
Abridged report on the distribution of Western Cape Bridal creeper (*Asparagus asparagoides*) in South Australia and Victoria

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EXECUTIVE SUMMARY

Two forms of Bridal creeper (*Asparagus asparagoides*) are now known to exist in South Australia and Western Victoria. A Western Cape form (WC) and the common Bridal creeper (BC) were both introduced from South Africa. The WC form is a more robust weed and was first recognised in the South East and Western Victoria in 2003, it currently exists in the 650mm to 800mm annual average rainfall regions in the SE of South Australia and SW Victoria.

The WC form is demonstrating a resistance to the *Puccinia myrsiphyllii* rust fungus released in Australia as a biological control of the common bridal creeper. The implication of this field observation is that the WC form has the ability to reinfest environments cleared of the common form by the rust or other control measures. This weed has the potential to cause a second bridal creeper invasion.

Rural Solution South Australia (RSSA) completed a successful GPS mapping exercise to establish the range and density of the plant in the region. Infestations were recorded at over 224 locations totalling an area of approximately 40ha centred in three major “hot spots”. These are around the towns of Millicent, Port Mac Donnell and Nelson. The current known infestations in the South East are within the Hundreds:

- Caroline; at Donovans, Glenelg River and Dry Creek, Wild Dog and Honey suckle Flats in SA Forest reserves.
- Mac Donnell; near Port Mac Donnell, Brown Bay, Mount Schank and Allendale East.
- Kongorong; near Forest reserves 598, 421 and Corattum.
- Mount Muirhead and Mayurra; near Millicent and Canunda National Park
- Victoria near Oxbow Lake, west of Nelson and south east of Nelson at Millhouse Road. A low-density infestation was also recorded 15km ESE of Nelson in a pine plantation.

The weed appears to favour higher rainfall regions and is found in a band within 15 km of the coast. Complete control of the WC Bridal creeper is not feasible in many of these areas because of its establishment in native bushland. Herbicide trials currently being conducted by Forestry SA will determine the best chemical treatment and timing for effective control.

Factors influencing the spread, establishment and control of Western Cape Bridal creeper:

- the WC form has only been recognised in southern Australia in the last three years and may be a recent incursion;
- the WC form could have the potential to replace the common Bridal creeper form;
- current mapping has determined locations and levels of rust outbreaks on both forms of Bridal creeper;
- the mapping program has recorded negative finds that might indicate the potential areas where WC could spread;

EXECUTIVE SUMMARY

- future work might require accurate mapping of the WC form's control after the application of either herbicides or bio-control organisms.

Complete control of the WC Bridal creeper is not feasible in many of these areas because of the extent of its establishment. It is easier and more efficient in the long term to contain current infestations by focusing on new outbreaks, outliers, areas of low density and areas of easy access for chemical control (i.e., forestry reserves and some roadside vegetation). The benefits of successive eradication programs in these areas may prevent further spread of the weed. Herbicide trials currently being conducted by Forestry SA will determine the timing of treatments and best chemicals for eradication. It is recommended that low density, outlying, and invasive infestations be treated first, these include:

- Canunda National Park near Devils Gap
- Brown Bay
- Mount Schank
- Dry Creek
- Forest reserves 598,421 near Kongorong
- Roadside infestation near Corattum
- Clarke's Park Reserve near Port MacDonnell West and south east of Nelson (Vic)

A public awareness and education campaign was introduced to help identify and map the WC Bridal creeper's distribution in the SE of SA and SW Vic. Workshops were held with regional Animal and Plant Control Officers, Department of Environment and Planning, Forestry SA, Bush Care and revegetation groups and the Department of Primary Industries in Victoria.

The identification of WC Bridal creeper is based on its robust growth and a larger leaf with a leathery texture. The leaf colour is a darker green than the common form. The stem is also thicker and may appear to branch more prolifically. As the Western Cape form is sometimes found amongst common Bridal Creeper, it may stand out. If the common form is growing in ideal conditions, then the colour and leaf size may be similar. The best way of confirming the presence of the weed is to dig up the tubers. Follow the stem of a suspect plant to the ground and scratch away the soil. The WC Bridal creeper has larger tubers that are closer to the surface and grow horizontally in the soil. They are arranged in a rosette around the rhizome that grows downwards. The tubers of the Common Bridal creeper are smaller and grow deeper in soil.

Continued studies are recommended (in conjunction with CSIRO Entomology Canberra) on the seedling stage that is highly susceptible to the rust *Puccinia myrsiphylli*. This work has the potential to provide a way of reducing the spread of the weed. A 22% level of leaf rust infestation on the WC form was recorded in the mapping survey near Millicent and some plants also had high populations of leafhoppers. It is recommended that a study be completed on the ecology of this localised biocontrol activity. If strains of both organisms are found to be effective they may be successfully transferred to other locations.

