

Review of the current taxonomic status and authorship for *Asparagus* weeds in Australia

Kathryn L. Batchelor and John K. Scott, CSIRO Entomology, Private Bag 5, PO Wembley, Western Australia 6913, Australia.
Email: kathryn.batchelor@csiro.au, john.k.scott@csiro.au

Summary

Over the last 20 years, many scientific papers and reports have been produced outlining the establishment, distribution and weed status of *Asparagus* weeds in Australia. Differing use of authorship and species names are present in this literature resulting in confusion over which species are actually present. This paper examines the taxonomic status and authorship of the eight *Asparagus* species naturalized in Australia: *A. aethiopicus* L., *A. africanus* Lam., *A. asparagoides* (L.) Druce, *A. declinatus* L., *A. officinalis* L., *A. plumosus* Baker, *A. scandens* Thunb., and *A. virgatus* Baker. *Asparagus asparagoides* is found in two forms, one with a widespread distribution and a second form, currently of restricted distribution in South Australia and Victoria. There are at least nine other *Asparagus* species in cultivation or present in Australian herbariums, but they are not known to be naturalized in bushland. Clarification of the nomenclature of *Asparagus* species and a better understanding of the phylogeny within the family will assist in the management and policy decisions on weed control for each species, for example, the nomination of various *Asparagus* species as target species for biological control.

Introduction

The family Asparagaceae consists of one genus, *Asparagus*, under current taxonomic revisions and includes approximately 120 species mostly of southern African, European and Asian origin. Australia has one native species, *Asparagus racemosus* Willd., located in far northern Queensland, Northern Territory and northern Western Australia, which has a distribution that extends to north-eastern South Africa, northern Botswana and Namibia. All other Asparagaceae in Australia are introduced from southern Africa and Europe (one species, *A. officinalis* L., crop asparagus). At least eight of these species have naturalized in southern and/or central eastern Australian bushlands where they have become environmental weeds. This paper summarizes the taxonomy of *Asparagus* species naturalized in Australia and identifies issues that require further research.

Systematic taxonomy of genera within the Asparagaceae

The debate over whether the Asparagaceae contains one genus *Asparagus* with or without subgenera, or up to 16 separate genera has been going for over 200 years. The taxonomic history of the Asparagaceae is well covered in recent papers. Clifford and Conran (1987a,b,c) follow Obermeyer's (1983) treatment of the southern African Asparagaceae species and use the three genera *Asparagus*, *Myrsiphyllum* and *Protasparagus* for Asparagaceae species in Australia. Malcomber and Sebsebe Demissew (1993) determined that the characters used to separate *Protasparagus* and *Asparagus* were insufficient and they should both be treated as the sub-genus *Asparagus* under the genus *Asparagus*, with *Myrsiphyllum* Willd. also retained as a sub-genus. Fellingham and Meyer (1995) agreed with Malcomber and Sebsebe Demissew (1993), but found the characters used to warrant *Myrsiphyllum*'s sub-generic status to be inconsistent and returned all southern African species to the genus *Asparagus* with no sub-genera. All subsequent papers on *Asparagus* have followed Fellingham and Meyer's (1995) treatment. Generally the family Asparagaceae is considered to comprise the one genus *Asparagus* (Kleinjan and Edwards 1999). However, *Hemiphyllacus*, a small Mexican genus, is possibly included in the family based on recent evidence from embryology, cytology and molecular analyses (Rudall *et al.* 1998).

Evidence from molecular phylogeny

Three studies have examined the molecular phylogeny of *Asparagus* species, however two of the studies only included a small number of species. Lee *et al.* (1997) examined the phylogenetic relationships of 10 species in the genus *Asparagus* using chloroplast DNA. Their research raises the possibility that dioecy and polyploidy in the *Asparagus* is monophyletic in origin, but they concede variability in nuclear DNA and the inclusion of many more *Asparagus* species is required to further understand the taxonomy and evolution of this genus. Stajner *et al.* (2002) examined the nuclear genome size and genetic similarity of 10 species of *Asparagus* based on their potential application for cross-breeding with crop asparagus, *Asparagus officinalis*. They found the European

dioecious species examined had on average twice the genome size of the South African hermaphroditic species and, based on internal transcribed spacers of nuclear ribosomal DNA, the species can be divided into two clusters, one of European species and the other of southern Africa species.

