

MISTLETOE SUCCESS FOR THE CHRISTCHURCH BOTANIC GARDENS

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Mistletoes belong in the order Santalales, represented by 88 genera comprising 1600 species (Nickrent 2011). The two largest families are Loranthaceae and Viscaceae consisting of c. 1000 and 550 species, respectively. There are several other smaller families including Misodendraceae, Santalaceae, and Amphorogynaceae that make up the remaining species.

Mistletoes are obligate stem hemi-parasites, producing a portion of their own food through photosynthesis. They have specialised roots called haustoria that penetrate a host species to extract water and nutrients to supplement their growth. New Zealand is home to eight species of mistletoe, all of which are endemic except for *Ileostylus micranthus* which extends to Norfolk Island, and *Korthalsella salicornioides* which is found in Madagascar and New Caledonia (Kirby 2014). The majority of New Zealand mistletoes are classified as At Risk (de Lange et al. 2013) and a ninth species, *Trilepidea adamsii*, is now considered extinct (Norton 1991). Mistletoe decline in New Zealand can be attributed to several factors including pollen limitation, dispersal limitation, herbivory and habitat fragmentation (Norton 1991; Ladley & Kelly 1996; Ladley et al. 1997; Sweetapple et al. 2002).

Ileostylus micranthus, the focus of this study, has the lowest host specificity of all the New Zealand mistletoes and has been recorded parasitising 209 different species (Department of Conservation [DoC] 1997). *Ileostylus micranthus* is also the most widespread in New Zealand. However, it is largely absent from Christchurch. It was more widespread in pre-European times where forest patches once stood, and is still recorded from the native remnant, Riccarton Bush, along with *Tupeia antarctica* and *Korthalsella lindsayi* (Molloy 1995). *Ileostylus micranthus* is still found in relative abundance in the nearby Port Hills and Banks Peninsula (Wilson 1996).

Research has investigated whether the patchy distribution of *I. micranthus* in Christchurch and the surrounding areas is due to environmental factors or dispersal limitation (von Tippleskirch 2001). It was found that long distance dispersal limitation and environmental effects were likely preventing the natural spread back into the city (von Tippleskirch 2001). The main dispersers of *I. micranthus* are tui (*Prothemadera novaezelandiae*), bellbird (*Anthornis melanura*), silvereye (*Zosterops lateralis*), and introduced blackbirds (*Turdus merula*) (Ladley & Kelly 1996). However, tui, which is a long-distance disperser, is locally extinct in Christchurch and the Port Hills.

Ileostylus micranthus is known to parasitise some host species more and less commonly than others (Bannister & Strong 2001), and there is evidence to suggest regional variation in common host species including preferences for *Podocarpus totara*, *Pseudopanax arboreus* and *Coprosma propinqua* in Northland, Rotorua and the West Coast, respectively (DoC 1997; Norton & de Lange 1999). There has been no research to date, on host specificity in Christchurch. The closest has been in Banks Peninsula where Wilson (1996) recorded 38 host species for *I. micranthus*, and found *Coprosma* species were the most favoured.

The aim of this trial was to determine the establishment rate of *I. micranthus* on a range of native and exotic host species at a single site in Christchurch. This trial was used as a precursor to a city-wide citizen science project that aims to return *I. micranthus* to the city.

Methods

Species studied

Ileostylus micranthus (Hook.f.) Tiegh, pirita, green mistletoe (Fig. 1). The genus *Ileostylus*, in the family Loranthaceae, is monospecific. *Ileostylus micranthus* can grow up to 1 m in diameter often forming multiple haustoria. Flowering takes place from September to December. The berry-like fruit is bright orange and viscid, ripening December to July (New Zealand Plant Conservation Network 2015).



Figure 1 *Ileostylus micranthus* in fruit.

Study Site

The Christchurch Botanic Gardens, located within Hagley Park (43° 31' 48" S, 170° 37' 13" E), covers an area of 21 ha confined by a loop of the Avon River with a further 12 hectares of collections in the neighbouring Hagley Park. The Christchurch Botanic Gardens display numerous collections, including ornamental exotic and native trees and shrubs.