Further studies (molecular) could determine whether *P. myrsiphylli* is influencing the establishment of the WC form in locations where both WC and Common BC occur in close proximity. Studies are also needed to assess the effectiveness of the beetle and leafhopper species of the control in the WC Bridal creeper.

1. INTRODUCTION

Two distinct forms of bridal creeper *Asparagus asparagoides* (L.) Druce are now recorded in the South East of South Australia and lower Western District of Victoria. Common bridal creeper (BC) is a widely distributed form of *A. asparagoides*, while the less common Western Cape (WC) form has recently been recorded in the South East of South Australia and SW Victoria. The precise known distribution of WC has been mapped and morphological features distinguishing it from common bridal creeper are described.

Bridal creeper (*Asparagus asparagoides* (L.) Druce Asparagaceae) is unusual amongst members of subgenus *Myrsiphyllum* in being both widespread and variable. At least two forms (Eastern and Western Cape) have been observed within the species (Obermeyer 1984), with Cooke and Robertson (1990) regarding the western form around Cape Town as an ecotype and the taxon most likely in South Australia. Kleinjan and Edwards (1999) reappraised these forms, mainly for southern Africa, finding a number of significant gross morphological differences, also concluding that the predominant Australian form was in fact the one from the eastern Cape. The distribution of the Western Cape form (WC) in South Africa was found to be restricted to the area where < 20% of the annual average rainfall occurs between the months of December to February (Kleinjan and Edwards, 1999). In these areas the climate is described as having “winter-rainfall”. In southern Australia the WC form has been located in areas of the South East of SA and the Western District of Victoria that match the “winter-rainfall” region of 13% of the total from December to February (Australian Government Bureau of Meteorology, www.bom.gov.au). The distribution of the common bridal creeper (BC) in South Africa includes winter-and summer-rainfall regions (Kleinjan et al., 2004).

Amateur botanist Kath Alcock of Naracoorte first collected seeds of the WC form from Clarke’s Point walk near Port Mac Donnell in June 2003. She illustrated the plant’s habit in a number of watercolour illustrations dating from 21/6/03. These include the flowers, fruits, and underground tuberous roots (see Figs. 1 to 4). She also succeeded in cultivating the WC form from seed; a single plant took 2 to 3 years to mature and produce fruit.

Recent field observations and anecdotal evidence indicates that the WC form has probably been growing in the SE for at least 6 to 7 years (D. Gannaway, pers.comm.). Both forms were probably introduced as ornamental plants and have spread to native bush habitats by birds feeding on the sticky red fruits; notably Silver Eyes, Currawongs, Black Birds, Wattle Birds and Emus (R. Johnson and T. Wynniat, pers. comm.). Foxes and rabbits have also been recorded spreading the seeds (Willis, 2000). WC invades native bush corridors, roadsides and nature reserves. New infestations occur under bird perching areas such as tall trees and fences lines. Occasionally, large numbers of seeds germinate beneath the climbing plants. In protected coastal dune systems, foxes eat ripe fruits and distribute seed in their faeces along runs and walking paths.

Puccinia myrsiphylli (Thuem.) Wint., a rust fungus of *A. asparagoides*, was isolated from plants in southern Africa and released in Australia in a biological control program by the CSIRO Canberra (Kleinjan et al, 2004). Since its release, the rust has been detected on common BC in many areas of South Australia. However, the WC form appears to be less

INTRODUCTION

susceptible to the phylloclade-infesting disease and could possibly replace the BC form (L. Morin, pers.comm.)

2. AIM AND OBJECTIVES

- Map known locations of Western Cape form of Bridal creeper (WC).
- Determine distribution limits of WC in the south east of South Australia and Western Victoria
- Implement a public awareness campaign about recognising the weed and reporting back locations via a mapping survey brochure.
- Locate incursion sites and search surrounding areas of a 1 km radius to detect other possible incursions.
- Recommend treatment of infestations of WC with herbicide to contain regional spread, (Forestry SA trials underway).

3. METHODOLOGY

3.1 MAPPING METHODS

Locations where the WC form was first identified by CSIRO were revisited from July to December 2005. The extent of infestations were mapped along transects at intervals of 100 m to 1000 m using a Trimble GeoExplorer XT GPS with settings: Datum Geocentric Datum of Australia (GDA) 94, Projection: Universal Transverse Mercator (UTM), Zone 54. Infestations were recorded either as a point, line or polygon shape, using a buffer radius of 1 or more metres for points and lines. Density cover was recorded as low (1-25 %), medium (25-50 %) or high (50-70 %). Organisms affecting the plants were recorded as limiters, (e.g., rust, leaf hoppers, beetles or snails). The land use on which plants occurred (i.e., roadside, reserve, grazing, residential or other) and the dominant overstorey (i.e., native, exotic or absent) were noted, as were reproductive features (i.e., flowering or fruits present). This data is presented in the Appendices. Mapping of the survey points was extended in a 1 km radius from any positive finds, with negative findings also being recorded.