Both Lee *et al.* (1997) and Stajner *et al.* (2002) did not use outgroup taxa in their analyses. This issue and a larger sample size (24 species) were addressed in a study by Fukuda *et al.* (2005) of the molecular phylogeny of *Asparagus* inferred from plastid *petB* intron and *petD-rpoA* intergenic spacer sequences. They found evidence supporting a monophyletic origin of *Asparagus* and the sub-division of *Asparagus* into more than three groups. The Eurasian species of *Asparagus* formed a monophyletic group, whereas the southern African species are potentially paraphyletic, comprising more than the two groups (*Myrsiphyllum* e.g. *A. asparagoides* (L.) Druce and *Protasparagus* e.g. *A. plumosus* Baker and *A. aethiopicus* L.) that are currently recognized in some taxonomic treatments. *A. asparagoides* is the most different from all other *Asparagus* species. The Australian native, *A. racemosus* is most similar to southern African species.

Current taxonomy of *Asparagus* weeds in Australia

Asparagus aethiopicus L.

SYNONYMS: *Protasparagus aethiopicus* (L.) Oberm., *Asparagus lanceus* Thunb., *Asparagus sprengeri* Regel

CULTIVARS: 'Sprengeri'

COMMON NAMES: Sprengers fern, asparagus fern.

NATIVE DISTRIBUTION: Western and Eastern Cape regions of South Africa.

DISTRIBUTION IN AUSTRALIA: Coastal northern New South Wales (inc. Lord Howe Island) and southern Queensland, South Australia and Western Australia.

NOTES: In Green's (1986) examination of the correct name for *A. sprengeri*, listed as a synonym of *A. densiflorus* by Jessop (1966), he found the species to be a cultivar of *A. aethiopicus* and not *A. densiflorus*. Green's (1986) assessment was not reflected in Obermeyer and Immelman's (1992) review of southern African Asparagaceae where they list *A. densiflorus* as having two cultivars – 'Sprengeri' and 'Myersii'. Following Green (1986), the name *A. densiflorus* is no longer current in Australian Herbaria, but the species does exist in cultivation as *A. densiflorus* cv 'Myersii'. However, the climate-based prediction for *A. aethiopicus* and *A. densiflorus* (Kunth) Jessop indicates that Australian material might be more appropriately named *A. densiflorus*.

Asparagus africanus Lam.

SYNONYMS: *Protasparagus africanus* (Lam.) Oberm.

COMMON NAMES: Asparagus fern
 NATIVE DISTRIBUTION: Coastal Western Cape, Eastern Cape and KwaZulu-Natal regions of South Africa.
 DISTRIBUTION IN AUSTRALIA: Coastal South-east Queensland where it is a serious weed (Conran and Forster 1986).
 NOTES: Obermeyer and Immelman (1992) describe *A. africanus* as 'up to 0.6 m or more high'. Australian material appears to be much larger implying that it would be worthwhile verifying the identification. It is likely that *A. africanus*, being found in both Mediterranean and subtropical climates in southern Africa (Obermeyer and Immelman 1992), will need to be re-examined as it may contain more than one species.

Asparagus asparagoides (L.) Druce
 SYNONYMS: *Medeola asparagoides* L., *Myrsiphyllum asparagoides* (L.) Willd., *Asparagus medeoloides* Thunb., *Elide asparagoides* (L.) Kerguelen, *Dracaena medeoloides* L.f., *Elachanthera sewelliae* F.Muell., *Luzuriaga sewelliae* (F.Muell.) K.Krause.