Trial

Ileostylus micranthus fruit were collected in May 2016 from two sites within the Port Hills and Banks Peninsula. All of the mistletoe plants from which collections were made were parasitising *Chamaecytisus palmensis* (tree lucerne).

The fruits (referred to as seeds below) were sown on 28 host species, 19 native and 9 exotic (Table 1). The host plants chosen for this trial were known host species for *I. micranthus* (DoC 1997) and preference was given to those with a north facing aspect (for ample light and optimum growth). The mistletoe seed was sown over three days. On 31 May 2016, 198 seeds were sown in the rain. The following day, the seeds were checked and those that had slid down the branches, were re-placed. The remainder of the seeds were sown in dry weather on 3 June 2016 (119 seeds) and 10 June 2016 (85 seeds). Seed sowing was undertaken following the guidelines outlined in (Ladley 2007). A total of 402 seeds were sown, 264 on native host species, and 138 on exotic species.

On 14 September 2017, the number of mistletoe seed that had established on each host species was counted. *Ileostylus micranthus* was considered to have established when the first set of true leaves emerged because this indicates that the haustorium has connected to the host stem (Fig. 2).



Figure 2 *Ileostylus micranthus* establishment on native *Sophora*.

Results

An overall establishment rate of 8.96% was measured. There were an additional 10 mistletoe seeds still at the germination phase that could still potentially establish.

There was a higher establishment rate on native host species (12.5%) compared to exotic host species (<1%) (Fig. 3). Of the 264 seeds sown on native host plants 33 seedlings had established. Of the remaining 138 seeds sown on exotic species, only one seedling established and this was on tree lucerne (*Chamaecytisus palmensis*).

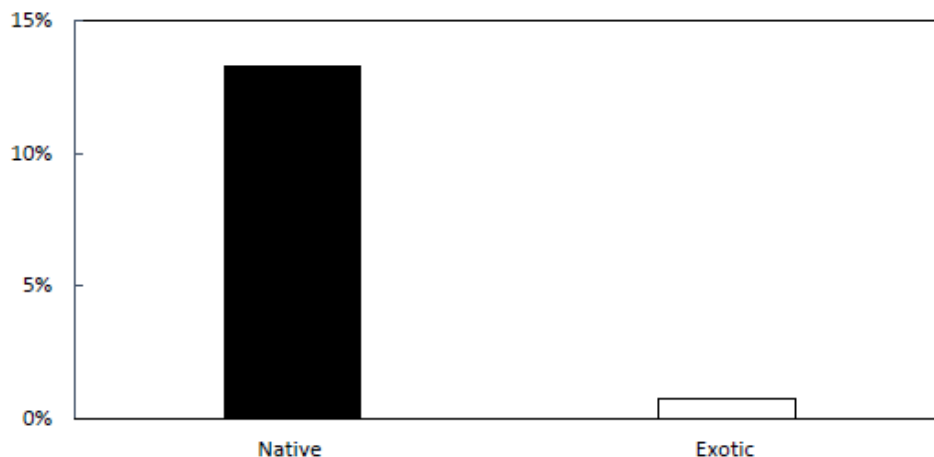


Figure 3 Percentage of established seedlings on native and exotic hosts in the Christchurch Botanic Gardens in 2016.

Ileostylus micranthus seedlings established on eight of the 19 native species selected as host plants (Fig. 4). *Coprosma rigida* came out as the most favoured host with a 50% success rate of established seedlings, followed by *Carmichaelia* sp. (47.1%) and *Coprosma rotundifolia* (41.5%). Eleven native species hosts had no seedlings establishment.