3.2 MAPPING RECORDS

Land use: i.e., Roadside, Government Reserve, Private Reserve Grazing, Woodlot, Residential, Other.

Density cover: Low (1-25%), Medium (26-50%), High (51 to > 76%).

Location Number: Each location was allocated an infestation number, for Polygon and Line infestations a repeated infestation number was recorded.

Species: Records were made of Western Cape (WC), Common (BC) or both forms present. Absence of bridal creeper was recorded at certain locations.

Shape: Point and line records were given a buffer zone radius in metres, and subsequent polygon shapes were generated by a GIS program. Irregular Polygons were collected in the field using a GPS program.

Plants flowering or producing fruit:

Yes or No, determined by the presence of either flowers or fruit.

Overstorey Species:

Recorded the dominant overstorey group, i.e., native, exotic or both.

Comments: Any other comments and information such as presence of rust, leafhoppers, beetle damage, snails, plant age i.e., seedlings or mature, health of vegetation.

3.3 MORPHOLOGY OF BRIDAL CREEPER FORMS



Figure 1. Common Bridal creeper



Figure 2. Leaves and flowers of Western Cape form of Bridal creeper.

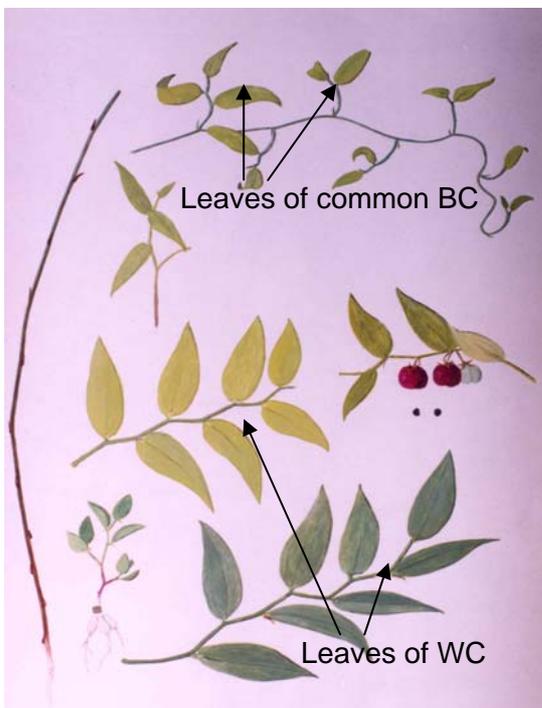


Figure 3. Leaves of Common and Western Cape form of Bridal creeper.

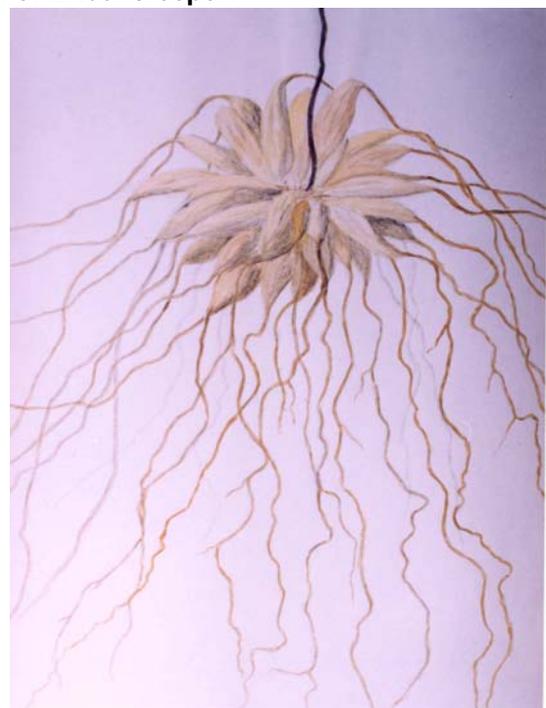


Figure 4. Tubers of Western Cape form of Bridal creeper.

4. RESULTS

4.1 **DISTRIBUTION OF WESTERN CAPE AND COMMON BRIDAL CREEPER FORMS**

The first set of locations of the Western Cape form of bridal creeper were provided by DWLBC via CSIRO, (Table 1.). These sites formed the target points from which to extend the survey.

Table 1. Locations of Western Cape Bridal creeper infestations in South Australia and Victoria, July 2005 (provided by CSIRO Entomology Canberra, July 2005).

