeper in the soil (Carr 1996, France 1996). Below-ground biomass of well established infestations is also rarely completely killed with one-off application of foliar herbicides, probably due to the high root to shoot ratio, which makes it difficult to get sufficient herbicide through the foliage and into the root system (Pritchard 2002).

Phenology
In South Africa, bridal creeper adapts its phenology to different seasonal rainfall patterns (Kleinjan and Edwards 1999). It behaves similarly in Australia, where its major distribution is in winter-rainfall dominant regions. In most areas, shoots emerge from the below-ground rhizome either slightly before or with the onset of the first late-summer or autumn rains. For example, Raymond (1996, 1999) found that shoots began emerging in April 1992 at her intensively monitored study site on the Mornington Peninsula (Figure 6). However, a major rainfall event in January 1993 triggered emergence earlier than usual in the following growing season. Furthermore, the emergence of bridal creeper shoots from the below-ground biomass has been shown to be linked with decreasing temperatures in autumn in the absence of substantial rains (Stansbury 1995, Raymond 1999).

Seeds readily germinate throughout autumn and winter if conditions and microhabitat are adequate. Seedlings have a good chance of surviving over the dry summer period providing they have had time to develop some below-ground reserves (Cooke and Robertson 1990, Raymond 1999).

In Australia, flowering generally occurs in late winter to early spring (Robertson 1983, Raymond 1995, 1999), while in South Africa flowers are produced as early as July (Kleinjan and Edwards 1999). Flowers occur only on shoots from well-established plants (Robertson 1983). Fruits develop in the spring and mature into red berries in late spring to late summer, depending on the region. For example, fruits ripened much earlier (October to November) at sites in Western Australia with a Mediterranean-type climate than at southern Victorian sites (December to January) (Stansbury 1996, Raymond 1999).

Above-ground biomass begins to senesce in mid to late spring. The onset of senescence is earlier when plants are exposed to more direct sunlight. Shoots typically senesce from the apex down and take several weeks to die back completely (Raymond 1999). By December senescence is usually complete in areas with distinct winter rainfall patterns (Robertson 1983, Stansbury 1995, Kleinjan and Edwards 1999).

Not all shoots senesced during the summer months at the study site of Raymond (1995, 1996, 1999) in 1992–93 (Figure 6) because it was wetter than usual. This finding indicated that senescence is probably more associated with a drastic decrease in moisture levels rather than with increasing temperatures. Such phenology has been observed in areas of South Africa where rainfall is evenly distributed throughout the year (Kleinjan and Edwards 1999). Similar phenology is found in areas such as Tamworth in north-eastern New South Wales, where there is slightly more summer than winter rainfall (J. Hosking personal communication). Although there is always some above-ground growth present under these conditions, there is still an annual turnover of shoots with most of them dying during the summer months.

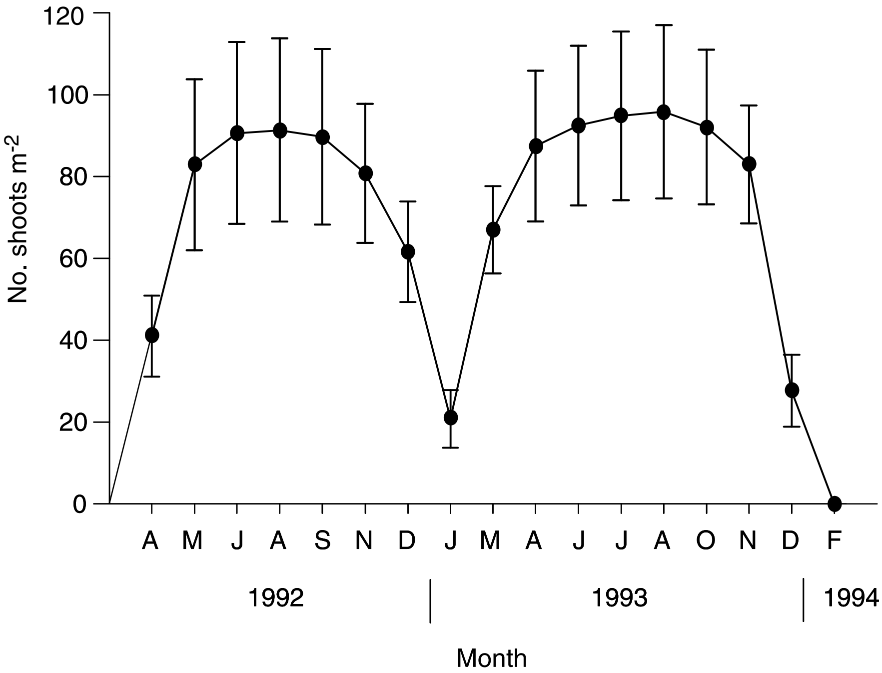


Figure 6. Shoot density recorded every six weeks from April 1992 to February 1994 in permanent plots at a site in the Mornington Peninsula National Park, Victoria. No shoots were present six weeks prior to the first assessment. Reproduced with permission from Raymond (1999).

Mycorrhiza
Mycorrhizal associations between bridal creeper and any fungi have not been investigated. It is noteworthy that colonization by vesicular-arbuscular mycorrhizal fungi has been observed in secondary but not storage roots of cultivated asparagus, *Asparagus officinalis* L. (Wacker *et al.* 1990).

Reproduction

Floral biology
Bridal creeper flowers are bisexual and self-compatible. Cross-pollination has been demonstrated in hand-pollinated flowers, but the level of outcrossing versus selfing still remains to be determined (Raymond 1995, 1999). Honeybees, *Apis mellifera* L., visited bridal creeper flowers in large numbers during the day at one of the study sites of Raymond (1995, 1999), collecting both pollen and nectar.

Shoots that emerge early in the growing season are the only ones that will produce floral structures and fruits (Raymond 1996, 1999, Stansbury 1999b). Buds flower and wither within two weeks and, by the third week swelling of the ovary is usually visible (Raymond 1999). Up to 40% of flowers set fruit at a study site in South Australia (Robertson 1983), while fruit set ranged between 3.5 and 25% at sites on the Mornington Peninsula where more than 80% of buds had flowered (Raymond 1995 1996, 1999). Raymond (1999) explained that such low fruit set was probably due to a combination of climatic or site-specific factors such as high intraspecific competition and stress among flowering shoots, extreme shading, herbivory on buds and flowers and mouldiness of developing fruits leading to abortion. However, it may simply be explained by the fact that flowering shoots were not climbing on a support (see below).

Seed production and dispersal
Mature bridal creeper fruits contain, on average, two to three seeds (Raymond 1999, Stansbury 1999b). In rare cases, the number of seeds per fruit is as high as 14 (K.L. Batchelor and J.K. Scott unpublished results). Fruit production is generally prolific on climbing shoots but rare or limited on long prostrate stems (Kleinjan and Edwards 1999, Stansbury 1999a,b). For example, at Western Australian sites the mean number of fruits produced by bridal creeper climbing on a 1 m wide × 2 m tall trellis ranged between 527 and 3787,

while plants provided with no support produced 0 to 5 fruits m^{-2} (C.D. Stansbury unpublished results).

Frugivorous birds are recognized as important contributors to seed dispersal in bridal creeper (Raymond 1995, 1999, Stansbury 1996, 1999b, 2001). Over her two year study, Raymond (1995, 1999) observed that birds were the primary dispersal agents of bridal creeper, removing 58–78% of fruits. Bridal creeper berries have similar physical characteristics and nutritional value to bird-dispersed fruits of native Australian species in wet sclerophyll forests (Raymond 1999). Fruits are retained on plants long after shoots have senesced and their bright colour makes them attractive to frugivorous birds. At least 12 bird species, both native and exotic, have been recorded feeding on bridal creeper berries and potentially dispersing seeds in southern Australia (see Table 1 in Stansbury 2001). Bridal creeper fruits, however, may not necessarily be their preference. For example, silvereyes (*Zosterops lateralis* Latham) in Western Australia were seen switching from bridal creeper berries to newly ripened fruits of a nearby common fig (*Ficus carica* L.) tree growing in the wild (Stansbury 1996). In South Australia, common starlings (*Sturnus vulgaris* L.) are believed to be the primary agent responsible for bridal creeper spread to remote areas on the Nullabor Plain (P. Sheridan personal communication). On the other hand, silvereyes are the main dispersers in Western Australia, the irrigated Riverland area of South Australia, Victoria and Lord Howe Island (Raymond 1999, Stansbury 2001, Le Cussan 2006, P. Sheridan personal communication). Ground-foraging birds, such as common blackbirds (*Turdus merula* L.) and emus (*Dromaius novaehollandiae* Latham) also contribute to secondary dispersal of fruits (Loyn and French 1991, Raymond 1999).

Bird dispersal of seeds is highly stochastic and consequently dispersal is difficult to predict precisely (Siderov *et al.* 2005). The dispersal pattern is influenced by the behaviour of different bird species and habitat structure, since many birds fly to perch-trees to consume fruits (Raymond 1999, Siderov and Ainsworth 2004). Stansbury's (2001) diffusion model showed that bridal creeper distribution at Bold Park in Western Australia was correlated with the flight pattern of silvereyes, with a mean distance for seed dispersal of 90.5 m. Occasional long-distance dispersal is also possible and may significantly increase rate of spread at a landscape scale. Based on silvereyes' gut passage rates and flight speed, the maximum potential seed dispersal distance has been estimated to be 12 km (Stansbury 2001). Nevertheless, gradual, short-distance bird dispersal of bridal creeper seeds along roadsides and wildlife corridors that connect disparate habitats has the potential to increase the rate of invasion of remnant vegetation patches at a local scale (Siderov and Ainsworth 2004, Siderov *et al.* 2006).

Bridal creeper seeds are also dispersed by other animal vectors. Seeds have been observed in rabbit (*Oryctolagus cuniculus* L.) droppings in the vicinity of warrens and there is anecdotal evidence that foxes (*Vulpes vulpes* L.) are dispersal agents (Graham and Mitchell 1996, Raymond 1995, 1999). Fox baiting has been suggested as a way to control long-distance spread of bridal creeper (Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ] *et al.* 2001). Mud containing seeds that adheres to animals, vehicles and machinery is also believed to contribute to dispersal (Parsons and Cuthbertson 2001), although this would be of relatively minor importance. Graham and Mitchell (1996) also observed situations where seeds dispersed downstream by flood events.