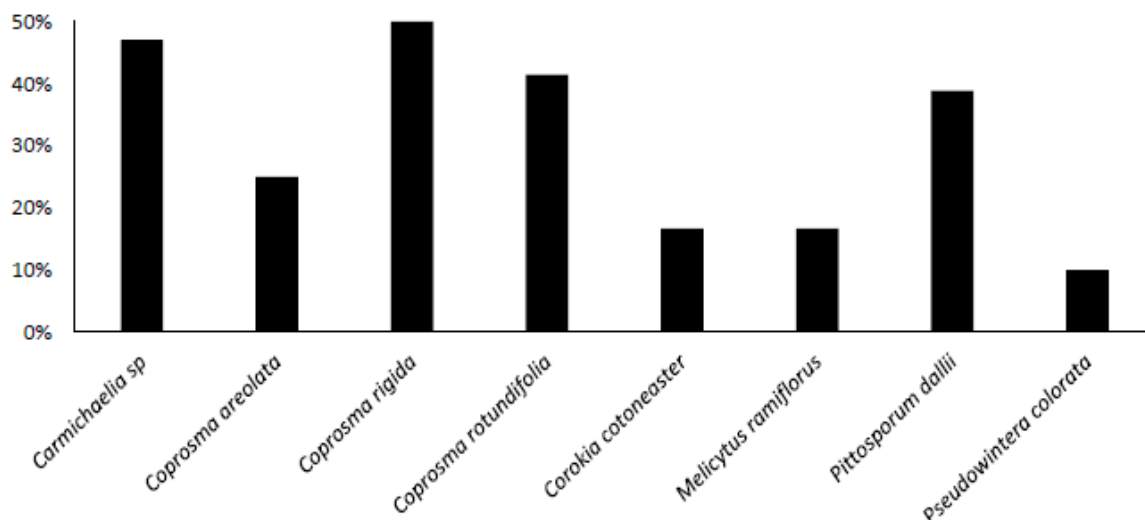


Figure 4 Establishment rates of *Ileostylus micranthus* on native species. Only species for which there was successful establishment are shown.

Discussion

The establishment rate found in this trial (c. 9%) was lower than the 16% establishment rate for *I. micranthus* found by Ladley & Kelly (1996). This could be a reflection of the host species studied. The Ladley & Kelly (1996) study was in native forest stands. The establishment rate on native host species in this trial (12.5%) is more comparable to those results.

Although *Ileostylus* has a low host specificity, our results indicate a preference to establish on native host plants, particularly *Coprosma*, supporting the data presented by Wilson (1996). All three species of *Coprosma* used in our study yielded good establishment rates *C. rigida* (50%), *C. rotundifolia* (41.5%) and *C. areolata* (25.0%). In addition, the only exotic host with successful establishment was *Chamaecytisus palmensis*, which we have seen to be a dominant host species in the Port Hills. Further supporting the idea of regional host specificity, totara (*Podocarpus totara*) and *Pseudopanax arboreus*, which are common host species in Northland and Rotorua, respectively (DoC 1997) had no seedling establishment in this trial.

Surprisingly, *I. micranthus* seeds did not establish on some native species growing in sunny situations, including *Sophora microphylla* and *Streblus heterophyllus*. The sparseness of the leaves on *Sophora* cast little shade and the specimen we chose was a young tree with sparse canopy, which might have meant the environment for seedling establishment was too hot. The seedlings produced cotyledons but appeared to become desiccated over the summer. A similar situation occurred with *Streblus*. This could mean establishment success is affected by exposure to extreme temperature and moisture fluctuations.

In conclusion, we demonstrated that *I. micranthus* can be successfully established in urban Christchurch, indicating that we can probably bring mistletoe back into the city. Our results showed a strong preference for establishment on native host species and support a potential regional host specificity for *Coprosma* in Christchurch.

