

Survey of New Zealand native legumes growing in Australia to assess their susceptibility to attack by the gall wasp *Trichilogaster acaciaelongifoliae* (Pteromalidae).

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Introduction

Sydney Golden wattle (SGW) or *Acacia longifolia* is native to South East Australia (Figure 1) where it is a very common plant. It is a weed of increasing importance in New Zealand where it is invading habitats such as back dunes and wetlands, threatening biodiversity values in Northland and Manawatu. SGW is a weed in other parts of the world too, notably in Portugal, where it forms monocultures in vast areas of coastal dunes (Marchante et al., 2011). It was once a serious weed in South Africa. However, in the 1980's, two insects were imported from Australia (the native range of the wattle) as biological control agents. These have controlled the weed so well that it is no longer regarded as an environmental threat in South Africa (Impson et al., 2011). One of the biological control agents used in that program was a minute pteromalid wasp called *Trichilogaster acaciaelongifoliae* (Figure 2). Adult wasps lay eggs into flower buds early in development. These remain dormant for many months until the following winter when galls begin to form in place of the bud. Each gall represents one less pod producing seed in the following spring. Galls can be large and can deform and kill branches. Heavy gall loads can even kill plants. Attack by this wasp has reduced the annual seed production of SGW in South Africa by over 90%. It is proposed that this insect should be introduced to New Zealand for the biological control of SGW here. Details about this proposal can be found here: <https://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol/approvals/current-applications/sydney-golden-wattle>.

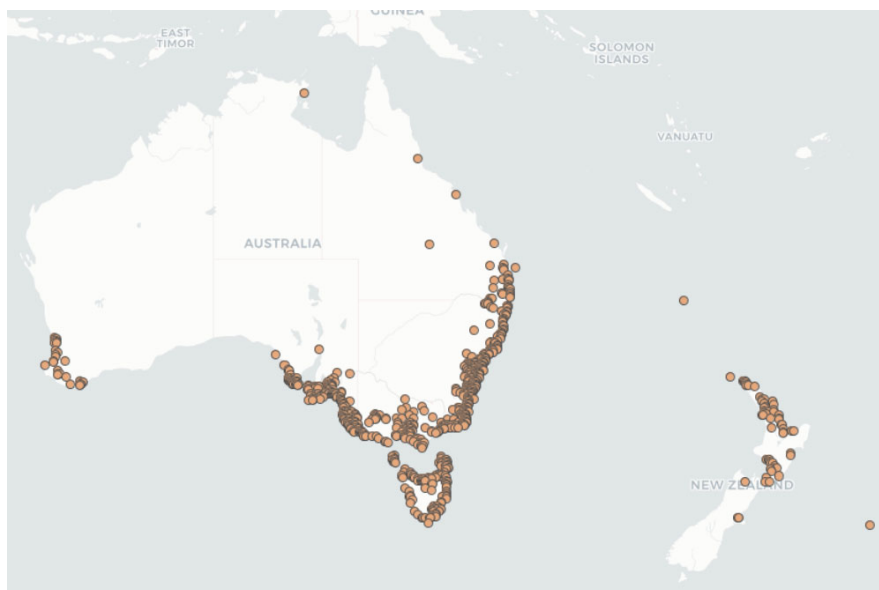


Figure 1. Distribution of *Acacia longifolia*. (Flora of Australia online <https://profiles.ala.org.au/opus/foa/profile/Acacia%20longifolia>)

occasionally been found on *A. melanoxylon* (Tasmanian blackwood) and *Paraserianthes lophantha* (brush wattle) (Impson et al., 2011). Otherwise, the gall wasp has only been recorded from *Acacia longifolia* in South Africa. Neither of these trees support development in Australia.