Physiology of seeds and germination

Seeds of bridal creeper have an after-ripening requirement that ensures they do not germinate too soon after they are produced, when conditions are likely not to be optimal for seedling growth (Robertson 1983). Raymond (1999) found that seeds stored for 2–6 months germinated twice as fast as fresh seeds, but the total number of seeds that germinated was lower after 8 to 12-months' storage. Passage of seeds through the gut of silvereyes was also observed to reduce the after-ripening period and enhance germination by 1.2 to 1.5 times compared to unpassed seeds. Raymond (1999) commented that gut passage of seeds may have removed germination inhibitors in the seed coat or increased permeability to gases, but it is unlikely to have influenced penetration by water since unpassed seeds imbibe water readily.

Mature seeds can germinate over a wide range of temperatures (10–30°C) in both constant light or darkness, but germination is optimal at lower temperatures of approximately 15–20°C (Robertson 1983, Fox 1984, Raymond 1999). Willis *et al.* (2003), however, observed a strong inhibitory effect of light on germination when fluctuating light and temperature regimes were used. Bridal creeper seeds can also germinate when exposed to water potentials as low as -0.44 MPa, making them moderately tolerant of moisture stress (Raymond 1999). Raymond (1999), however, showed that seed viability was not affected by exposure to high (30°C) and low (5°C) temperatures, or low water potentials (<-0.44 MPa). The effect of fluctuating temperatures on seed germination in the field has never been examined. Nonetheless, Stansbury (1999a,b) found that more seedlings survived at sites in Western Australia with summer soil temperatures averaging 24°C than at sites where average temperature was above 27°C.

The effect of smoke and heat shock treatment (90°C for 10 min) on germination of bridal creeper seeds has been investigated, but results of different trials have been contradictory, highlighting the need for further work in this area (Willis *et al.* 2003). Emergence of bridal creeper seedlings within four weeks of a wildfire at Stokes National Park, Western Australia, suggested that seeds can survive fire (France 1996).

Raymond (1999) demonstrated that most bridal creeper seeds were naturally buried within three months and that the seed bank is mostly transient, with only <5% carryover of viable seeds between years at Mornington Peninsula National Park. She observed that seeds persisted longer on the soil surface than buried at 2 or 5 cm, with more than 55% of surface seeds and none of buried seeds viable after 18 months (Figure 7). Most viability loss was attributed to decay occurring within three months of burial. During that period more than 50% of seeds at both burial depths and only 2% of surface seeds had germinated (Figure 7). Surface seeds began germinating only after they were covered by litter. Raymond (1999) did not observe any evidence of seed predators, such as ants, removing seeds.

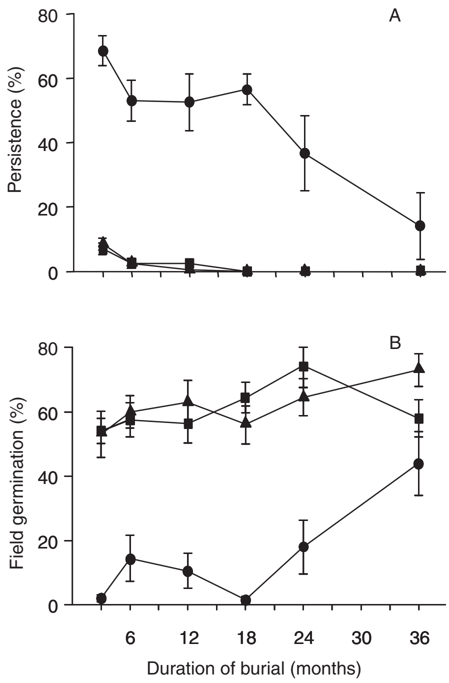


Figure 7. Fate of bridal creeper seeds located on the soil surface (circles) or buried at depths of 2 cm (squares) and 5 cm (triangles) over time at a site in the Mornington Peninsula National Park, Victoria. (a) persistence of seeds (viable but ungerminated), (b) germination of seeds in the field. Reproduced with permission from Raymond (1999).

In another experiment conducted in the You Yangs Regional Park, Victoria, Raymond (1999) obtained similar germination in undisturbed sites and sites exposed to a single small-scale soil disturbance. Nonetheless, seedlings established more readily when they germinated in microsites under tree canopies rather than in the open. Seedling establishment was also promoted by litter cover.

Vegetative reproduction
Whilst seeds remain the most important means for bridal creeper dispersal, established plants can also increase in size through spread of branching rhizomes bearing meristematic buds. Stansbury and Scott (1999) estimated from a landholder survey that patches of about 10 m^2 expanded radially by approximately 0.6 m $year^{-1}$. This expansion rate however, is most likely an overestimate considering the rate of new tuber production per year recorded by Raymond (1999) (see above). Rhizome fragmentation has been used to increase numbers of plants in the nursery trade (Bodkin 1986). Earthworks (e.g., roadside grading) can spread rhizomes over considerable distances to start new infestations.

Hybrids
There are no known hybrids of bridal creeper. In South Africa, *A. asparagoides* is reported to grow sympatrically with other closely-related species such as *Asparagus ovatus* T.M.Salter and *A. kraussianus* (Kunth) Macbride (Kleinjan and Edwards 1999), but no plants of indistinct (hybrid) form have ever been found at these sites (P.B. Edwards personal communication). Artificial crosses between broad-leaved *Asparagus* species have not been attempted as far as we know.

Population dynamics
At a local scale, vegetative extension of below-ground rhizomes is the main means of increase in area occupied by bridal creeper. Local populations can also increase via spread of fragmented rhizomes. Average shoot densities up to 95.8 m^{-2} have been recorded at one study site in Victoria (Raymond 1995, 1996, 1999) (Figure 6). At that site, shoots that emerged within one week of the commencement of the growing season were more than three times longer and produced significantly more cladodes than those that emerged in the following six weeks. Less than 20% of shoots died during the growing season, followed by high mortality at the onset of the warm weather at the end of the season. High levels of summer rainfall during the 1992-1993 summer in southern Victoria led to the survival of some shoots until the following April, after new shoots had started to emerge (Raymond 1995, 1996, 1999). These new shoots did not emerge from the same location as those of the previous season.

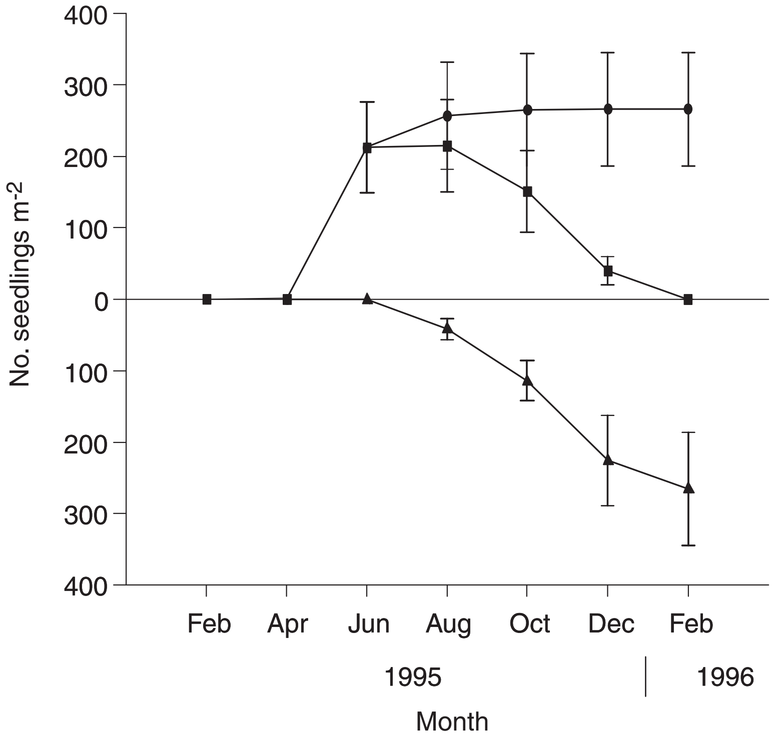


Figure 8. Seedling dynamics over one year at a site in the Mornington Peninsula National Park, Victoria; cumulative recruitment (circles), senesced seedlings (triangles) and total seedling number (squares). Reproduced with permission from Raymond (1999).

Fruits are mostly produced on shoots of established plants that emerge at the very beginning of the growing season (Raymond 1996, 1999). Fruit densities have been recorded to be as high as 2149 fruits m^{-2} in infestations where no artificial support was provided (Raymond 1999). Seedling recruitment is highly variable and fluctuates from year to year and site to site. At one of Raymond's (1999) sites on the Mornington Peninsula, 80% of seedlings emerged between April and June and reached an average of 214.5 seedlings m^{-2} by August (Figure 8). More than 40% of seedlings died during the growing season, probably because of litter disturbance, and the remaining seedlings senesced at the beginning of summer in December. The following season up to 69% of the seedlings that survived the first growing season had re-emerged by June. Survivorship was likely affected by competition for resources amongst seedlings and with established bridal creeper plants or other species (Raymond 1999).

Life expectancy of bridal creeper cannot be determined from established infestations because it is impossible to identify individual plants (Raymond 1999). Long-term monitoring of seedlings to reproductive maturity and beyond is required to assess longevity. There has only been one study on the population dynamics of bridal creeper (Raymond 1995, 1996, 1999), and more studies are required to document variation between populations across its distribution.

Importance
Detrimental
Rapid growth of bridal creeper in autumn and its climbing habit provide canopy dominance and make it highly competitive. Once a bridal creeper infestation is established, the amount of light reaching the soil surface is very low, thereby preventing other plants from persisting. Raymond (1999) reported that the amount of irradiance reaching the soil surface was reduced by 93% under a canopy of bridal creeper foliage. Competitiveness of bridal creeper is also due to the quantity of below-ground reserves that occupy most of the space available in the substrate.