Place	Description	Latitude	Longitude
Port MacDonnell (SA)	Past Dingley Dell	-38.0307596	140.4046632
Roadside	Cottage	-38.0217160	140.4055200
Donovan	Viewing Platform	-38.0024300	140.5716488
Donovan	Clarke's Park	-38.0307488	140.4049656
Donovan	Donovan's lookout	-37.5935160	140.5716920
Millicent	Millicent, Boandik Rd	-37.3594742	140.1919225
Nelson (Vic)	Millhouse Rd (1)	-38.04121159	141.0220284
	Millhouse Rd (2)	-38.04122135	141.0219422

The WC bridal creeper was recorded during the recent mapping survey in the following South Australian Hundreds:

- Caroline (at Donovans, Glenelg River and Dry Creek, Wild Dog and Honey suckle Flats in SA Forest reserves).
- MacDonnell (near Port MacDonnell, Brown Bay, Mount Schank and Allendale East).
- Kongorong (near Forest reserves 598, 421 and Corattum).
- Hundreds of Mount Muirhead and Mayurra (near (Millicent and Canunda National Park).

In Victoria the WC form was detected at Oxbow Lake, Nelson, east of Nelson at Millhouse Road and a in a pine plantation 15 km SE of Nelson.

4.1.1 REGIONAL MAP OF BRIDAL CREEPER INFESTATIONS

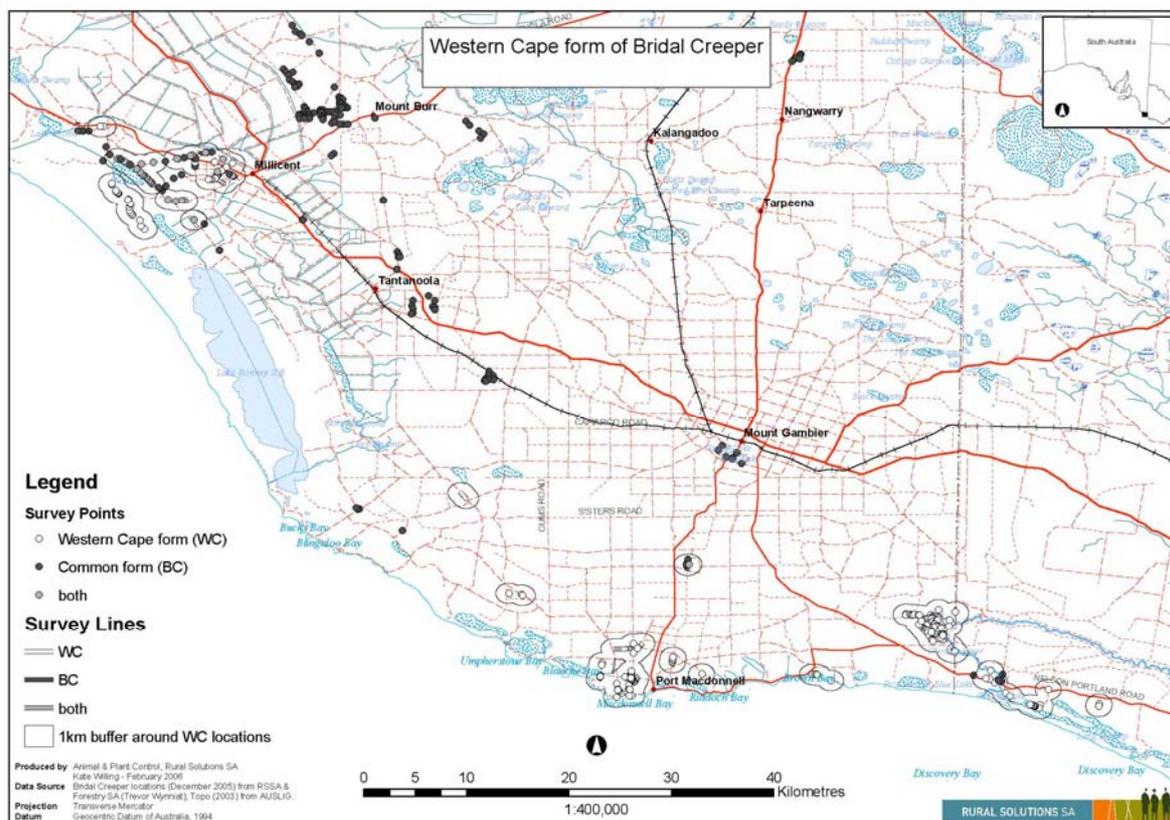


Figure 5. Lower South East regional map with locations of both Bridal creeper forms of *Asparagus asparagoides*.