Marchante et al. (2011) proposed biocontrol of *A. longifolia* in Portugal and conducted experiments and surveys to predict the likely host range of *T. acaciaelongifoliae*. They concluded that the gall wasp would only attack SGW in Portugal. The European Food Safety Authority (EFSA, 2015) agreed that *T. acaciaelongifoliae* posed no significant threat to native plants in Europe and approved release of the SGW gall wasp into the European Union. It was reported established in Portugal in 2017. A discussion of the evidence for host-specificity of *T. acaciaelongifoliae* can be found here: https://www.landcareresearch.co.nz/_data/assets/pdf_file/0007/178972/host-ranges-agents-sydney-golden-wattle.pdf.

Evidence for the high degree of host specificity of the gall wasp can be inferred from these sources:

- Knowledge of the hosts of *Trichilogaster* species (Prinsloo & Naser 2007; Kleinjan & Hoffman, 2013)
- Host surveys in the native range in Australia (Noble, 1940)
- Host records in the adventive range
- Results of host range tests conducted in the 1980s (Kleinjan & Hoffman, 2013)
- Results of host range tests completed before release in Portugal (Marchante et al., 2011)

The host range of *T. acaciaelongifoliae* is restricted to *Acacia* species belonging to Clade D of the mimosoid tribe. Its primary hosts belong to the *longifolia* subclade, but the consistent observation of inferior gall formation on *A. melanoxylon* suggests that species of the *cognata* subclade (and the *aneura* subclade?) might also fall into the fundamental host range of the gall wasp. Observations of galls on *P. lophantha* in South Africa remain anomalous. Consistent use of *C. striatus* in oviposition tests also remains anomalous, but this species is not considered to be at risk in Europe. *T. acaciaelongifoliae* galls are not thought to mar the value of ornamental wattles in Australia or South Africa other than *A. longifolia* and *A. floribunda*.

The New Zealand flora records four genera of indigenous legumes growing on the mainland; *Sophora* (8 spp.), *Carmichaelia* (23 spp), *Montigena* (1 sp.), and *Clianthus* (2 spp.) (<http://www.nzflora.info/>). These genera belong to the Papilionoid clade of the Leguminosae. It is considered highly unlikely that these could be potential hosts of *T. acaciaelongifoliae* because:

- All *Trichilogaster* species have a narrow host range, and are associated strictly with *Acacia* species (Kleinjan & Hoffman, 2013)
- *T. acaciaelongifoliae* galls have never been found on any papilionoid species in Australia.
- In its native range *T. acaciaelongifoliae* galls have only been recorded from *A. longifolia* and *A. floribunda* (e.g. Noble 1940).
- In its adventive range, spillover gall production has been observed on two further mimosoid species, *A. melanoxylon* and *P. lophantha*, but both are sub-optimal hosts and galls form only sporadically with negligible effects (EFSA, 2015)
- In tests prior to introduction to South Africa or Portugal, no galls were observed on any plants outside the genus *Acacia*

This is sufficient evidence, without further experimentation, to conclude that *T. acaciaelongifoliae* would pose negligible risk to non-target native, economic or ornamental legume species in New Zealand. However, New Zealand native legume species are grown as specimen and amenity plants in

Australia, within the natural range of *T. acaciaelongifoliae*. This provided an opportunity to reinforce this conclusion by observing directly whether these species are susceptible to the gall wasp in its native range. This report describes the results of a survey of New Zealand native plants growing in three botanic gardens and one rural town in NSW and Victoria to establish the presence or absence of *T. acaciaelongifoliae* galls. The survey was conducted in December 2019.

Methods

Site selection

Staff of The Royal Botanic Gardens, NSW were contacted to enquire whether New Zealand native legume species were growing in the gardens. Only two *Sophora* specimens were known to grow in the Sydney gardens, but a large range of species had been planted in the Blue Mountains Botanic Gardens at Mt Tomah near Lithgow. *Acacia longifolia* was reported to grow in the gardens in Sydney, and on the outskirts of the Mt Tomah gardens.