Bridal creeper is recognized as one of the most troublesome environmental weeds in southern Australia, and is ranked in the top 20 Weeds of National Significance (Thorp and Lynch 2000). It is a major problem for conservation because it can change the structure, floristic composition and ecology of natural ecosystems. A serious invader of both disturbed and undisturbed habitats, it can quickly dominate understorey vegetation, modify the aesthetics, affect access and change the overall structure of the landscape (Hobbs 1991, Humphries *et al.* 1991, Adair and Groves 1998, Raymond 1999, Siderov *et al.* 2005).

Bridal creeper is a highly competitive species that poses a direct threat to at least 16 native plant species in South Australia and New South Wales (Davies 1986, 1995, Sorensen and Jusaitis 1995, Quarmby 2005, Willis *et al.* 2003, Taylor 2003, Downey 2006). Bridal creeper is likely to have adverse impacts on biodiversity in other States where it is invasive, but these have not yet been recorded (Downey 2006). In addition to the species listed in Downey (2006), the orchid species *Pterostylis bryophila* Jones in South Australia is also considered under threat due to habitat loss and bridal creeper invasion (Quarmby 2005). Furthermore, a recent assessment made in south-eastern New South Wales, which involved an extensive consultation process, suggests that up to 52 additional plant species are potentially threatened by bridal creeper invasion (Downey 2006).

The impact of bridal creeper invasion on threatened plant species can be dramatic. For example, the density of the sand-hill greenhood orchid, *Pterostylis arenicola* M.A.Clem. & J.Stewart, at Tailem Bend, South Australia was four times higher in plots where bridal creeper was absent compared to infested plots (Sorensen and Jusaitis 1995). In south-eastern New South Wales, two of the largest and most ecologically significant populations of the small shrub *Pimelea spicata* R.Br are in danger of extinction primarily due to invasion by bridal creeper (Groves and Willis 1999, Willis *et al.* 2003).

Bridal creeper has also been identified as a threat to four endangered ecological communities in New South Wales (Downey 2006). Indeed it is believed to have the potential to eliminate most understorey species of invaded habitats (Humphries *et al*. 1991). Downey (2006) also identified 11 additional ecological communities in New South Wales, including six already listed under the New South Wales *Threatened Species Conservation Act 1995,* that are potentially threatened by bridal creeper.

Bridal creeper has also been shown to eliminate or restrict growth of a wide range of other native plant species. Turner and Virtue (2006) demonstrated an increase in biomass and plant number of the native shrubs *Rhagodia parabolica* R.Br. and *Rhagodia candolleana* Moq., the groundcover *Enchylaena tomentosa* R.Br. and perennial grasses in plots where bridal creeper was controlled over an eight year period. Similarly, the number and abundance of native plant species was negatively correlated to bridal creeper cover at sites in south-western Western Australia (P.J. Turner personal communication) and South Australia (Stephens 2005).

Regeneration of native communities after bridal creeper removal may be slow where few propagules of native plants are left in the soil. Below-ground biomass may also impede seedling establishment of native species by occupying all of the space available in the substrate or by changing soil chemistry. Turner and Virtue (2006) observed that dead rhizomes and tubers were still present eight years after bridal creeper had been killed. The decomposition rate of bridal creeper's below-ground biomass has not been investigated. In a preliminary experiment, an allelopathic response was obtained when bridal creeper roots were completely mashed up and added to a hydroponic system, but these conditions were highly artificial and results cannot be extrapolated to the field (A.J. Willis unpublished results). However, it is noteworthy that root tissue of cultivated asparagus incorporated into soil is reported to have allelopathic effects on lettuce, tomato and asparagus seedlings (Shafer and Garrison 1986).

At Mt. Billy Conservation Park, a remnant eucalypt woodland in South Australia, greater accumulation of litter was observed in habitats invaded by bridal creeper compared to uninvaded native areas (Holt 2005, Stephens 2005). This difference was probably due to litter becoming trapped in the climbing stems and foliage. Increased litter accumulation can change decomposition, nutrient and soil dynamics, which in turn may affect establishment and growth of native species. Despite the significant decrease in plant diversity and changes in habitat due to bridal creeper invasion, Stephens (2005) found a very abundant and diverse arthropod and wasp community in both native and bridal creeper invaded habitats. These study sites, however, were not completely colonized by bridal creeper and consequently the weed may not yet have caused a habitat change significant enough to detect flow-on negative effects on the arthropod community (Stephens 2005).

Bridal creeper's possible detrimental effects on native vertebrate fauna of natural ecosystems have not been documented. During the fruiting stage, established infestations can harbour large numbers of exotic birds such as common blackbird and starling (Raymond 1999, Stansbury 2001), which are considered pests in Australia (Bomford and Hart 2002). Although most frugivorous birds appear to prefer fruits of native species over bridal creeper fruits, it is possible that availability of large quantities of the latter has a negative impact on the regeneration of native species (Raymond 1999).

Bridal creeper is not a weed of pastures as it cannot withstand constant grazing (Siderov and Ainsworth 2004). It is also not an invader in broadacre cropping situations probably because of the limited seed input in such environments, preference for shaded habitats and the vulnerability of seedlings to cultivation. Bridal creeper is, however, a troublesome weed of citrus orchards in Australia, where it smothers trees, displaces citrus roots and reduces fruit production (Kwong *et al*. 2002, Kwong and Holland-Clift 2004). The smothering increases humidity around trees and provides optimal conditions for development of diseases such as collar rot and *Septoria* fruit spot. It is estimated that at least 20% of growers who manage a total of more than 6500 ha of citrus orchards in districts bordering the Murray River from Mildura to Cobram, are affected by bridal creeper (Kwong and Holland-Clift 2004). Grower's perceptions of the negative impacts of bridal creeper on their orchard ranged from increased labour and financial costs, damage to citrus trees, reduced fruit production, impediment to irrigation and fruit harvesting, and unsightliness. The cost of control is estimated to be as high as \$2000 ha^{-1} y^{-1} (Kwong and Holland-Clift 2004). In very severe infestations, where >80% of the orchard is covered by bridal creeper, growers believed that it is often cheaper in the long run to remove trees and replant.

National expenditure on bridal creeper control in natural ecosystems is impossible to estimate, as many councils, community groups and government agencies contribute resources towards management of this species and control cost per weed species is not necessarily recorded. The cost of research and implementation of the biological control program for bridal creeper was estimated in 2002 to have reached at least \$6 million (Morin *et al.* 2006).

Bridal creeper is not known to be an alternative host for diseases of economic or environmentally important plants. Its fruits are unpalatable to humans (Raymond 1999), but not reported as toxic.

Beneficial

Bridal creeper has few redeeming qualities. It was widely grown as an ornamental plant from the mid 1880s to the early twentieth century, but its popularity declined substantially afterwards. Today it is still sometimes seen growing in home gardens (J. Hosking personal communication), although it is not sold anymore in nurseries and it is legislated against in all States.

Bridal creeper's fruits form part of the diet of a small number of native birds (Stansbury 2001), whose normal host plants may occur in low density due to habitat degradation or destruction. Its foliage is non-toxic to mammals. It is reported to form a significant part of the diet of tammar wallabies (*Macropus eugenii* Desm.) on Garden Island in Western Australia (Bell *et al.* 1987). Sheep and cattle have also been observed grazing on the foliage (Siderov and Ainsworth 2004), but there is no information on its nutritional value.

A higher number of soil/litter-associated pollinators of the endangered orchid, *P. bryophila*, was recorded at bridal creeper-invaded study sites in South Australia (Stephens *et al.* 2003, Stevens 2005). It appeared that bridal creeper provided a favourable habitat for these specific pollinators and did not affect their movement or pollination efficiency within the invaded habitat.

In South Africa, bridal creeper is believed to have therapeutical attributes. A lotion prepared from its root biomass is used to bathe sore eyes (Guillarmod 1971), although no detail on efficacy and extent of use is provided in the literature. Tubers have been seen being sold in the Cape Town market as a remedy for stomach problems, but again no detail is known of the recommended method of preparation or the dose rate (P.B. Edwards personal communication). The chemical composition of bridal creeper's below and above-ground parts has not been investigated.

Legislation

Asparagus asparagoides is prohibited for import to Australia under Commonwealth plant quarantine legislation (*Quarantine Act 1908*) (Anon. 2005c). It is not permitted entry into Western Australia under the *Plant Diseases Act 1974* and is declared a category P1 plant that cannot be sold, distributed or moved within the State, under the *Agriculture and Related Resources Protection Act 1976* (Anon. 2005d,e). Importation into Tasmania is also restricted under the *Weed Management Act 1999* and the *Plant Quarantine Act 1997* (Anon. 2005f). In that State, restrictions or measures for bridal creeper are specified in the weed management plan that is required under the *Weed Management Act 1999* (Anon. 2005f). It must not be sold or distributed throughout the State. Under the legislation, inspectors may require that land owners implement measures to reduce the number of bridal creeper plants or eradicate or restrict the weed from particular areas.

Under the new South Australian *Natural Resources Management Act 2004*, bridal creeper must be controlled and its trade and movement are illegal throughout the State (Anon. 2005g). In New South Wales bridal creeper is legislated under the *Noxious Weeds Act 1993*, and must not be sold, propagated or knowingly distributed and the weed must be prevented from spreading to an adjoining property (W4c) in eight local council areas in the Sydney region (Anon. 2005h). On Lord Howe Island it is listed under category W3 and must be prevented from spreading and its numbers and distribution reduced. In the new Act implemented on 1 March 2006, bridal creeper is banned from sale and movement (Class 5) for the whole of the State (D. Gannaway personal communication). Land holders are also required to control the plant (Class 4) in local council areas identified in the Act.

Bridal creeper is a Class 1 plant in Queensland under the *Land Protection (Pest and Stock Route Management) Act 2002*, because it is not commonly present in the State and has the potential to cause adverse economic, environmental or social impact (Anon. 2005i). It must be eradicated if it establishes in the State. It is declared a prohibited plant (no sale or movement) in the Australian Capital Territory under the *Pest Plants and Animals Act 2005* (Anon. 2006c). It is listed as a noxious weed to be eradicated or not to be introduced to the Northern Territory (class A and C weed) under the *Northern Territory Weed Management Act 2001* (Anon. 2006d). Bridal creeper has recently been declared a restricted weed in Victoria under the *Catchment and Land Protection Act 1994*, banning its sale and movement across the State (Anon. 2005j).