COMMON NAMES: Bridal creeper, bridal veil creeper, florist's smilax, smilax.

NATIVE DISTRIBUTION: Widespread in the Western Cape, Eastern Cape, KwaZulu-Natal region extending to the Northern Province. Also recorded in Namibia and tropical Africa.

DISTRIBUTION IN AUSTRALIA: Widespread in southern Western Australia, South Australia, Victoria, northern Tasmania, sporadic throughout coastal, central and south-west irrigated regions of New South Wales.

NOTES: There is currently no taxonomic distinction between the widespread form of *Asparagus asparagoides* and the south-western Cape form as described by Kleinjan and Edwards (1999) and discussed in Coles *et al.* (2006). Further research on the two forms is required to determine if they are two different species.

Most recent scientific papers incorrectly assign the authorship of *A. asparagoides* to W. Wight. The correct authorship is *A. asparagoides* (L.) Druce, as W. Wight, a contributor to the 1909 Century Dictionary and Cyclopaedia, lists *A. asparagoides* under the genus *Myrsiphyllum* in the context of the treatment by Baker (1875), where *A. asparagoides* is in the sub-genus of *Myrsiphyllum* (Willd.) Baker. Druce (1914) made the first new combination of *A. asparagoides*, based on *Medeola asparagoides* from Linnaeus (1753).

Asparagus declinatus L.

SYNONYMS: *Myrsiphyllum declinatum* (L.) Oberm., *Asparagus crispus* Lam., *Asparagus flexuosus* Thunb., *Asparagus decumbens* Jacq., *Asparagopsis decumbens* (Jacq.) Kunth

COMMON NAMES: Bridal veil, bridal veil creeper, bridal creeper.

NATIVE DISTRIBUTION: Western edge of the Western Cape and Northern Cape regions of South Africa.

DISTRIBUTION IN AUSTRALIA: South-west Western Australia, South-west and south-central South Australia (including Kangaroo Island).

Asparagus officinalis L.

CULTIVARS: examples 'Mary Washington', 'Edulis', 'Purple Passion', 'Atlas', 'Jersey Giant' 'UC157'.

COMMON NAMES: Asparagus, crop asparagus, garden asparagus, edible asparagus.

NATIVE DISTRIBUTION: Southern Europe, Northern Africa.

DISTRIBUTION IN AUSTRALIA: southern Western Australia, southern South Australia, Victoria, New South Wales and southern Queensland.

Asparagus plumosus Baker

SYNONYMS: *Protasparagus plumosus* (Baker) Oberm.

COMMON NAMES: Climbing asparagus fern, ferny asparagus.

NATIVE DISTRIBUTION: Eastern South Africa.

DISTRIBUTION IN AUSTRALIA: South-west Western Australia, Eyre and Fleurieu Peninsula of South Australia, north-coast New South Wales (inc. Lord Howe Island) and southern Queensland.

NOTES: This species has been referred to as *A. setaceus* (Kunth) Jessop, but this name may have been misapplied. Clifford and Conran (1987b) list *A. setaceus* as a synonym of *A. plumosus*, but they are recognized as two different species by Obermeyer and Immelman (1992) and Fellingham and Meyer (1995). Some of the confusion may stem from the description of fruit colour: in Obermeyer and Immelman's (1992) description of South African Asparagaceae, they describe the *A. plumosus* berry as red and *A. setaceus* as black. Conran and Forster (1986) and Clifford and Conran (1987b) describe the berry of *A. plumosus* as black and Green (1994) describes *A. plumosus* berry as red. Imada *et al.* (2000) point out that *A. setaceus* has been used extensively in horticultural references based on Jessop (1966), but that the two species involved can be separated by the arrangement of their cladodes: all in one plane (*A. plumosus*) or radiating in many planes (*A. setaceus*). In Jessop's (1966) revision of the southern African Asparagaceae where *A. plumosus* is treated as a synonym of *A. setaceus*, he describes *A. setaceus* as having cladodes in one plane and the berry as red. Imada *et al.* (2000) conclude that the widespread cultivated species is *A. plumosus* and that it is now naturalized on three Hawaiian islands. Both Green (1994) and Clifford and Conran (1987b) describe *A. plumosus* as having

