

The continuing spread of fireweed (*Senecio madagascariensis*) – the hottest of topics

Brian M. Sindel^{1,3}, P.W. Michael⁴, Rachel E. McFadyen^{2,3} and J. Carthew¹

¹ School of Environmental and Rural Science, University of New England, Armidale, New South Wales 2351, Australia

² Block B, 80 Meiers Road, Indooroopilly, Queensland 4068, Australia

³ CRC for Australian Weed Management,

⁴ 5 George Street, Epping, New South Wales 2121, Australia

Email: bsindel@une.edu.au

Summary Fireweed (*Senecio madagascariensis*) is one of the worst weeds of coastal pastures of south-eastern Australia. Originating in south eastern Africa, it was introduced to the Hunter Valley in Australia around 1918 (probably through shipping) and has spread north and south in coastal New South Wales and southern Queensland. It has been known in Argentina since the 1940s and is also now known to occur in Japan, Hawaii and Uruguay. In this paper, we examine reports of recent spread of fireweed in Australia and factors that may affect its potential distribution. The weed is causing considerable concern to farmers in some areas of Australia and there is debate as to how easy or difficult it is to control. The question of whether the weed warrants investment in a biological program is discussed.

Keywords Potential distribution, biological control.

INTRODUCTION

Fireweed (*Senecio madagascariensis* Poir.) is an invasive weed that commonly occurs in temperate and subtropical pastures along the south east coast of Australia. Containing pyrrolizidine alkaloids, it is poisonous to livestock, particularly cattle. However, once cattle are familiar with the weed, they tend to avoid it, enabling it to compete more vigorously with pastures, resulting in reduced productivity. Poisoning is more likely to occur when: other feed is limited; plants are young and not easily differentiated from the rest of the pasture; contaminated hay is consumed; or when stock are newly introduced to the weed (Sindel *et al.* 1998). While herbicides are available that effectively kill fireweed, year-long management is made difficult because of the ability of the weed to germinate and flower throughout much of the year (Sindel and Michael 1996).

In Australia, fireweed was introduced to the Hunter Valley around 1918 (Sindel 1986), probably through shipping. By the 1980s the weed had spread north and south in coastal New South Wales and southern Queensland in similar climatic regions to where it

originated in southern Africa and also where it is found in Argentina (Sindel and Michael 1992).

In this paper, we examine reports of the more recent spread of fireweed in Australia and factors that may affect its potential distribution. Because of its spread, the weed is causing considerable concern to farmers along the south coast and southern Tablelands of NSW, on the northern Tablelands of NSW and in parts of Queensland. There is heated debate as to the ease or otherwise with which it can be controlled. The question of whether biological control should again be considered for this weed is discussed.

TAXONOMICAL REVISIONS

Senecio madagascariensis was first described by Poirlet in Madagascar in 1817. It has also been described by various other names in Argentina, where it became apparent from the 1940s but was not correctly named until 1978. Until the 1980s in Australia it was confused with a similar native *Senecio* species (then called *S. lautus*). It was first correctly named in 1981 as *S. madagascariensis* and recognised as a southern African plant (Michael 1981). Subsequent investigations have shown that our *S. madagascariensis* is most similar to plants from the KwaZulu-Natal province in South Africa, and that this region is its most likely origin (Radford *et al.* 2000).

Some native plants were confused with *S. madagascariensis* (e.g. *S. lautus* var. *dissectifolius*), particularly in south eastern coastal areas. Following concerns by Michael (1992) and Belcher (1993, 1994) and subsequent detailed taxonomic work on the lautusoid *Senecio* complex, these are no longer considered to be *S. lautus* but are referred to as *S. pinnatifolius* (Radford *et al.* 2004, Thompson 2005). A range of other natives in the lautusoid complex have also been described (Thompson 2005).

Differentiation between *S. madagascariensis* and native *Senecio* species (particularly *S. pinnatifolius* which commonly co-occurs with the introduced fireweed) has been important. Many of these natives have been regarded as essentially non-weedy (Sindel 1986),

some occur outside the range of *S. madagascariensis* (in all but northern tropical Australia), and the toxic alkaloids vary. The fact that the invasive *S. madagascariensis* is introduced also opens up the possibility of biological control of the weed in Australia.