Weed management

As for other environmental weeds, lack of economic returns from control expenditure often precludes deployment of control actions against bridal creeper at a local scale. Use of traditional control methods may also not be appropriate or feasible in some areas because of size and inaccessibility of infestations, risk of off-target damage when herbicides are used in conservation areas and labour-intensiveness of hand weeding because of the thick mat of rhizomes and tubers. These difficulties and the extensive Australian distribution of bridal creeper justify the substantial investment that has been made to develop effective classical biological control options.

Prior to initiation of a control program, it is useful to map the distribution and densities of bridal creeper infestations in the targeted area or region (Carr 1996). Such a map provides the basis for prioritizing areas for control. Carr (1996) recommends initially focusing control efforts on low density infestations occurring in bushland with the highest conservation value before tackling more seriously infested areas. Targeting control towards climbing plants that produce the most fruits within the core infestation has been suggested to limit spread (ARMCANZ *et al.* 2001).

Since most bridal creeper seeds are bird-dispersed within 300–500 m of the source (Stansbury 2001, Siderov *et al.* 2006), it is recommended to control outlying plants or patches within a buffer zone of 500 m around the edge of a main infestation (ARMCANZ *et al.* 2001). Siderov *et al.* (2006) emphasized the importance of controlling bridal creeper along paths and tracks within remnant vegetation because they act as a conduit for invasion. Alternatively, reducing the number, or modifying the spatial arrangement, of tracks within a reserve can be considered to limit seed dispersal within the area.

Herbicides

Several herbicide trials have been conducted in the last 20 years (Cooke and Robertson 1990, Pritchard 1991, 1995, 1996, 2002, McQuinn 1994, Dixon 1996), identifying glyphosate, metsulfuron methyl and some related sulfonylureas as the most effective non-selective systemic herbicides against bridal creeper (Table 1). In a series of pot trials, Pritchard (1991) found that bridal creeper foliage was more sensitive to sulphonylurea herbicides than glyphosate, but that glyphosate efficacy was improved with addition of the adjuvant Pulse® (0.5% v/v). Increasing rates of these herbicides did not improve control in most situations and especially when repeat applications were made over consecutive years (Cooke and Robertson 1990, Pritchard 2002). Triclopyr/picloram, bromacil and a paraquat-amitrole-MSMA mixture have also been reported to give good initial control in the field, but less control was achieved with 2,2-DPA, 2,4-D/picloram, amitrole, triclopyr, tribenuron methyl and flumetsulam, and no control was observed with fluroxypyr and MCPA/diflufenican (Cooke and Robertson 1990, personal communications cited in Pritchard 1991, Yates 1997, Pritchard 2002).

Until recently, trials were generally carried out for a single year and did not attempt to measure herbicide impact on bridal creeper below-ground biomass. However, Pritchard (2002) demonstrated that a single application of glyphosate (180 g 100 L^{-1}) and Pulse® (0.5% v/v) reduced the living root system by 78% compared to untreated plots. Between 90–99% of the root biomass was killed following a repeat application one or two years after the initial application. In contrast, a single application of metsulfuron methyl (1.5 g 100 L^{-1}) only reduced living root biomass by 32% and a repeat application after one year of 1.5, 3 and 6 g 100 L^{-1} decreased the root system by 41–92%, 29–53% and 74%, respectively (all rates with additive BS1000® (0.25% v/v)). Glyphosate (360 g a.i. L^{-1}; rate 20 mL L^{-1}) combined with metsulfuron methyl (Brushoff® 600 g a.i. kg^{-1}; rate 0.1 g L^{-1}) and a surfactant (LI700®; 5 mL L^{-1}) is currently used in the eradication campaign against bridal creeper on Lord Howe Island at readily accessible sites (Le Cussan 2006).

To achieve best results with chemical control of bridal creeper, a spray program of at least three years is recommended (Robertson 1983, Cooke and Robertson 1990, McQuinn 1994, Dixon 1996, Pritchard 1996, 2002). Repeat applications of herbicides are essential to kill plants that are missed in the first year, any new regrowth and seedlings, and to have a significant impact on below-ground biomass. A longer control program with herbicide applied every 2–3 years, rather than annually, may be a more efficient use of time

Table 1. Herbicides that provided significant control (>90% when quantified) of bridal creeper in different field trials.

Herbicide	Formulation	Rate	Surfactant/Penetrant	Comments	Reference
Glyphosate	Glyphosate 360™ (360 g a.i. L^{-1})	360 g L^{-1} 1 L ha^{-1}, 1/100	n/a		Dixon 1996
		360 g L^{-1}, 1/50	n/a		Graham and Mitchell 1996
		360 g L^{-1}, 1/70	n/a		France 1996
		180 g 100 L^{-1} spray vol.: 1000 L ha^{-1}	With Pulse® (0.5% v/v)	Higher rate and lower spray volume did not improve results. More effect on root system than other herbicides.	Pritchard 1996, 2001
Metsulfuron methyl	Ally® Brushoff® (600 g a.i. kg^{-1})	2.5-5 g ha^{-1} in 500–1000 L water	With BS 1000® (Alcohol alkoxylate) or Pulse® (modified polydimethylsiloxane) (0.2% v/v) with Ally	May be more cost-effective than glyphosate in areas where the roots of non-target plants are protected by a good layer of litter.	Dixon 1996
	Brushoff	1.5 g 100 L^{-1} spray vol.: 1000 L ha^{-1}	With BS 1000® (0.25% v/v) or Pulse® (0.5% v/v)	Higher rates and lower spray volume did not improve results.	Pritchard 1996, 2001
Thifensulfuron methyl/ metsulfuron methyl	Harmony M® (682/68.2 g a.i. kg^{-1})	15/1.5 g 100 L^{-1} spray vol.: 1000 L ha^{-1}	With BS 1000® (0.25% v/v)	Higher rate and lower spray volume did not improve results. Offered no improvement in root control over metsulfuron methyl.	Pritchard 1996, 2001
Chlorsulfuron	Glean® (750 g a.i. kg^{-1})	1.9 g 100 L^{-1} spray vol.: 1000 L ha^{-1}	With BS 1000® (0.25% v/v)	Offered no improvement in root control over metsulfuron methyl.	Pritchard 1996, 2001
TANK-MIXES					
Glyphosate and metsulfuron methyl	Glyphosate 360™ and Brushoff®	90 g plus 1.5 g 100 L^{-1} spray vol.: 1000 L ha^{-1}	With Pulse® (0.5% v/v)	Lower spray volume did not improve results	Pritchard 1996

These herbicides may not be approved for use on bridal creeper in all States/Territories and permits are required for off-label uses. Check with State or Territory weed management agency or local noxious weed authority for up-to-date information on registered herbicides and best application methods and dosage.

and resources without compromising outcomes (McQuinn 1994, Pritchard 1996, 2002, ARMCANZ *et al.* 2001). Indeed, regrowth should be more abundant and vigorous two years after initial application, enabling higher uptake of herbicide and potentially more impact on the root systems.

Best control outcomes have been achieved when metsulfuron methyl or glyphosate was applied onto actively growing bridal creeper in the early to late-flowering stage (August-September) (Dixon 1996, Pritchard 2002). Nevertheless, good control was also obtained with applications made at the flower bud to green berry stage (Pritchard 2002). Spraying before flowering is advocated by some authors to allow better translocation to the rhizome (Cooke and Robertson 1990) and to prevent off-target damage to indigenous species that emerge in spring (Carr 1996).

Effectiveness of glyphosate in killing bridal creeper is greatly enhanced when all foliage of an infestation is sprayed (Dixon 1996, Graham and Mitchell 1996). Graham and Mitchell (1996) recommend use of a marker dye in the herbicide mix and delineating grids using flagging tape to ensure that no plants are missed or only partly sprayed. Portable sprayers are generally used to apply herbicides to bridal creeper that is closely associated with native vegetation and difficult to access with vehicles (Graham and Mitchell 1996). They are also ideal for spot-spraying isolated plants, regrowth or new recruits that emerge in years following initial herbicide treatments or after a fire (France 1996). Techniques such as physically pulling off bridal creeper foliage from surrounding native vegetation before spraying or wiping instead of spraying have been suggested to minimize non-target effects from applications of non-selective herbicides (Carr 1996, Graham and Mitchell 1996, ARMCANZ *et al.* 2001). However, the inefficiency and extra labour cost to implement such techniques make them suitable only for areas of high conservation value (Graham and Mitchell 1996).

The main challenge in using herbicides to control bridal creeper in natural ecosystems is to avoid damage to non-target species. In Pritchard's (1996, 2002) field trials, sedges and grasses present in treated plots were killed by glyphosate applications but not by metsulfuron methyl or other sulfonylurea herbicides tested. In contrast, minimal or no damage was observed after applications of any of the herbicides to foliage of trees and shrubs on which bridal creeper was climbing. Several herbaceous species also survived after applications of metsulfuron methyl in Western Australian trials (Dixon 1996). Furthermore, some native plants even survived after plots were sprayed with glyphosate, probably because they were partly protected from the spray by a dense bridal creeper canopy or were at a growth stage that is more tolerant to the herbicide. It may be more appropriate to use metsulfuron methyl instead of glyphosate, even if it provides a lower control of bridal creeper below-ground biomass, in areas where it is not possible to avoid spraying desirable ground species (Yates 1997, Pritchard 2002). Nonetheless, glyphosate can generally be sprayed onto bridal creeper climbing trunks of trees without causing any non-target damage (Graham and Mitchell 1996). Concerns have been raised about possible adverse effects on native vegetation of long-term use of metsulfuron methyl, which can remain active in alkaline soils for many months (ARMCANZ *et al.* 2001). It is thus recommended to avoid application of this herbicide near the root zone of trees (Dixon 1996).

Chemical control of bridal creeper in citrus orchards is not perceived by growers as being very effective, probably because it cannot be used on bridal creeper growing amongst citrus foliage due to the high risk of damage to citrus trees (Kwong and Holland-Clift 2004). For high value citrus crops, trees can be 'skirted', whereby lower limbs are pruned to enable under tree access for spot-spraying with glyphosate (ARMCANZ *et al.* 2001).