BRIDAL CREEPER INFESTATION NEAR PORT MACDONNELL (SA)

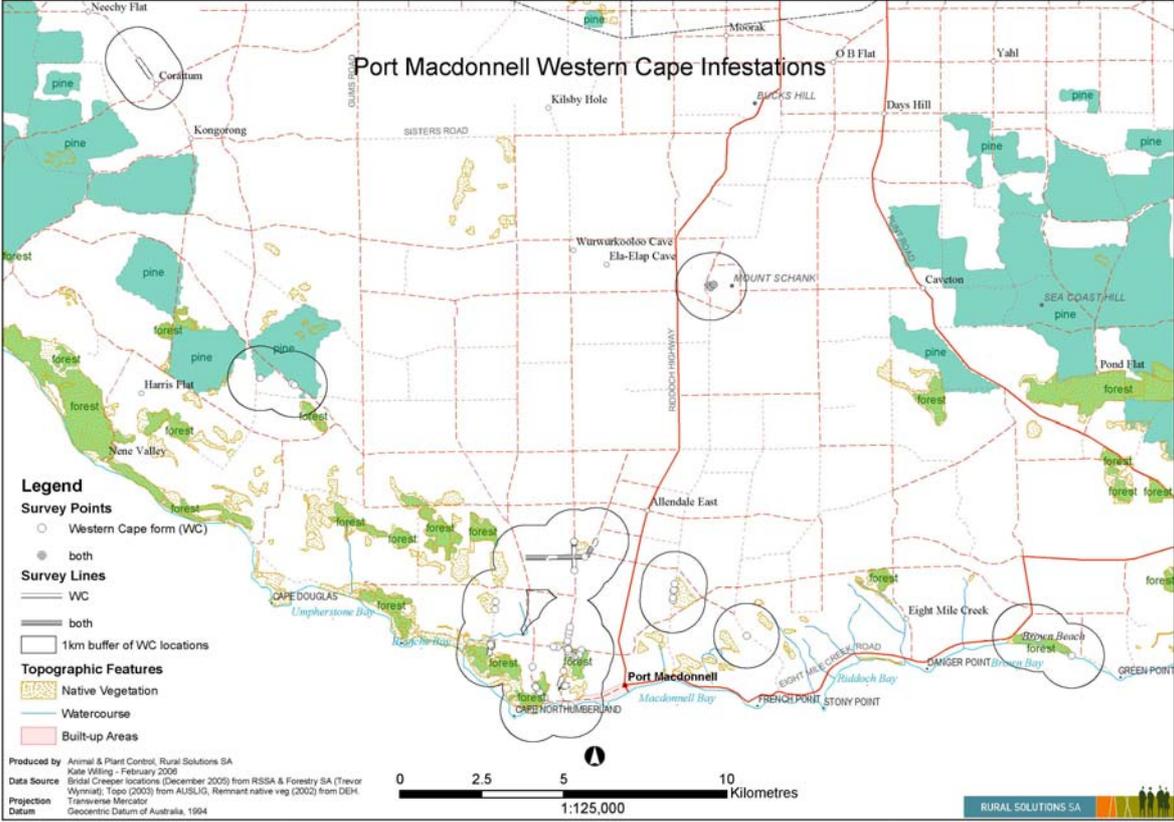


Figure 7. Western Cape and Common Bridal creeper infestations near Port MacDonnell.