RECENT SPREAD

In the late 1980s, fireweed was restricted principally to coastal pastures from north of Brisbane to Nowra. Small infestations were present near Bega on the south coast of NSW (Sindel and Michael 1988) with isolated plants further inland, particularly at Dubbo on the Central Western Plains of NSW within the confines of the Western Plains Zoo (Sindel and Michael 1992). Based on the then distributions in Australia and overseas, Sindel and Michael (1992) predicted that fireweed could well spread further north in eastern Queensland, further south through coastal Victoria, and into higher altitude areas in tropical Queensland. Areas with heavy frosts may have reduced the 'weediness' of the species, since young seedlings were shown to be somewhat sensitive to frost (Sindel and Michael 1989).

Fireweed is now widespread in the Bega area where once it occurred only in isolated patches, and reportedly it is spreading in the Dorriggo area on the Northern Tablelands and in the Monaro region on the Southern Tablelands of NSW. This suggests that the weed has not yet reached its potential distribution in Australia. In 2007 the weed was also reportedly found growing near Rockhampton and on the Atherton Tablelands in far north Queensland, in line with predictions by Sindel and Michael (1992).

FACTORS AFFECTING FURTHER SPREAD

Frost Carthew (2006) recently investigated the effect of frost on the growth of fireweed and whether fireweed could be cold acclimated (hardened off) at low temperatures, and therefore be protected from the deleterious effects of frost.

Visual damage, colour assessment, dry weights and plant survival all indicated that plants grown under warmer conditions prior to frosting were more susceptible to frost than plants exposed to cooler temperatures. These results suggest that fireweed does become cold acclimated and that frost may not be as important a factor in limiting the spread of fireweed as first thought. Future studies will be needed to investigate the relative invasiveness of fireweed in colder Tableland areas compared with warmer coastal regions.

Climate change If as predicted, the climate is becoming warmer and drier in many parts of Australia, the continued spread of fireweed and its potential

distribution will be affected. The movement of the weed into cooler highland areas seems to be occurring now in NSW and Queensland, and may continue in the future. Likewise, cooler southern Australian areas may become more susceptible to invasion.

The realised distribution of a weed is often tempered by factors in addition to climatic suitability or by factors that interact with climate. For example, the rust fungus *Puccinia lagenophorae* that commonly infects fireweed in Australia in wet weather may become less of a constraint on growth and reproduction of the weed if there are drier times ahead, though increasing temperatures may be of benefit. The extent to which this pathogen constrains fireweed in Australia is largely unknown.

CASE FOR AND AGAINST BIOCONTROL

A dense pasture sward helps to reduce the establishment of fireweed seedlings, increases their rate of mortality, and reduces the vigour and seeding capacity of surviving plants. This finding has led to the view that fireweed is simply a management problem with which individual farmers need to deal. However, given the weed's apparent continuing spread and the continued dry conditions in many regions leading to low pasture cover with few economical options available to many farmers, there is a case for considering biological control.

Previous preliminary investigations with *Phycitodes* sp. and *Lobesia* sp. moths from Madagascar showed that their host ranges were too wide and that native *Senecio* species may sustain damage if such insects were introduced (McFadyen and Sparks 1996). However, the fact that the native and toxic *S. brigalowensis* (Thompson 2005) exploded throughout central Queensland pastures in 2007 (REM observations), indicates that it too can behave in a weedy fashion in favourable seasons. For biological control agents that are not absolutely specific to *S. madagascariensis*, a cost benefit analysis is required to weigh up the advantages and disadvantages of the release of such organisms. Alternatively, rust fungi are likely to be more specific to *S. madagascariensis* and therefore be more acceptable for biocontrol (Morin 2003).

Fireweed is also now known to occur in Japan, Hawaii and Uruguay, as well as Argentina, and the origin of the fireweed that occurs in Australia appears to be the same as for that found in Hawaii (Le Roux *et al.* 2006). As a result, there may well be opportunities for collaboration in any biological control program. The identification of the region of origin of Australian fireweed in the KwaZulu-Natal province of South Africa and its general lack of weediness there, gives both direction for where to search for prospective biological

control agents and some hope for finding agents that could suppress fireweed's growth in Australia.