Other treatments

Prevention Education campaigns to increase community awareness of problems caused by bridal creeper are imperative to keep un-infested areas free of the weed (ARMCANZ *et al.* 2001). Sale and distribution of plants are prohibited across Australia. Gardeners are encouraged to prevent further spread by avoiding planting or dumping of garden refuse containing bridal creeper from their properties (ARMCANZ *et al.* 2001). Soil hygiene is also important to prevent spread of viable rhizomes by earthmoving equipment (Cooke and Robertson 1990, Graham and Mitchell 1996, Davies 2000).

Hand weeding Bridal creeper is easily recognized and isolated young plants with an underdeveloped root system can be pulled-out by hand when growing in loose soil (Carr 1996). Manual removal of mature bridal creeper and its root system, a method often referred to as 'grubbing', is only appropriate for small isolated infestations, particularly in areas of high conservation value (Robertson 1983, Cooke and Robertson 1990, Carr 1996). It is also used by growers in citrus orchards who are reluctant to use herbicides (Kwong and Holland-Clift 2004). Follow-up weeding is often required because bridal creeper regenerates from small pieces of living rhizome left behind in the soil (Pike 1996). Removed root mats should be disposed of by deep burial (>2 m deep) or dried and burnt (Graham and Mitchell 1996, Pike 1996).

Hand weeding is time and labour intensive and consequently not suitable for severe and extensive bridal creeper infestations (Robertson 1983). Removal of well-developed mats of rhizomes and tubers can create excessive disturbance that hinders natural bush regeneration and facilitates weed invasion (Carr 1996). Carr (1996) emphasized that hand weeding should be done only at the rate of natural regeneration to avoid over-clearing the area.

A minor bridal creeper hand weeding initiative was undertaken in the mid-1990s in the Boomerang Gorge, Yanchep National Park in an attempt to limit further spread of the weed (Pike 1996). The project was eventually abandoned because of difficulties in obtaining funding to support volunteers' activities and better control prospects with other methods such as herbicide applications and biological control. Hand digging with removal of underground rhizomes and tubers is the main treatment method in the bridal creeper eradication campaign on Lord Howe Island (Le Cussan 2006).

Slashing and grazing Mechanical removal of bridal creeper above-ground biomass is effective at reducing seed production if performed before fruiting, but many repeated slashings are necessary to exhaust stored underground reserves (Robertson 1983). Repeated mechanical defoliation of bridal creeper in glasshouse experiments has been shown to reduce stored below-ground reserves (Raymond 1999, L. Morin and A.J. Willis unpublished results). However, plants totally defoliated every five weeks for eight months still produced a few new tubers and survived (Raymond 1999). Slashing is sometimes carried out in citrus orchards around trees infested by bridal creeper (Kwong and Holland-Clift 2004). Pruning of lower branches of trees is often required prior to slashing.

Bridal creeper is palatable to mammals. Tammar wallabies (Bell *et al.* 1987) and quokka (*Setonix brachyurus* Quoy and Gaimard) (Carr 1996) are reported to eat bridal creeper foliage. On Garden Island in Western Australia, Bell *et al.* (1987) observed a reduction of more than 97% in bridal creeper cover in plots exposed to grazing by tammar wallabies (>100 individuals km^{-2}) for two years compared to plots located within an enclosure. Slow invasion of bridal creeper from infested tracks to the centre of a reserve on Phillip Island, Victoria, may be due to feeding of swamp wallabies (*Wallabia bicolor* Desm.) within remnant vegetation (Siderov and Ainsworth 2004).

Livestock grazing is potentially an effective control method for bridal creeper. Siderov and Ainsworth (2004) found no bridal creeper occurring next to fenced areas of pasture where it was abundant and supported the implementation of controlled grazing in areas fenced off for revegetation to keep bridal creeper in check. Such an approach may be more efficient than regularly searching the area to remove newly-established seedlings (Siderov and Ainsworth 2004, Siderov *et al.* 2006), but may not be appropriate when the area is revegetated with native species palatable to livestock. Cooke and Robertson (1990) reported use of sheep to reduce bridal creeper density prior to chemical control on Kangaroo Island, South Australia.

Fire Bridal creeper is not killed by bushfires unless the fire is very intense (Carr 1996, Yates 1997). It is usually one of the first species to emerge after a late summer or early autumn wild fire (France 1996, Graham and Mitchell 1996). Land managers are encouraged to take advantage of a wild fire and implement chemical control of emerging seedlings and regrowth in the burnt areas before regeneration of sensitive native species (Carr 1996, France 1996, Graham and Mitchell 1996). Access to infested areas for spraying is also considerably improved after a fire because most woody shrubs have usually been destroyed (Yates 1997). Willis *et al.* (2003) suggested use of fire in autumn, after most annual shoots have emerged, and post-fire application of herbicide on regrowth to maximize depletion of below-ground reserves. Application of glyphosate following a prescribed burn has been found to be the most effective initial control treatment against bridal creeper at two study sites in South Australia (Yates 1997). Although not yet investigated in the field, this strategy could significantly reduce bridal creeper infestations while stimulating germination of native species such as *P. spicata* (Willis *et al.* 2003). There is no contra-indication to use biological control for bridal creeper post-fire. Indeed, biological control agents are most likely to recolonize sites if they are present in unburnt nearby areas (Morin *et al.* 2006).

Revegetation Natural ecosystems may take many years to recover after an area is cleared of bridal creeper (Turner and Virtue 2006). Presence of bare ground after bridal creeper is controlled increases the likelihood of re-invasion by bridal creeper or other weeds. Land managers can either rely on natural recovery processes or actively revegetate controlled sites with indigenous species. Pike (1996) observed natural regeneration of native plants, such as *Hardenbergia comptoniana* (Andrews) Benth. and *Acacia pulchella* R.Br. in an area of the Boomerang Gorge where bridal creeper had been hand weeded.

Natural enemies

During 1996 and 1997, prior to the release of exotic biological control agents, 34 bridal creeper infested sites in Western Australia (each of approximately 100 m^2) were surveyed for presence of natural enemies (including a sample of about 100 leaves and fruits subsequently examined in the laboratory) (K.L. Batchelor and J.K. Scott unpublished results). Very little leaf damage and no fruit or seed damage were observed. Raymond (1995, 1999) found only two phytophagous species feeding on bridal creeper near one of her study sites in Victoria: the weevil *Phlyctinus callosus* Boheman and larvae of an unidentified Lepidoptera. Light brown apple moth (*Epiphyas postvittana* Walker) larvae were also seen eating ripe fruit pulp but not damaging seeds. Only one diseased specimen of bridal creeper infected by a *Phoma* sp. pathogen has been lodged in an Australian mycological herbarium before biological control was implemented (R. Shivas personal communication). Localized snail (*Helix aspersa* Müller) damage has been observed on bridal creeper foliage in the field (L. Morin personal observations).

Field surveys were initiated in South Africa in the late 1980s to identify natural enemies of bridal creeper and determine distribution, seasonal occurrence and impact of those with potential for biological control (Kleinjan and Scott 1990, Scott and Kleinjan 1991, Edwards 1995). Surveys encompassed the range of bridal creeper in South Africa, but mostly concentrated on regions of the Western Cape Province that are climatically similar to Australian infested areas.

Natural enemies associated with bridal creeper in South Africa are discussed in Kleinjan and Edwards (2006). Following extensive excavations, bridal creeper tubers and rhizomes were found to be relatively free of damage from natural enemies (Scott and Kleinjan 1991, Edwards 1995). The weevil *Brachycerus* sp. (Curculionidae) found on bridal creeper foliage may also feed on tubers in the larval stage but it has still not been observed in the field or laboratory (Kleinjan and Edwards 2006). Only two natural enemies, the moth *Zalaca snelleni* (Wallengren) (Noctuidae) and larvae of the wasp *Eurytoma* sp. (Eurytomidae), were observed feeding on fruits and seeds of bridal creeper (Edwards 1995, Kleinjan and Edwards 2006). *Eurytoma* sp. was imported into an Australian quarantine facility for host range testing in 1999, but rearing difficulties and host requirements when bridal creeper is not in seed remain to be resolved. Larvae of four moth species belonging to the Noctuidae (*Agrotis* sp., *Euplexia augens* Felder & Rogenhoven, *Lycophotia oliveata* (Hampson), *Cucullia terrensis* Felder & Rogenhoven) were collected on bridal creeper foliage and reared in the laboratory, but their specificity has not been investigated (Edwards 1995, Kleinjan and Edwards 2006). An unidentified cecidomyiid fly (Cecidomyiidae) observed producing galls on growing tips of bridal creeper and other African *Asparagus* spp. and a foliage-feeding flea beetle, *Hespera* sp. (Chrysomelidae), were not investigated further (Kleinjan and Edwards 2006).

Three other natural enemies that affect bridal creeper foliage were identified as having the greatest potential for biological control: an undescribed leafhopper, *Zygina* sp. (Cicadellidae), the rust fungus *Puccinia myrsiphyllii* (Theum) Wint. (Uredinales) and an undescribed leaf beetle, *Crioceris* sp. (Chrysomelidae) (Edwards 1995, Kleinjan and Edwards 2006). Field observations in South Africa and preliminary host-specificity tests in the laboratory revealed that these natural enemies had a narrow host range (Witt and Edwards 2000, 2002, Kleinjan *et al.* 2004b). Additional detailed host-specificity testing performed in containment facilities in Australia indicated limited risk of these agents towards non-target plant species (Scott *et al.* 1999, Morin 1999, Batchelor and Woodburn 2001). Based on these results, the leafhopper, rust fungus and leaf beetle were approved for release in 1999, 2000 and 2002, respectively (Morin *et al.* 2006).

The rust fungus strain released in Australia, a single-uredinium isolate made from infected material collected at Joubertsdal Farm near Swellendam in the winter-rainfall area of the Western Cape, only infects bridal creeper (Morin 1999). The leafhopper can only complete normal development on bridal creeper, although it can cause minor feeding damage on a few other species within and outside the *Asparagus* genus (Scott *et al.* 1999). Crop asparagus and the only native *Asparagus* species in Australia, *Asparagus racemosus* Willd., are not suitable hosts for the leaf beetle (Batchelor and Woodburn 2001). The biology, release, establishment and initial impact of biological control agents released in Australia are discussed in detail in Morin *et al.* (2006).