BRIDAL CREEPER INFESTATIONS NEAR THE SOUTH AUSTRALIAN AND VICTORIAN BORDER

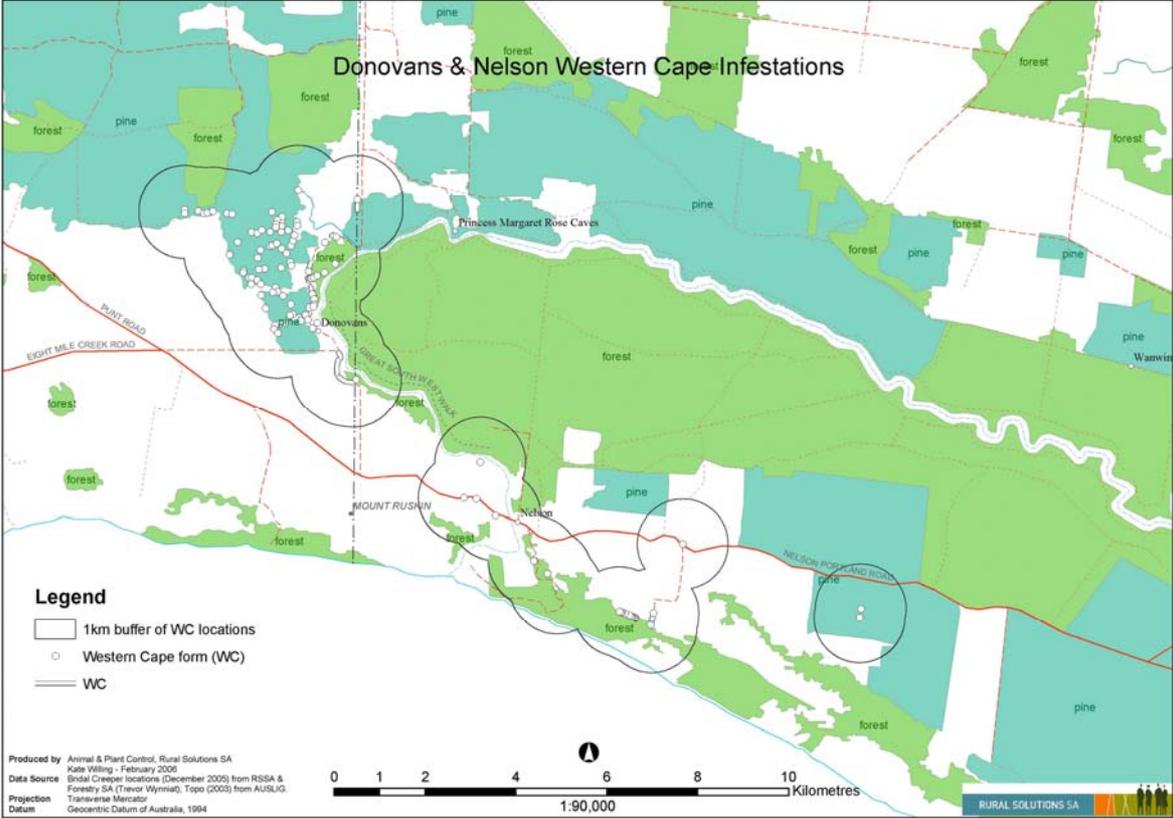


Figure 8. Western Cape Bridal creeper infestations near SA and VIC border.

5. DISCUSSION

There are clear, statistically significant, morphological and anatomical differences between WC and BC forms in South Australia and Victoria. A publication currently being prepared by the authors and other contributors outlines these differences and recommends that the WC bridal creeper be re-classified as a separate species from *A. asparagoides*. The main distinguishing features are summarised from a paper submitted to Pest Plant Quarterly, March 2006.

The distinguishing characters of WC and BC are not easily or directly visible to the naked eye on herbarium material, many of which lack tubers (a problem also noted by Obermeyer 1992 for South African collections). This makes the need to determine taxon boundaries based on living species in the field all the more important (Kleinjan and Edwards, 1999). Extensive field surveys within South Australia and Victoria have supported Kleinjan and Edwards's (1999) conclusion that the WC bridal creeper is a separate taxon from common BC within the *A. asparagoides* broad-phyloclade species complex (Obermeyer; 1992; Fellingham and Meyer 1995). Nevertheless, this may reflect founder effects due to only some variants reaching Australia and spreading here. Both forms have consistently been found to have a number of morphological characters that distinguish them apart. Separation is clearly based on tuber size (WC robust, BC slender), the phyloclade cuticle periclinal surface (WC finely rugose, BC smooth with irregular, scattered verrucae) and phyloclade marginal cell features (WC rounded dome-shaped to bullate, BC papillate). In addition, the flowers per phyloclade axil are 2-3 for WC and mainly solitary (sometimes paired) for BC. Developing fruits in transverse section are conspicuously 3-lobed and rounded for WC, but obscurely 6-lobed with the lobes flattened to only slightly rounded in BC.

Molecular studies in *Asparagus* have also found possible markers at the species level that might be useful for determining relationships between the different forms (Štajner et al. 2002, Fukuda et al. 2005), and there are already known to be differences in ITS (sequences between the *A. asparagoides* forms (L. Morin pers. comm.). Molecular studies on both WC and BC forms may also help to determine whether WC was an early, suppressed introduction that is now spreading as biocontrol of the BC form takes effect, or whether the former represents a recent incursion. The evidence that WC bridal creeper was introduced in the mid 1800s is compelling because some of the current infestations occur near ports that coincide with a history of shipping from overseas, i.e., locations such as Port Mac Donnell and Nelson. It was common practice for vessels to stop off at Cape Town in South Africa, unload cargo and take on soil as ship ballast. Seeds of both Bridal creepers could have been introduced into SA and Vic when ships unloaded soil ballast after reaching their destination. Along with the numerous ship wrecks occurring near the SE coast during the 1800s and early 1900s many opportunities have occurred for seed contaminated soil to be deposited near shore.