Staff of the Royal Botanic Gardens Victoria reported that *A. longifolia* is systematically removed from the Melbourne gardens when it is found because it tends to be weedy. I was directed to Sandringham Beach and Brighton Beach, two coastal areas where *A. longifolia* was known to be abundant, and to Elsternwick Park. These sites were 8-10km distant from the Botanic gardens.

Two large *Sophora* trees were reported from street plantings in Buninyong, 6 km south of Ballarat, Victoria.

New Zealand native legumes species have also been recorded from Botanic gardens in Tasmania and South Australia, but these centres were not visited.

Survey methods

Botanic gardens at Bennelong Point (Sydney), Mt Tomah and Melbourne were visited, and a visit was made to the town of Buninyong.

Local *Acacia longifolia* plants were examined at each site to ensure that *T. acaciaelongifoliae* was present in the area. Galls were found wherever the host plant occurred. Galling was relatively uniform from plant to plant, and between stems within plants. Galling intensity was crudely estimated as the number of galls per metre of stem.

The Royal Botanic Gardens Melbourne contained an array of well-grown New Zealand native species as well as congeners of New Zealand natives. For example, *Sophora toromiro* (Easter Island kowhai) and *Sophora howinsula* (Lord Howe Island kowhai) were examined as surrogates for New Zealand *Sophora* species. The presence or absence of galls on these plants was noted. All of the New Zealand *Sophora* specimens growing in the gardens were labelled as *Sophora microphylla* or *Sophora tetraptera*. Revision of the genus (Heenan et al., 2001) recognizes eight indigenous species in New Zealand and it is likely that some specimens in the gardens would be better referred to other species. *Swainsona sejuncta* plants growing in the gardens were also examined as the species *Montigena novaezelandiae* once belonged to this genus and it can usefully be regarded as a congener. The Lord Howe Island species *Carmichaelia exsul* is the only member of this genus that is not endemic to New Zealand. The planting plan for relevant species for the Melbourne site was developed by correlating lists from the Living Collection Census (<https://data.rbg.vic.gov.au/rbgcensus/>), with a map of named beds (Figure 3).

were under 2 m tall and not in good condition There were no galls present, but there was also no evidence that they had produced buds. This result was discounted.

Blue Mountains Botanic Garden, Mt Tomah

Staff at Mount Tomah reported heavy galling of *Acacia longifolia* plants in the staff residential area adjacent to the garden. Correspondence with Royal Botanic Gardens staff indicated that the gardens had a strong catalogue of New Zealand native plants, including a significant collection of *Carmichaelia* species. The Gardens were visited on this advice. Consulting their databases on arrival confirmed that a significant planting of New Zealand species had indeed been established many years ago, including 11 *Carmichaelia* species, 6 *Sophora* species and *Clianthus puniceus*. Unfortunately, records showed that all specimens were now dead. A single *Sophora* 'microphylla' tree was later found and examined by park staff. It was free of galls.

Buninyong township

Two large New Zealand *Sophora* sp. trees grow as roadside plantings in this small Victorian town (Figure 4). There were no galls on either *Sophora* plant and no sign of woody remains of galls from the previous year. *Acacia longifolia* was abundant at two nearby sites and was heavily galled (Figure 5). For example, there were 7-20 galls per m of stem at Webb's Hill Road, approximately 1 km distant from the *Sophora* plants. Galls were also found at Allen St., approximately 400m from the kowhai trees.

Figure 4 & 5. *Sophora* sp. *Trichilogaster acaciaelongifoliae* galls on *Acacia longifolia* in roadside planting at Buninyong, VIC



Melbourne Royal Botanic Garden

No Sydney golden wattle was found in Elsternwick Park, but there were large populations growing on the foreshore behind both Brighton and Sandringham beaches. These plants were heavily attacked by *T. acaciaelongifoliae*, and infestation commonly exceeded 10 galls per meter of stem (Figure 6).