Although the rust fungus has already demonstrated its reliability and superiority in reducing density of bridal creeper populations across most of its range in Australia, it is likely to be complemented by the two invertebrate agents at some sites. For example, Turner *et al.* (2004) showed that a combined attack by the leafhopper and rust fungus resulted in an additive reduction to bridal creeper relative growth rate. The leaf beetle, if it establishes widely, should be active early in the growing season before populations of the other agents build up (Morin *et al.* 2006). It may also have a main role to play in inland areas where conditions are not optimal for the rust fungus.

The biological control program against bridal creeper has involved community groups, land managers and schools for redistributing the leafhopper and rust fungus to new sites to enhance natural spread across Australia (Batchelor and Woodburn 2002, Woodburn *et al.* 2002, Kwong 2002, Batchelor *et al.* 2004). Some community groups have redistributed the rust fungus using a method referred to as the 'spore water' approach, which involves application of spores suspended in water onto bridal creeper using standard spray equipment (Overton and Overton 2006). The redistribution program has also been embraced by citrus growers in Victoria and New South Wales, where agents can easily be integrated with other current pest management practices (Kwong and Holland-Clift 2004). On-ground implementation of the program has been supported by field days and a dedicated web site comprising protocols and a regularly updated map of release sites (Morin *et al.* 2006). Trials are underway to document the success of the program in controlling bridal creeper.

A combination of biological and chemical control with other weed management tactics such as fire may be necessary in some areas to tackle bridal creeper more effectively (Willis *et al.* 2003). No research has yet been carried out to devise a practical and effective strategy to integrate the different control methods available.

Acknowledgments

We gratefully acknowledge CSIRO, the Cooperative Research Centre for Weed Management Systems that operated from 1995 to 2002 and the current Cooperative Research Centre for Australian Weed Management for their continued support of studies relating to biological control of bridal creeper. The South Australian Animal and Plant Control Commission and the Australian and New Zealand Environment and Conservation Council (previously CONCOM) were instrumental in funding initial research on bridal creeper biological control. Recently the National Heritage Trust and the Department of Environment and Heritage have ensured continuation of the program. We also acknowledge the hundreds of community members who have contributed their time in the fight against this weed. We thank John Hosking (NSW Department of Primary Industries), Richard Groves (CSIRO Plant Industry), John Virtue (Animal & Plant Control Group Department of Water Land & Biodiversity Conservation Government of South Australia) and Dane Panetta (Queensland Department of Natural Resources and Mines) for comments on an earlier draft of the manuscript.

References

Adair, R.J. and Groves, R.H. (1998). 'Impact of environmental weeds on biodiversity: A review and development of a methodology'. (Environment Australia, Canberra).

Agriculture and Resource Management Council of Australia and New Zealand, Australia and New Zealand Environment and Conservation Council and Forestry Ministers. (2001). 'Weeds of National Significance: Bridal creeper (*Asparagus asparagoides*) strategic plan'. (National Weeds Strategy Executive Committee, Launceston).

Anon. (2005a). CalFlora: Information on California plants for education, research and conservation. [web application]. 2005. Berkeley, California: The CalFlora Database [a non-profit organization]. URL: http://calflora.org/ (accessed 29 November 2005).

Anon. (2005b). Bridal Creeper, *Myrsiphyllum asparagoides*. Tamar Valley Weed Strategy, Tasmania. URL: http://www.weeds.asn.au/weeds/txts/brdlcrpr.html (accessed 30 November 2005).

Anon. (2005c). Australian Government, Department of Agriculture, Fisheries and Forestry, Australian Quarantine and Inspection Service, Canberra URL:

http://www.daff.gov.au (accessed 16 December 2005).

Anon. (2005d). Noxious weed lists, Weeds Australia. John Thorp Australia, Launceston, Tasmania. URL: http://www.weeds.org.au/noxious.htm (accessed 16 December 2005).

Anon. (2005e). Permitted and quarantine species lists, Department of Agriculture, Western Australia, Perth. URL: http://www.agric.wa.gov.au (accessed 16 December 2005).

Anon. (2005f). Weeds, pest and diseases, Department of Primary Industries, Water and Environment, Tasmania. Hobart. URL: http://www.dpiwe.tas.gov.au (accessed 16 December 2005).

Anon. (2005g). Natural Resources Management Act 2004, Declaration of animals and plants. *The South Australian Government Gazette*, 30 June 2005.

Anon. (2005h). Weeds policy, legislation and strategy, NSW Department of Primary Industries – Agriculture. State of New South Wales. URL: http://www.agric.nsw.gov.au/ap/weeds/ (accessed 16 December 2005).

Anon. (2005i). Declared plants of Queensland, weeds and pest animal management, Department of Natural Resources and Mines. URL: http://www.nrm.qld.gov.au/pests/weeds/declared_plants (accessed 16 December 2005).

Anon. (2005j). Declaration of certain plants to be restricted weeds. Catchment and Land Protection Act 1994. *Victorian Government Gazette* G43 (27 October 2005), 2389.

Anon. (2006a). USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?4494 (accessed: 26 January 2006).

Anon. (2006b). Australia's Virtual Herbarium. Council of Heads of Australian Herbaria. URL: http://www.chah.gov.au/avh/ (accessed 31 January 2006).

Anon. (2006c). Pest plants and animals (Pest Plants) Declaration 2005 (No. 1). Disallowable instrument DI2005-256. ACT Legislation Register. URL: http://www.legislation.act.gov.au (accessed 17 January 2006).

Anon. (2006d). Declared weeds of the NT. The Department of Natural Resources, Environment and The Arts, Northern Territory. URL: http://www.nt.gov.au/nreta/naturalresources/weeds/weedslist.html (accessed 17 January 2006).

Arber, A. (1924). *Myrsiphyllum* and *Asparagus*: a morphological study. *Annals of Botany* 38, 635-59.

Batchelor, K.L., Morin, L., Swirepik, A. and Woodburn, T.L. (2004). Community involvement in the distribution of the biological control agents for bridal creeper, *Asparagus asparagoides*. Proceedings of the XI International Symposium on Biological Control of Weeds, eds J.M. Cullen, D.T. Briese, D.J. Kriticos, W.M. Lonsdale, L. Morin, and J.K. Scott, pp. 381-5. (CSIRO Entomology, Canberra).

Batchelor, K.L. and Woodburn, T.L. (2001). Application to release from quarantine *Crioceris* sp. (Coleoptera: Chrysomelidae), a biological control agent for *Asparagus asparagoides* (bridal creeper). A report for Biosecurity Australia (CSIRO Entomology, Perth).

Batchelor, K.L. and Woodburn, T.L. (2002). Community involvement in distributing the bridal creeper leafhopper *Zygina* sp., a biocontrol agent for bridal creeper, *Asparagus asparagoides*. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 453-5. (Plant Protection Society of WA Inc., Perth).

Beauglehole, A.C. (1988). 'The distribution and conservation of vascular plants in the north east area, Victoria'. (E. Davis and Sons Pty Ltd, Portland).

Bell, D.T., Moredoundt, J.C. and Loneragan, W.A. (1987). Grazing pressure by the tammar (*Macropus eugenii* Desm.) on the vegetation of Garden Island, Western Australia, and the potential impact on food reserves of a controlled burning regime. *Journal of the Royal Society of Western Australia* 69, 89-94.

Bodkin, F. (1986). 'Encyclopaedia Botanica: The essential reference guide to native and exotic species in Australia'. (Angus & Robertson, Sydney).

Bomford, M. and Hart, Q. (2002). Non-indigenous vertebrates in Australia. *In* 'Biological invasions: economic and environmental costs of alien plant, animal, and microbe species', ed. D. Pimentel, pp. 25-44. (CRC Press Inc., Boca Raton, USA).

Brookes, M. and Barley, R. (1992). Plants listed in nursery catalogues 1855 to 1889. (Ornamental Plant Collection Association, South Yarra).

Carr, B. (1996). Bridal creeper at Woodman Point – its current status and recommended control strategies. *Plant Protection Quarterly* 11, 67-9.

Clifford, H.T. and Conran, J.G. (1987). 2. *Asparagus*, 3. *Protasparagus*, 4. *Myrsiphyllum*. *Flora Australia* 45, 159-65.

Coles, R.B., Willing, K.L., Conran, J.G. and Gannaway, D. (2006). The identification and distribution of the western cape form of bridal creeper (*Asparagus asparagoides*) in the south east of South Australia and western Victoria. *Plant Protection Quarterly* 21, 104-8.

Conran, J.G. (1994). 4. *Myrsiphyllum*. *In* Flora of Victoria, Vol. 2, Ferns and allied plants, Conifers and Monocotyledons, eds N.G. Walsh and T.J. Entwisle, pp. 641-3. (Inkata Press, Melbourne).

Cooke, D.A. and Robertson, M. (1990). Bridal creeper, *Myrsiphyllum asparagoides*, in South Australia. Proceedings of the 9th Australian Weeds Conference, ed. J.W. Heap, pp. 113-5. (Crop Science Society of South Australia, Adelaide).

Cooper, J. and Warren, W. (2006). Tasmania and asparagus weeds: hanging in the balance. *Plant Protection Quarterly* 21, 117.

Courtot, Y. (1965). Recherches sur la morphologie, l'anatomie, la croissance et les mouvements revolufis de deux Liliacees: *Bulbine annua* et *Asparagus medeoloides*. *Annales Scientifiques Université de Besançon Botanique* 3, 5-98.

Dahlgren, R.M.T., Clifford, H.T. and Yeo, P.F. (1985). 'The families of the monocotyledons: structure, evolution and taxonomy'. (Springer Verlag, Berlin).

Davies, R.J.P. (1986). 'Threatened plant species of the Mount Lofty Ranges and Kangaroo Island regions of South Australia'. (Conservation Council of South Australia, Adelaide).

Davies, R.J.P. (1995). 'Threatened plant species management in National Parks and Wildlife Act Reserves in South Australia'. (Black Hill Flora Centre, Athelstone).

Davies, R.J.P. (2000). Description, distribution, conservation status and weed management of box and buloke grassy woodlands in South Australia. *In* 'Temperate eucalypt woodlands in Australia: biology, conservation, management and restoration', eds R.J. Hobbs and C.J. Yates, pp. 167-89. (Surrey Beatty & Sons, Chipping Norton, NSW).