CONCLUSION

Weeds such as fireweed can create considerable consternation within communities, often because of their invasiveness and impact on the social and financial wellbeing of the landholders concerned, and the failure of management strategies to halt the invasion of the weed. Fireweed in Australia is a hot topic in this regard. An integrated approach to weed management requires utilisation of a range of techniques. Given the continued spread of fireweed both in Australia and overseas, the prospect of climate change leading to further spread, and its origin having been identified, there is a sound case for further investigation of the potential for biological control of fireweed in Australia.

REFERENCES

- Belcher, R.O. (1993). The '*Senecio* aff. *lautus*' complex (Asteraceae) in Australia. I. Criteria for exclusion of lautusoid *Senecio* of Australia from *S. lautus sensu stricto* of New Zealand. *Australian Systematic Botany* 6, 359-63.
- Belcher, R.O. (1994). The '*Senecio* aff. *lautus*' complex (Asteraceae) in Australia. II. Clarification of names given to pseudolautusoid Australian specimens of *Senecio* by Richard and by Candolle. *Australian Systematic Botany* 7, 71-85.
- Carthew, J. (2006). The effects of frost on fireweed (*Senecio madagascariensis*). Honours thesis, University of New England.
- Le Roux, J.J., Wieczorek, A.M., Ramadan, M.M. and Tran, C.T. (2006). Resolving the native provenance of invasive fireweed (*Senecio madagascariensis* Poir.) in the Hawaiian Islands as inferred from phylogenetic analysis. *Diversity and Distributions* 12, 694-702.
- McFadyen, R. and Sparks, D. (1996). Biological control of fireweed. Proceedings of the Eleventh Australian Weeds Conference, ed. R.C.H. Shepherd, pp. 305-8. (Weed Science Society of Victoria, Melbourne).
- Michael, P.W. (1981). Alien plants. In 'Australian vegetation', ed. R.H. Groves, pp. 44-64. (Cambridge University Press, Cambridge).
- Michael, P.W. (1992). *Senecio lautus sensu lato* – an unresolved complex. *Australian Systematic Botany Newsletter* 72, 10-1.
- Morin, L. (2003). Potential for fireweed biocontrol. A report for the Shoalhaven City Council. CSIRO Entomology.
- Radford, I.J., Muller, P., Fiffer, S. and Michael, P.W. (2000). Genetic relationships between Australian fireweed and South African and Madagascan populations of *Senecio madagascariensis* Poir. and closely related *Senecio* species. *Australian Systematic Botany* 13, 409-23.
- Radford, I.J., Cousens, R.D. and Michael, P.W. (2004). Morphological and genetic variation in the *Senecio pinnatifolius* complex: are variants worthy of taxonomic recognition? *Australian Systematic Botany* 17, 29-48.
- Sindel, B.M. (1986). The ecology and control of fireweed (*Senecio madagascariensis* Poir.). *Plant Protection Quarterly* 1, 163-72.
- Sindel, B.M. and Michael, P.W. (1988). Survey of the impact and control of fireweed (*Senecio madagascariensis* Poir.) in New South Wales. *Plant Protection Quarterly* 3, 22-8.
- Sindel, B.M. and Michael, P.W. (1989). Frost as a limiting factor in the distribution of *Senecio madagascariensis* Poir. (fireweed) in Australia. Proceedings 12th Asian-Pacific Weed Science Society Conference, Taegu, Republic of Korea, pp. 453-9. (Asian-Pacific Weed Science Society).
- Sindel, B.M. and Michael, P.W. (1992). Spread and potential distribution of *Senecio madagascariensis* Poir. (fireweed) in Australia. *Australian Journal of Ecology* 17, 21-6.
- Sindel, B.M. and Michael, P.W. (1996). Seedling emergence and longevity of *Senecio madagascariensis* Poir. (fireweed) in coastal south-eastern Australia. *Plant Protection Quarterly* 11, 14-9.
- Sindel, B.M., Radford, I.J., Holtkamp, R.H. and Michael, P.W. (1998). The biology of Australian weeds. 33. *Senecio madagascariensis* Poir. *Plant Protection Quarterly* 13, 2-15.
- Thompson, I.R. (2005). Taxonomic studies of Australian *Senecio* (Asteraceae): 5. The *S. pinnatifolius*/*S. lautus* complex. *Muelleria* 21, 23-76.