The spread of the WC Bridal creeper by vectors such as animals and birds can result in new infestations occurring rapidly over large areas. Seed extracted from emu dung in the Canunda National Park in SA has shown that individual birds regularly consume ripe fruits during summer (January/February 2006). Up to 579 seeds per dung pad can be deposited on bush paths. Similar observations have been made in the Forestry SA Reserve at Dry Creek (T. Wynniat, pers.comm., 2005).

The rust *P. myrsiphylli* was released in Australia for biological control by CSIRO (Kleinjan et al., 2004). Since its release the rust has been detected on BC in many areas of South

Australia. The WC bridal creeper is less susceptible to the bridal creeper rust fungus than the common form disease. At a site near Millicent, rust infestation measurements were made on plants estimated to be greater than three years old in September 2005. *P. myrsiphylli* pustules on the WC form showed 22 % of phylloclades infested with an area cover of 3.4 %, whilst the BC form had 96 % of phylloclades infested and an area cover of 9.2 % (Unpublished data, R. Coles). The difference in susceptibility of mature WC and BC plants to the rust *P. myrsiphylli* could be related to variations in the cuticle and epidermal cell structure. The WC leaf cuticle is smooth with large underlying isodiametric epidermal cells while the leaves of BC have a series of ridges or verrucae on the surface and smaller upright and rectangular epidermal cells. These different leaf structures near the stomata could affect moisture and humidity retention on the leaf surfaces and subsequently affect the microclimate in which rust spores germinate. This physical difference of the leaf surface for both forms might explain the low rust infectivity recorded in the field on the WC form.

The WC form has been located in areas of the South East of SA and Western Victoria that match the “winter-rainfall” region of its native range in South Africa (i.e., 13 % of the total rainfall from December to February and in the 650–800mm annual average rainfall). The distribution of WC bridal creeper was found to be within 15km from the coast, similar also to its native distribution.

In the SE of SA and SW Vic., WC bridal creeper persisted until the beginning of February 2006, while common BC senesced or was affected by rust. The prolonged survival of WC enabled mapping to be extended to a later stage after common BC had died back. This shows the vigorous nature of WC compared to common BC.

Amateur botanists have observed new WC infestations establishing near Millicent in areas where the rust had been introduced to control BC. Further studies could determine whether *P. myrsiphylli* released in 2000 is influencing the establishment of WC form in locations where both WC and BC occur in close proximity. Studies are also needed on the WC Bridal creeper to assess the effectiveness of the beetle (*Crioceris* sp) released in 2002 and leafhopper (*Zygina* sp) released in 1999 previously introduced to control BC (Batchelor and Woodburn 2002a,b).

6. SUMMARY

There are clear, statistically significant morphological and anatomical differences between WC and BC forms in South Australia and Victoria. Extensive field surveys within South Australia and Victoria have supported Kleinjan and Edward's (1999) conclusion that the WC form is a separate taxon from the BC form. Both forms have consistently been found to have a number of morphological characters that distinguish them apart. Separation is clearly based on tubers size, i.e., Western Cape **robust**, (Elongated tubers near the soil surface, average diameter 43.2 ± 13.6 mm, up to 73 mm long) Common Bridal creeper form **slender**, (Smaller, elongate to spherical tubers, average diameter 22.5 ± 2.6 mm, up to 42 mm long).

The rust, *Puccinnia myrisphylii* was released by CSIRO Canberra as a biocontrol organism for common BC. It was recently found on WC infestations near Millicent, the plants estimated to be greater than three years old were less susceptible to infection than BC. For example mature plants of WC had a 22% infection while mature common BC plants had 96% infection. In contrast the seedlings of Western Cape Bridal creeper were found to be highly susceptible to rust infection in trials conducted by CSIRO Canberra (L. Morin pers.comm.).

Distribution of WC bridal creeper was confined to southern Australia in the lower South East of SA and western Vic. 296 sites in 224 locations covering an area of approximately 40ha with WC were recorded in the survey during July 2005 to February 2006. WC bridal creeper was not found any further north than Rendlesham and extended 15km in land from the coast. Three areas with high levels of infestation were recorded in the SE, i.e., (1) Millicent where both forms of BC and WC were frequently recorded growing together (2) Port Mac Donnell and (3) Donovans where the WC form was dominant in these regions. In Vic. WC form was occasionally found on roadsides 11km east of the SA border. It was also found in the township of Nelson and north towards the Glenelg River. A high-density infestation was recorded 3km SE of Nelson in a coastal tea tree forest off Millstead Road. Low-density populations were found in pine plantations 8km SSE of Nelson and 2.5km north of the coast.

Eight significant infestations of WC bridal creeper (see Conclusions and Recommendations) are recorded as having the highest priority to control. These infestations occur in national parks, bush reserves, along roadsides and in pine plantations.