Dixon, I.R. (1996). Control of bridal creeper (*Asparagus asparagoides*) and the distribution of *A. declinatus* in Kings Park Bushland, 1991–1995. *Plant Protection Quarterly* 11, 61-3.

Downey, P.O. (2006). The weed impact to native species (WINS) assessment tool – results from a trial for bridal creeper (*Asparagus asparagoides* (L.) Druce) and ground asparagus (*Asparagus aethiopicus* L.) in southern New South Wales. *Plant Protection Quarterly* 21, 109-16.

Druce, G.C. (1914). Supplement to botanical exchange club report for 1913. *Report of the Botanical Society and Exchange Club of the British Isles* 3(5), 411-5.

Edwards, P.B. (1995). Biological control of bridal creeper, *Myrsiphyllum asparagoides* – a review of research in South Africa. Weeds of conservation concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 22-6. (South Australia Department of Environment and Natural Resources, Animal and Plant Control Commission, Adelaide).

Esler, A.E. and Astridge, S.J. (1987). The naturalisation of plants in urban Auckland, New Zealand 2. Records of introduction and naturalisation. *New Zealand Journal of Botany* 25, 523-37.

Fellingham, A.C. and Meyer, N.L. (1995). New combinations and a complete list of *Asparagus* species in southern Africa (Asparagaceae). *Bothalia* 25, 205-9.

Fox, J. (1984). A comparison of two climbing plant species (one native and one exotic) at Woodman Point, Western Australia. *Western Australian Naturalist* 16, 11-5.

France, R. (1996). Observations and management of bridal creeper at Stokes National Park, Western Australia. *Plant Protection Quarterly* 11, 70.

Fukuda, T., Ashizawa, H., Suzuki, R., Ochiai, T., Nakamura, T., Kanno, A., Kameya, T. and Yokoyama, J. (2005). Molecular phylogeny of the genus *Asparagus* (Asparagaceae) inferred from plastid *petB* intron and *petD-rpoA* intergenic spacer sequences. *Plant Species Biology* 20, 121-32.

Graham, M.S. and Mitchell, M.D. (1996). Practical experiences in management for control of bridal creeper (*Asparagus asparagoides*) on nature reserves in the southern wheatbelt of Western Australia. *Plant Protection Quarterly* 11, 64-6.

Grant, M. (1996). Bridal creeper occurrence in Albany District. *Plant Protection Quarterly* 11, 71.

Groves, R.H. and Willis, A.J. (1999). Environmental weeds and loss of native plant biodiversity: some Australian examples. *Australian Journal of Environmental Management* 6, 164-71.

Guillarmod, A.J. (1971). 'Flora of Lesotho (Basutoland)'. (Verlag von J. Cramer, Lehre, Germany).

Hobbs, R.J. (1991). Disturbance a precursor to weed invasion in native vegetation. *Plant Protection Quarterly* 6, 99-104.

Holt, V. (2005). The impact of bridal creeper (*Asparagus asparagoides*) on ground-dwelling and leaf litter insect biodiversity. Honours Thesis, The University of Adelaide, Adelaide.

Horlock, J. (2005). The management and threat of weeds – a VicRoads perspective. *Plant Protection Quarterly* 20, 112-3.

Humphries, S.E., Groves, R.H., and Mitchell, D.S. (1991). Plant invasions of Australian ecosystems: a status review and management directions. *Kowari* 2, 1-134.

Jacobs, S.L.W. and Pickard, J. (1981). 'Plants of New South Wales, a census of the Cycads, Conifers and Angiosperms'. (Government Printer, Sydney).

Jessop, J.P. (1986). *Asparagus, Myrsiphyllum, Protasparagus*. *In* Flora of South Australia. Part IV. Alismataceae – Orchidaceae, eds J.P. Jessop and H.R. Toelken, pp. 1749-65. (South Australia Government Printing Division, Adelaide).

Keighery, G. (1996). Native, naturalized and cultivated Asparagaceae in Western Australia. *Plant Protection Quarterly* 11, 49-50.

Kleinjan, C.A. and Edwards, P.B. (1999). A reappraisal of the identification and distribution of *Asparagus asparagoides* in southern Africa. *South African Journal of Botany* 65, 23-31.

Kleinjan, C.A. and Edwards, P.B. (2006). *Asparagus* weeds in Australia – a South African perspective with emphasis on biological control prospects. *Plant Protection Quarterly* 21, 63-8.

Kleinjan, C.A., Edwards, P.B. and Hoffmann, J.H. (2004a). Impact of foliage feeding by *Zygina* sp. on tuber biomass and reproduction of *Asparagus asparagoides* (L.): relevance to biological control in Australia. *Biological Control* 30, 36-41.

Kleinjan, C.A., Morin, L., Edwards, P.B and Wood, A.R. (2004b). Distribution, host range and phenology of the rust fungus *Puccinia myrsiphylli* in South Africa. *Australasian Plant Pathology* 33, 263-71.

Kleinjan, C.A. and Scott, J.K. (1990). Preliminary observations on the natural enemies of southern African Asparagaceae. Proceedings of the 9th Australian Weeds Conference, ed. J.W. Heap, p. 479. (Crop Science Society of South Australia, Adelaide).

Kloot, P.M. (1986). Checklist of the introduced species naturalized in South Australia. *Department of Agriculture South Australia Technical Paper* 14, 1-111.

Kwong, R. (2002). Weed Warriors – increasing awareness of weeds in schools. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 442-5. (Plant Protection Society of WA Inc., Perth).

Kwong, R. and Holland-Clift, S. (2004). Biological control of bridal creeper, *Asparagus asparagoides* (L.) W.Wight, in citrus orchards. Proceedings of the 14th Australian Weeds Conference, eds B.M. Sindel and S.B. Johnson, pp. 329-32. (Weed Society of New South Wales, Sydney).

Kwong, R., Roberts, K. and Schneider, H. (2002). Bridal creeper – a serious weed of citrus orchards. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, p. 227. (Plant Protection Society of WA Inc., Perth).

Lawrie, S.L. (2004). Asparagus weeds research and management in South Australia. Proceedings of the 14th Australian Weeds Conference, eds B.M. Sindel and S.B. Johnson, pp. 203-6. (Weed Society of New South Wales, Sydney).

Le Cussan, J. (2006). Eradication of invasive alien plants on Lord Howe Island, New South Wales using three Asparagus species (*Asparagus asparagoides, A. plumosus, A. aethiopicus*) as a case study. *Plant Protection Quarterly* 21, 117-21.

Loyn, R.H. and French, K. (1991). Birds and environmental weeds in south-eastern Australia. *Plant Protection Quarterly* 6, 137-49.

Malcomber, S.T. and Demissew, S. (1993). The status of *Protasparagus* and *Myrsiphyllum* in Asparagaceae. *Kew Bulletin* 48, 63-78.

McQuinn, D.J. (1994). Chemical control of bridal creeper in South Australia. Results of field trials on Yorke Peninsula and Upper S.E. Managing weeds for Landcare 1994: a workshop on protecting our land from invading weeds, compiler R.J. Carter, p. 6. (South Australia Animal and Plant Control Commission, Adelaide).

Meney, K., Dixon, B. and Moonie, P. (2002). Control of bridal creeper *Asparagus asparagoides* on Kings Park Scarp and limiting factors on its growth and spread. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 113-6. (Plant Protection Society of WA Inc.).

Morin, L. (1999). Application for release of the rust fungus, *Puccinia myrsiphylli*, for the biological control of bridal creeper, *Asparagus asparagoides* (Asparagaceae). A report for Biosecurity Australia. (CSIRO Entomology, Canberra).

Morin, L., Neave, M., Batchelor, K. and Reid, A. (2006). Biological control: a promising tool for managing bridal creeper in Australia. *Plant Protection Quarterly* 21, 69-77.

Mulvaney, M.J. (1991). Far from the garden path: an identikit picture of woody ornamental plants invading south-eastern Australian bushland. Ph.D. Thesis, Australian National University, Canberra.

Obermeyer, A.A. (1984). Revision of the genus *Myrsiphyllum* Willd. *Bothalia* 15, 77-88.

Obermeyer, A.A. (1992). 2. *Myrsiphyllum*. *Flora of Southern Africa* 5, 71-82.

Overton, D. and Overton, B. (2006). The development of 'spore water' on Kangaroo Island for rapid spread of bridal creeper rust fungus. *Plant Protection Quarterly* 21, 77-8.

Parsons, W.T. and Cuthbertson, E.G. (2001). 'Noxious weeds of Australia', second edition. (CSIRO Publishing, Collingwood, Victoria).

Pheloung, P.C. and Scott, J.K. (1996). Climate-based prediction of *Asparagus asparagoides* and *A. declinatus* distribution in Western Australia. *Plant Protection Quarterly* 11, 51-3.

Pigott, J.P. and Farrell, P. (1996). Factors affecting the distribution of bridal creeper (*Asparagus asparagoides*) in the lower south-west of Western Australia. *Plant Protection Quarterly* 11, 54-6.

Pigott, J.P. and Lund, D.J. (1996). Improved mapping and useability of weed location data recorded by a GPS – distribution of bridal creeper (*Asparagus asparagoides*) in the Wickepin Shire of Western

Australia. *Plant Protection Quarterly* 11, 57-8.

Pike, D. (1996). Boomerang Gorge bridal creeper project. *Plant Protection Quarterly* 11, 72-3.

Pritchard, G.H. (1991). Control of bridal creeper with herbicides. *Plant Protection Quarterly* 6, 126.

Pritchard, G.H. (1995). Review of existing control measures for bridal creeper. Weeds of conservation concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 50-7. (South Australia Department of Environment and Natural Resources, Animal and Plant Control Commission, Adelaide).

Pritchard, G.H. (1996). Bridal creeper control with herbicides. Proceedings of the 11th Australian Weeds Conference, ed. R.C.H. Shepherd, pp. 424-7. (Weed Science Society of Victoria, Melbourne).

Pritchard, G.H. (2002). Evaluation of herbicides for the control of the environmental weed bridal creeper (*Asparagus asparagoides*). *Plant Protection Quarterly* 17, 17-26.

Quarmby, J. (2005). Draft recovery plan for twelve threatened orchids in the Lofty Block region of South Australia 2005–2010. Department for Environment and Heritage, South Australia, Adelaide.