cladodes and branchlets in the one plane, and if fruit colour is not important, then the specimens are probably *A. plumosus*. But, the fruit characteristics are usually reliable at specific level (Jessop 1966) therefore the confusion in Australian species still remains. A review of the herbarium specimens is required to determine whether there is an error in the description or that Australia does have both species naturalized.

Asparagus scandens Thunb.

SYNONYMS: *Myrsiphyllum scandens* Thunb. (Oberm.), *Asparagus pectinatus* Del., *Asparagopsis scandens* (Thunb.) Kunth., *Asparagus scandens* var. *deflexus* Baker.

COMMON NAMES: Asparagus fern, climbing asparagus fern.

NATIVE DISTRIBUTION: Western Cape region of South Africa.

DISTRIBUTION IN AUSTRALIA: South-west coast of Western Australia, Mount Lofty Ranges and Fleurieu Peninsula of South Australia, central coast area of Victoria and northern Tasmania.

NOTES: *A. scandens* is a weed in northern New Zealand where it is invading the understorey of lowland broad-leaved and secondary forest (Timmins and Reid 2000)

Asparagus virgatus Baker

SYNONYMS: *Protasparagus virgatus* (Baker) Oberm.,

COMMON NAMES: Asparagus fern
 NATIVE DISTRIBUTION: Eastern South Africa extending toward the Northern Province and also Namibia.

DISTRIBUTION IN AUSTRALIA: Coastal South-east Queensland.

Other *Asparagus* species in Australia

There are several other *Asparagus* species in cultivation in Australia that have not (yet) shown weedy potential. Keighery (1996) lists the following species as common in cultivation in the Perth area; *A. densiflorus* (Kunth) Jessop, *A. falcatus* L., *A. setaceus* (Kunth) Jessop (see notes under *A. plumosus*), and *A. verticillatus* L. Less common species in cultivation include *A. acutifolius* L., *A. crispus* Lamark, *A. tenuiflorus* Lamark and *A. virgatus* Bak. (Keighery 1996). Randall (2002) lists *A. filicinus* D.Don and *A. setaceus* as weeds in Australia, but we have not located a record of establishment.

Discussion

In attempting to summarize the current understanding of the taxonomy of the eight asparagus weeds in Australia we highlight some areas that require further clarification. A clear understanding and application of the names of species is important for any future policy decisions

including the application of noxious weed legislation and the nomination of species weeds (excluding *A. officinalis*) as targets for biological control. Of particular relevance is the use of *A. aethiopicus*/*A. densiflorus* and *A. plumosus*/*A. setaceus* as synonyms for each other between the Australian States. In the case of *A. plumosus*/*A. setaceus*, further examination of herbarium specimens is required to determine if both species are naturalized in Australia. The Western Cape form of '*Asparagus asparagoides*' (Coles *et al.* 2006), needs to be studied and named so it can be identified and targeted for control. Finally, the identification of Australian material as *A. africanus* also needs verification, but, along with the issues mentioned above, this may depend on a better understanding of the classification of *Asparagus* species in southern Africa.

Overall, the understanding of the phylogeny of Asparagaceae species is improving (Fukuda *et al.* 2005) although so far 24 out of the 100 to 300 species have been studied. The phylogeny is important because it will provide hypotheses to test the host range of potential biological control agents and to provide explanation of host range patterns. For example, future biological control of Asparagaceae species will largely be determined by how closely related the weed is to the crop species, *A. officinalis* and to the native *A. racemosus*. Finally, researchers and people with an interest in weeds should lodge specimens of asparagus weeds with official herbariums to both improve our knowledge of distributions, the range of variability present in Australia including new naturalizations, and to provide the specimens needed to elucidate the questions mentioned in this paper.