The planting plan for relevant species for the Melbourne site was obtained by correlating lists from the Living Collection Census (<https://data.rbg.vic.gov.au/rbgcensus/>), with a map of named beds (Figure 6). Fifty-two plants of interest were located and examined. No galls were observed on any of the New Zealand indigenous plants examined, nor on *S. toromiro*, *S. howinsula*, *S. davidii*, *C. exsul*, or *Swainsona sejuncta*, species that can be regarded as surrogates of those New Zealand species (Table 1).

Figure 6. *Trichilogaster acaciaelongifoliae* galls on *Acacia longifolia* at Brighton Beach in Melbourne.



Figure 7. *Sophora*, *Clianthus* and *Carmichaelia* plants growing in the Royal Botanic Gardens, Melbourne



Table 1. A list of the plant specimens examined at four sites in Australia and the presence/absence of galls of *Trichilogaster acaciaelongifoliae*

Host	Origin	Locality	Plant bed	Galls present	Comments
<i>Acacia longifolia</i>	Aus	Buninyong		Yes	477 Webb's Hill Rd & Allan St., heavily galled
		Sydney RBG	Bennelong Point	Yes	Two plants, one heavily trimmed and no galls.
		Blue Mountains BG		Yes	
		Brighton Beach, Mel.		Yes	100s of plants, Heavy consistent galling
		Sandringham Beach Mel.		Yes	Many plants, heavy galling
<i>Carmichaelia sp.</i>	NZ	Melbourne RBG	Metrosideros bed	No	
			-		
<i>C. australis</i>	NZ	Melbourne RBG	Phormium bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	small
<i>C. exsul</i>	L Howe I	Melbourne RBG		No	Surrogate for NZ species
<i>C. williamsii</i>	NZ	Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
<i>Clianthus sp.</i>	NZ	Melbourne RBG	Podocarpus bed	No	
		Melbourne RBG	Podocarpus bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
<i>C. maximus</i>	NZ	Melbourne RBG	Coprosma bed	No	
		Melbourne RBG	Coprosma bed	No	
		Melbourne RBG	Coprosma bed	No	No pods
		Melbourne RBG	Coastal bed	No	
		Melbourne RBG	Coastal bed	No	
<i>C. puniceus</i>	NZ	Melbourne RBG	Drinking fountain bed	No	
		Melbourne RBG	Drinking fountain bed	No	
		Melbourne RBG	Coastal bed	No	
		Melbourne RBG	Coastal bed	No	
		Melbourne RBG	Metrosideros bed	No	
		Melbourne RBG	Metrosideros bed	No	
		Melbourne RBG	Metrosideros bed	No	
		Melbourne RBG	Pomaderris bed	No	7 more specimens too young
<i>Sophora sp.</i>	NZ	Melbourne RBG	-	No	
		Sydney RBG	Bennelong Point	No	no evidence of flowering
		Sydney RBG	Bennelong Point	No	no evidence of flowering
		Buninyong	-	No	
		Buninyong	-	No	
		Blue Mountain BG	-	No	
<i>S. davidii</i>	China	Melbourne RBG	South China bed	No	
<i>S. fulvida</i>		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	

<i>S. 'microphylla'</i>	NZ	Melbourne RBG	Plant craft cottage bed	No	Large tree
		Melbourne RBG	Picnic Point	No	
		Melbourne RBG	Northern border bed	No	
		Melbourne RBG	Wintergarden bed	No	No pods
		Melbourne RBG	Coprosma bed	No	
		Melbourne RBG	Coprosma bed	No	v. tall
		Melbourne RBG	Podocarpus bed	No	
		Melbourne RBG	Pomaderris bed	No	
		Melbourne RBG	Metrosideros bed	No	
		Melbourne RBG	Cherry bed	No	
		Melbourne RBG	-	No	
<i>S. prostrata</i>	NZ	Melbourne RBG	Tilia bed	No	No pods or flowers evident
		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	
		Melbourne RBG	Divaricating shrubland bed	No	Small, no pods
		Melbourne RBG	Divaricating shrubland bed	No	Small, no pods
<i>S. 'tetraptera'</i>	NZ	Melbourne RBG	Pomaderris bed	No	v. tall tree, two further plants not found
<i>S. toromiro</i>	Easter I	Melbourne RBG	-	No	Surrogate for NZ species
		Melbourne RBG	Gleditsia bed	No	
		Melbourne RBG	Northern border bed	No	
		Melbourne RBG	-	No	
		Melbourne RBG	-	No	
<i>Swainsona sejuncta</i>		Melbourne RBG	Rockery bed, massed	No	Surrogate for <i>Montigena novaezelandiae</i>