7. CONCLUSIONS AND RECOMMENDATIONS

The WC bridal creeper was found to be far more widespread than the original six locations described by CSIRO Entomology in July 2005. WC bridal creeper was recorded in the recent mapping survey at 294 separate locations consisting of 177 WC points, 45 WC lines and 2 WC polygons = 224 WC locations. Forestry SA collected 70 WC points in Caroline forest. The locations are listed in the South Australian Hundreds:

- Caroline: at Donovans, Glenelg River and Dry Creek, Wild Dog and Honey suckle Flats in SA Forest reserves.
- MacDonnell: near Port MacDonnell, Brown Bay, Mount Schank and Allendale East.
- Kongorong: near Forest reserves 598, 421 and Corattum.
- Mount Muirhead and Mayurra: near Millicent and Canunda Nation Park.
- In Victoria near Oxbow Lake, west of Nelson and south east of Nelson at Millhouse Road.
- Low density infestations were also recorded 15km SSE of Nelson in a pine plantation.

Complete control of the WC bridal creeper is not feasible in many of these areas because of the extent of its establishment. The benefits of long-term management programs in these areas may prevent further spread of the weed. Herbicide trials currently being conducted by Forestry SA will determine the timing of treatment and best chemical control measures. It is recommended that low density infestations worthwhile treating include:

- Cannunda Nation Park near Devils Gap (Fig. 6);
- Brown Bay (Fig.7);
- Mount Schank (Fig. 7);
- SA Forest reserves 598 and 421 near Kongorong (Fig. 7);
- Roadside infestation near Corattum (Fig. 7);
- Clarke's Park Reserve near Port MacDonnell (Fig. 7);
- Dry Creek (Fig. 7);
- West and south east of Nelson, Vic. (Fig. 7).

Continued studies are recommended (in conjunction with CSIRO, Entomology Canberra) on the seedling stage that is highly susceptible to the rust *P. myrsiphylli*, that might have potential as a biological control organism in reducing the spread of the weed. A 22% level of leaf rust infestation was recorded in the mapping survey near Millicent with some plants also having high populations of leafhoppers. It is also recommended that a study be undertaken on the ecology of this localised biological control activity. If strains of both organisms are found to be effective they might be successfully transferred to other locations.

Further studies would determine if *P. myrsiphylli* is influencing the establishment of the WC form in locations where both WC and common bridal creeper occur together. Studies are also needed to assess the effectiveness of the beetle and leafhopper species of the control of the WC bridal creeper.

GLOSSARY

APC. Animal and Plant Control

Buffer zone. A neutral area that separates and minimises interactions between zones whose management objectives are significantly different or in conflict (e.g. a vegetated riparian zone can act as a buffer to protect the water quality and streams from adjacent land uses).

Bullate. Having bubble-or blister-like swellings.

District Plan. (District Soil Conservation Plan) An approved soil conservation plan under the repealed *Soil Conservation Act 1989*. These plans are taken to form part of the relevant regional NRM plans under the transitional provisions of the *Natural Resources Management Act 2004* (Schedule 4 –).

DEH. (Department of Environment and Heritage)

DPI. Department of Primary Industries

DWLBC. Department of Water, Land and Biodiversity Conservation. Government of South Australia.

Erumpent. Bursting through the surface or substratum.

Ecology. The study of the relationships between living organisms and their environment.

GIS (geographic information system). Computer software allows for the linking of geographic data (for example land parcels) to textual data (soil type, land value, ownership). It allows for a range of features, from simple map production to complex data analysis.

Habitat. The natural place or type of site in which an animal or plant, or communities of plants and animals, lives.

ITS. Internally transcribed spacer region of ribosomal DNA

Lake. A natural lake, pond, lagoon, wetland or spring (whether modified or not) and includes: part of a lake; and a body of water declared by regulation to be a lake; a reference to a lake is a reference to either the bed, banks and shores of the lake or the water for the time being held by the bed, banks and shores of the lake, or both, depending on the context.

Land. Whether under water or not and includes an interest in land and any building or structure fixed to the land.

Natural Resources Management (NRM). All activities that involve the use or development of natural resources and/or that impact on the state and condition of natural resources, whether positively or negatively.

Pasture. Grassland used for the production of grazing animals such as sheep and cattle.

Periclinal. Parallel to the surface.

Phylloclade. Green flattened photosynthetic stem.

PIRSA. (Department of) Primary Industries and Resources South Australia.

Pustules. A blister like, erumpent, spot or spore-mass.

Rugose. With many ridges or wrinkles.

Verrucose. Having small rounded processes or 'warts'.

Winter-rainfall region. A region where the percentage of the annual rainfall is less than 20% of the total that falls in the three summer months, December to February.

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