Acknowledgments

We thank Carien Kleinjan, University of Cape Town, South Africa and Karen Wilson, New South Wales Herbarium for discussions on *Asparagus* species identification. Thanks also to John Conran, University of Adelaide, South Australia, David Cooke, Department of Water, Land and Biodiversity Conservation, South Australia and Terry MacFarlane from the Western

Australian Herbarium for their comments on the manuscript.

References

- Baker, J.G. (1875). Revision of the genera and species of Asparagaceae. *Journal of the Linnean Society, Botany* 14, 508-632.
- Clifford, H.T. and Conran, J.G. (1987a). 2. *Asparagus*. *Flora of Australia* 45, 159.
- Clifford, H.T. and Conran, J.G. (1987b). 3. *Protasparagus*. *Flora of Australia* 45, 159-63.
- Clifford, H.T. and Conran, J.G. (1987c). 4. *Myrsiphyllum*. *Flora of Australia* 45, 163-5.
- Coles, R.B., Willing, K.L., Conran, J.G. and Gannaway, D. (2006). The identification and distribution of 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. and Forster, P.I. (1986). *Protasparagus africanus* (Asparagaceae) a serious weed for south-eastern Queensland. *Austrobaileya* 2, 300-4.
- Druce, G.C. (1914). *Report of the Botanical Exchange Club of the British Isles 1913*, 3, 414.
- 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.
- 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.
- Green, P.S. (1986). The correct name for *Asparagus sprengeri*. *The Plantsman* 7, 249-50.
- Green, P.S. (1994). Liliaceae. *Flora of Australia* 49, 502-13.
- Imada, C.T., Staples, G.W. and Herbst, D.R. (2000). New Hawaiian plant records for 1999. *Bishop Museum Occasional Papers* 63, 9-16.
- Jessop, J.P. (1966). The genus *Asparagus* in Southern Africa. *Bothalia* 9, 31-96.
- 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. *Southern African Journal of Botany* 65, 23-31.
- Lee, Y., Kanno, A. and Kameya, T. (1997). Phylogenetic relationships in the genus *Asparagus* based on the restriction enzyme analysis of the chloroplast DNA. *Breeding Science* 47, 375-8.
- Linnaeus, C. (1753). *Species plantarum: a facsimile of the first edition 1753 volume 1*. The Ray Society, London, 560 pp.
- Malcomber, S.T. and Sebsebe Demissew (1993). The status of *Protasparagus* and *Myrsiphyllum* in the Asparagaceae. *Kew Bulletin* 48, 63-78.
- Obermeyer, A.A. (1983). *Protasparagus* Oberm. nom. nov.: new combinations. *South African Journal of Botany* 2, 243-4.
- Obermeyer, A.A. and Immelman, K.L. (1992). *Protasparagus*. *Flora of Southern Africa* 5, 11-70.
- Randall, R.P. (2002). 'A global compendium of weed's. (R.G. and F.J. Richardson, Melbourne).
- Rudall, P.J., Engelman, E.M., Hanson, L. and Chase, M.W. (1998). Embryology, cytology and systematics of *Hemiphyllacus*, *Asparagus* and *Anemarrhena* (Asparagales). *Plant Systematics and Evolution* 211, 181-99.
- 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.
- Stajner, N., Bohanec, B. and Javornik, B. (2002). Genetic variability of economically important *Asparagus* species as revealed by genome size analysis and rDNA ITS polymorphisms. *Plant Science* 162, 931-7.
- Timmins, S.M. and Reid, V. (2000). Climbing asparagus, *Asparagus scandens* Thunb.: a South African in your forest patch. *Austral Ecology* 25, 533-8.
- Wight, W.F. (1909). (No title). In 'The century dictionary and cyclopedia: a work of universal reference in all departments of knowledge', ed. B.E. Smith, XI p. 845. (The Times Book Club, London).