Discussion

Acacia longifolia was consistently heavily galled wherever it was observed, and the relative distributions of both the plant and the gall wasp in SE Australia suggest that this is likely to be true throughout the natural range of *A. longifolia*. *T. acaciaelongifoliae* has been recorded elsewhere in the Melbourne suburbs. Although the nearest infestation in this survey was recorded approximately 8 km away from the Royal Botanic Garden Melbourne, it seems fair to assume that gall wasps would have been available to attack the New Zealand species in the garden had those plants been susceptible. Apart from fresh green galls, SGW plants carried brown woody galls, indicating a similar level of attack in at least one previous year.

At least 8 species of New Zealand native legume plus 4 closely related surrogate species were examined in the course of this survey. Sixty-nine individual plants were examined, 16 of which were discounted because there was no evidence of buds having been available for oviposition by the gall wasp. No galls were observed on any of the remaining 53 plants, indicating that there had been no infestation by gall wasps either in the current or the previous season.

In conclusion, there is no evidence that New Zealand species of *Sophora*, *Carmichaelia* or *Clianthus* growing in the native range of *Trichilogaster acaciaelongifoliae* are susceptible to this gall wasp. This confirms the conclusions drawn from field observations in Australia and South Africa, and from experimental studies in South Africa and Portugal that the gall wasp poses no negligible risk to non-target plants in New Zealand.

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References

EFSA Panel on Plant Health (2015) Risk to plant health in the EU territory of the intentional release of the bud-galling wasp *Trichilogaster acaciaelongifoliae* for the control of the invasive alien plant *Acacia longifolia* EFSA Journal 13 (4): 4079.

Heenan, P. B., de Lange, P. J., Wilton, A. D. (2001) *Sophora* (Fabaceae) in New Zealand: Taxonomy, distribution, and biogeography. *New Zealand Journal of Botany*, 39:1, 17-53, DOI: [10.1080/0028825X.2001.9512715](https://doi.org/10.1080/0028825X.2001.9512715)

Impson, F.A.C., Kleinjan, C.A., Hoffman, J.H., Post, J.A., Wood, A.R. (2011). Biological control of Australian *Acacia* species and *Paraserianthes lophantha* (Willd.) Nielsen (Mimosaceae) in South Africa. *African Entomology* 19: 186-207.

Kleinjan, C.A., Hoffman, J.H. (2013) Advances in clarifying the phylogenetic relationships of Acacias: relevance for biological control. *Acta Oecologica* 48: 21-29.

Marchante, H., Freitas, H., Hoffman, J.H. (2011) Assessing the suitability of a well-known bud-galling wasp, *Trichilogaster acaciaelongifoliae*, for biological control of *Acacia longifolia* in Portugal. *Biological Control* 56: 193-201.

Noble, N.S. (1940) *Trichilogaster acaciaelongifoliae* (Froggatt) (Hymenopt., Chalcidoidea), a wasp causing galling of the flower-buds of *Acacia longifolia* Willd., *A. floribunda* Sieber and *A. sophorae* R. BR. *Transactions of the Royal Entomological Society of London* 90:13–38.

Prinsloo, G.L., Naser, O.C. (2007) Revision of the pteromalid wasp genus *Trichilogaster* Mayr (Hymenoptera: Chalcidoidea): gall-inducers on Australian acacias. *African Entomology*, 15(1): 161-184.