Randall, R.P. and Lloyd, S.G. (2002). Weed warning from downunder – the weed potential of selected South African plants in cultivation in California. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 192-5. (Plant Protection Society of WA Inc., Perth).

Raunkiaer, C. (1934). 'The life forms of plants and statistical plant geography'. (Oxford University Press, London).

Raymond, K.L. (1995). The autecology of bridal creeper – how does it work? Weeds of conservation concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 17-21. (South Australia Department of Environment and Natural Resources, Animal and Plant Control Commission, Adelaide).

Raymond, K.L. (1996). Geophytes as weeds: bridal creeper (*Asparagus asparagoides*) as a case study. Proceedings of the 11th Australian Weeds Conference, ed. R.C.H. Shepherd, pp. 420-3. (Weed Science Society of Victoria Inc., Melbourne).

Raymond, K.L. (1999). Ecology of *Asparagus asparagoides* (bridal creeper), an environmental weed of southern Australia. PhD Thesis, Monash University, Clayton, Victoria.

Robertson, M. (1983). Bridal creeper (*Asparagus asparagoides* (L.) Wight) in southern Australian bushland. Management of weeds in recreational areas, particularly bushland and national parks: Proceedings of a workshop, eds G.M. Rowberry and P.M. Kloot, pp. 19-24. (Department of Agriculture and N.P.W.S., Adelaide).

Roy, B., Popay, I., Champion, P., James, T. and Rahman, A. (2004). 'An illustrated guide to common weeds of New Zealand', 2nd edition. (New Zealand Plant Protection Society, Auckland).

Scott, J.K. (1995). Bridal creeper, *Myrsiphyllum asparagoides*: the past, future and relations. Weeds of Conservation Concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 11-6. (Department of Environmental and Natural Resources and Animal and Plant Control Commission, Adelaide).

Scott, J.K. and Batchelor, K.L. (2006). Climate-based prediction of potential distribution of introduced *Asparagus* species in Australia. *Plant Protection Quarterly* 21, 91-8.

Scott, J.K., Batchelor, K. and Woodburn, T. (1999). Application for release from quarantine of *Zygina* sp., a biological control agent for *Asparagus asparagoides* (bridal creeper). (CSIRO Entomology, Perth).

Scott, J.K. and Kleinjan, C.A. (1991). Bridal creeper (*Myrsiphyllum asparagoides*) in Australia and developments towards its biological control. *Plant Protection Quarterly* 6, 116-9.

Scott, J.K. and Pigott, J.P. (1993). Distribution of bridal creeper (*Myrsiphyllum asparagoides*) in Western Australia. Proceedings of the 10th Australian and 14th Asian-Pacific Weeds Conference Papers, Vol II, pp 86-9. (Weed Science Society of Queensland, Brisbane).

Shafer, W.E. and Garrison, S.A. (1986). Allelopathic effects of soil incorporated asparagus roots on lettuce, tomato and asparagus seedling emergence. *HortScience* 21, 82-4.

Shepherd, R.C.H., Richardson, R.G. and Richardson, F.J. (2001). 'Plants of importance to Australia: a checklist'. (R.G. and F.J. Richardson, Meredith, Victoria).

Siderov, K. and Ainsworth, N. (2004). Invasion of bridal creeper (*Asparagus asparagoides*) in a remnant vegetation patch: methodology and initial results. Proceedings of the 14th Australian Weeds Conference, eds B.M. Sindel and S.B. Johnson, pp. 115-8. (Weed Society of New South Wales, Sydney).

Siderov, K., Ainsworth, N., Lowell, K.E. and Bellman, C. (2005). Modelling the recent invasion of a remnant reserve by the bird-dispersed weed *Asparagus asparagoides* (L.) W. Wight. Proceedings of SSC 2005 Spatial Intelligence, Innovation and Praxis: The national biennial conference of the Spatial Sciences Institute, eds C. Bellman, W. Cartwright and M. Shortis, pp. 471-80. (Spatial Sciences Institute, Canberra).

Siderov, K., Ainsworth, N., Lowell, K.E. and Bellman, C. (2006). An investigation of the invasion dynamics of *Asparagus asparagoides* at the habitat level using spatial analytical techniques. *Plant Protection Quarterly* 21, 85-8.

Sorensen, B. and Jusaitis, M. (1995). The impact of bridal creeper on an endangered orchid. Weeds of Conservation Concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 27-31. (Department of Environmental and Natural Resources and Animal and Plant Control Commission, Adelaide).

Stansbury, C.D. (1995). A biogeography of bridal creeper, *Myrsiphyllum asparagoides*: A case study within Yanchep National Park. Honours Thesis, Edith Cowen University, Perth.

Stansbury, C.D. (1996). Observations of birds feeding on bridal creeper (*Asparagus asparagoides*) fruits within Yanchep National Park, Western Australia. *Plant Protection Quarterly* 11, 59-60.

Stansbury, C.D. (1999a). Invasion criteria for the environmental weed bridal creeper, *Asparagus asparagoides* (L.) Wight, in south-west Australia. Geodiversity: Readings in Australian geography at close of the 20th century, eds J.A. Kesby, J.M. Stanley, R.F. McLean and L.J. Olive, pp. 73-87, Special Publication Series No. 6, School of Geography and Oceanography, University College. (Australian Defence Force Academy, Canberra).

Stansbury, C.D. (1999b). The invasiveness and biogeographical limits of the environmental weeds bridal creeper, *Asparagus asparagoides* and bridal veil, *A. declinatus* in south-western Australia. PhD Thesis, University of Western Australia, Perth.

Stansbury, C.D. (2001). Dispersal of the environmental weed bridal creeper, *Asparagus asparagoides*, by silvereyes, *Zosterops lateralis*, in south-western Australia. *Emu* 101, 39-45.

Stansbury, C.D. and Scott, J.K. (1999). The history, distribution and rate of spread of the invasive alien plant, bridal creeper, *Asparagus asparagoides* (L.) Wight, as determined from a questionnaire survey of landholders in south-western Australia. *Diversity and Distributions* 5, 105-16.

Stephens, C.J. (2005). Impacts of environmental weed invasion on arthropod biodiversity and associated community structure and processes. PhD Thesis, The University of Adelaide, Adelaide.

Stephens, C.J., Taylor, J.D. and Austin, A.D. (2003). Modification of insect-plant interactions: weed invasion and the pollination of an endangered orchid. *Records of the South Australian Museum* 7, 193-201.

Taylor, D.A. (2003). Draft recovery plan for 15 nationally threatened plant species on Kangaroo Island, South Australia. Environment Australia, Canberra.

Thorp, J.R. and Lynch, R. (2000). 'The determination of weeds of national significance'. (National Weeds Strategy Executive Committee, Launceston).

Turner, P.J. (2003). Interactions between an insect, a pathogen and their host plant, bridal creeper. Honours Thesis, University of Canberra, Canberra.

Turner, P., Morin, L., Williams, D. and Kriticos, D. (2004). Interactions between two biological control agents, an insect and a pathogen, and the response of their host. Proceedings of the 14th Australian Weeds Conference, eds B.M. Sindel and S.B. Johnson, p. 398. (Weed Society of New South Wales, Sydney).

Turner, P.J. and Virtue, J.G. (2006). An eight-year removal experiment measuring the impact of bridal creeper (*Asparagus asparagoides* (L.) Druce) and the potential benefit from its control. *Plant Protection Quarterly* 21, 79-84.

Valdés, B. (1980). 48. *Asparagus* L. *In* 'Flora Europaea. Vol. 5. Alismataceae to Orchidaceae (Monocotyledones)', eds T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters and D.A. Webb, pp. 71-3. (Cambridge University Press, Cambridge).

Wacker, T.L., Safir, G.R. and Stephenson, S.N. (1990). Evidence for succession of mycorrhizal fungi in Michigan asparagus fields. *Acta Horticulturae* 271, 273-8.

Wells, M.J., Balsinhas, A.A., Joffe, H., Engelbrecht, V.M., Harding, G. and Stirton, C.H. (1986). A catalogue of problem plants in southern Africa, incorporating the National Weed List of South Africa. *Memoirs of the Botanical Survey of South Africa* 53, 1-658.

Wight, W.F. (1909). No title given. The century dictionary and cyclopedia: A work of universal reference in all departments of knowledge, Vol. II., ed. B.E. Smith, p. 845. (The Times Book Club, London).

Williams, G. and Gerrand, D. (1998). 'Coastline survey of Asparagaceae and other environmental weeds in the Manning Valley, northern New South Wales'. (Coastcare and Greater Taree City Council, Taree, NSW).

Willis, A.J., McKay, R., Vranjic, J.A., Kilby, M.J. and Groves, R.H. (2003). Comparative seed ecology of the endangered shrub, *Pimelea spicata* and a threatening weed, bridal creeper: smoke, heat and other fire-related germination cues. *Ecological Management and Restoration* 4, 55-65.

Witt, A.B.R. and Edwards, P.B. (2000). Biology, distribution and host range of *Zygina* sp. (Hemiptera: Cicadellidae) a potential biological control agent for *Asparagus asparagoides*. *Biological Control* 18, 101-9.

Witt, A.B.R. and Edwards, P.B. (2002). Aspects of the biology, distribution, and host range of *Crioceris* sp. (Col.:Chrysomelidae: Criocerinae), a potential biological control agent for *Asparagus asparagoides* in Australia. *Biological Control* 23, 56-63.

Woodburn, T.L., Morin, L., Batchelor, K.L., Swirepik, A. and Armstrong, J. (2002). Enhancement of biological control of bridal creeper by using community as a resource. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 701-3. (Plant Protection Society of WA Inc., Perth).

Yates, E.J. (1997). Integrated management of bridal creeper (*Asparagus asparagoides*) in the Coorong region. Honours Thesis, The University of Adelaide, Adelaide.

Young, E. (1995). Report on a telephone survey of bridal creeper, *Myrsiphyllum asparagoides*, in heritage agreement areas in South Australia. Weeds of Conservation Concern: Seminar and workshop papers, eds D. Cooke and J. Choate, pp. 70-8. (Department of Environmental and Natural Resources and Animal and Plant Control Commission, Adelaide).