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References

- Bannister P, Strong GL 2001. The distribution and population structure of the temperate mistletoe *Ileostylus micranthus* in the Northern Cemetery, Dunedin, New Zealand. *New Zealand Journal of Botany* 39, 225–233.
- de Lange PJ, Rolfe JR, Champion PD, Courtney S, Heenan PB, Barkla JW, Cameron EK, Norton DA, Hitchmough RA 2013. Conservation status of

- New Zealand indigenous vascular plants, 2012. Wellington, Department of Conservation.
- Department of Conservation 1997. New Zealand's Loranthaceous mistletoes. Proceedings of a workshop hosted by the Threatened Species Unit, Department of Conservation, Cass, 17-20 July 1995.
- Kirby CL 2014. Field guide to New Zealand's epiphytes, vines & mistletoes. Environmental Research Institute, University of Waikato.
- Ladley JJ 2007. Mistletoe Conservation: tips for collecting and planting mistletoe seeds. Tasman District mistletoe field days. [http://www.openspace.org.nz/Site/About_QEII/Partnerships/Landcare_Research/Landcare_Research_Biodiversity/beechn_mistletoes.aspx sourced 3 Mar 2018].
- Ladley JJ, Kelly D 1996. Dispersal, germination and survival of New Zealand mistletoes (Loranthaceae): dependence on birds. *New Zealand Journal of Ecology* 20, 69–79.
- Ladley JJ, Kelly D, Robertson AW 1997. Explosive flowering, nectar production, breeding systems, and pollinators of New Zealand mistletoes (Loranthaceae). *New Zealand Journal of Botany* 35, 345–360.
- Molloy BP (Ed.) 1995. Riccarton Bush: Putaringamotu: natural history and management. Riccarton Bush Trust.
- New Zealand Plant Conservation Network 2015. *Ileostylus micranthus*. Retrieved from http://www.nzpcn.org.nz/c/flora/factsheets/NZPCN_Species_858.pdf
- Nickrent DL 2011. Santalales (including mistletoes). *Encyclopedia of life sciences*. John Wiley & Sons, Ltd: Chichester. DOI: 10.1002/9780470015902.a0003714.pub2
- Norton DA 1991. *Trilepidea adamsii*: an obituary for a species. *Conservation Biology* 5, 52–57.
- Norton DA, de Lange PJ 1999. Host specificity in parasitic mistletoes (Loranthaceae) in New Zealand. *Functional Ecology* 13, 552–559.
- Sweetapple PJ, Nugent G, Whitford J, Knightbridge PI 2002. Mistletoe (*Tupeia antarctica*) recovery and decline following possum control in a New Zealand forest. *New Zealand Journal of Ecology* 26, 61–71.
- von Tippelskirch M 2001. The reproductive biology of *Ileostylus micranthus*, (Loranthaceae), on Banks Peninsula: conservation implications in a fragmented landscape. Unpublished MSc thesis. University of Canterbury, Christchurch, New Zealand.
- Wilson HD 1996. Mistletoes on Banks Peninsula. *Canterbury Botanical Society Journal* 31, 14–24.

Table 1 List of host species on which *Ileostylus micranthus* seed was sown in the Christchurch Botanic Gardens.

Native	Exotic
<i>Carmichaelia</i> sp.	<i>Chamaecytisus palmensis</i>
<i>Coprosma areolata</i>	<i>Citrus reticulata</i> 'Burgess Scarlet'
<i>Coprosma rigida</i>	<i>Corylus avellana</i>
<i>Coprosma rotundifolia</i>	<i>Prunus serrulata</i> 'Kansan'
<i>Corokia cotoneaster</i>	<i>Prunus serrulata</i> 'Tai Haku'
<i>Fuscospora fusca</i>	<i>Prunus x yedoensis</i>
<i>Griselinia littoralis</i>	<i>Pyrus domestic</i> pear cv
<i>Lophomyrtus obcordata</i>	<i>Tilia platyphyllos</i>
<i>Melicytus ramiflorus</i>	<i>Ulmus glabra</i> 'Camperdownii'
<i>Metrosideros robusta</i>	
<i>Pittosporum dallii</i>	
<i>Pittosporum eugeniioides</i>	
<i>Pittosporum tenuifolium</i>	
<i>Podocarpus totara</i>	
<i>Pseudopanax arboreus</i>	
<i>Pseudowintera colorata</i>	
<i>Sophora microphylla</i>	
<i>Sophora prostrata</i>	
<i>Streblus heterophyllus</i>	