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Adventitious roots in *Kunzea triregensis* (Myrtaceae)

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Abstract

Adventitious roots are reported for *Kunzea triregensis* de Lange, an apparent first for this species and the Aotearoa / New Zealand indigenous representatives of *Kunzea* Rchb. It is noted that the roots were observed in a cultivated tree of this Manawatāwhi / Three Kings Islands endemic that had been raised from a cutting. The role of adventitious roots in Myrtaceae is briefly summarised and it is concluded that their production in *K. triregensis* is potentially a response to enable the tree to obtain water collected in the branch axils. As adventitious roots are known to be produced more frequently by cutting-grown Myrtaceae, it is possible that the roots reflect the cutting origin of the planted tree rather than the natural state for this species. Investigation of adventitious root production in natural populations of this species on Manawatāwhi / Three Kings Islands is advocated.

Keywords

Myrtaceae, *Kunzea*, adventitious roots, Aotearoa / New Zealand

Aotearoa / New Zealand Arborescent Myrtaceae

Of the arborescent indigenous Myrtaceae of Aotearoa / New Zealand (hereafter Aotearoa), adventitious roots have been recorded as being produced by *Metrosideros excelsa* Sol. ex Gaertn., *M. kermadecensis* W.R.B.Oliv., *M. robusta* A.Cunn., *M. umbellata* Cav. (Simpson 2005) and *Syzygium maire* (A.Cunn.) Sykes et Garn.-Jones (de Lange 2025a). Hitherto they have not been recorded from Aotearoa representatives of *Kunzea* Rchb. (ten species), *Leptospermum* J.R.Forst. & G.Forst. (three species), *Lophomyrtus* Burret (two species) or *Neomyrtus* Burret (one species) (Burrell 1965, de Lange 2014, de Lange 2025b, de Lange 2025c, de Lange 2025d, de Lange & Schmid 2021, de Lange et al. 2023, Schmid et al. 2023). Adventitious roots have been reported by Darby et al. (2021) for Australian *Leptospermum*, including one treated there as *L. scoparium*. However, *L. scoparium* J.R.Forst. & G.Forst. is now considered endemic to Aotearoa (Buys et al. 2019, de Lange et al. 2023), so the species used in that study remains unclear. Although adventitious roots were not developed, Cook et al. (1980) noted in their study of Aotearoa *Leptospermum* responses to waterlogging that plants from two populations of *L. scoparium* and one of *L. ericoides* A.Rich. subjected to experimental submergence developed aerenchyma, though this was more evident in their *L. scoparium* samples. *Leptospermum ericoides* was referred to *Kunzea ericoides* (A.Rich.) Joy Thomps. by Thompson (1983), though based on the source for their plants Cook et al. (1980) probably used *K. robusta* de Lange & Toelken for their study (see de Lange 2014). Here we report the occurrence of adventitious roots in *Kunzea triregensis* de Lange, the first such observation for the Aotearoa *Kunzea* species, and possibly the first for the genus as a whole.

Kunzea triregensis

Of the ten members of the Aotearoa *Kunzea ericoides* complex, *Kunzea triregensis* de Lange, endemic to Manawatāwhi / Three Kings Islands (hereafter Manawatāwhi), is the only species to be wholly allopatric (de Lange 2014). Together with *Kunzea amathicola* de Lange & Toelken, *K. triregensis* forms a distinct grouping within the Aotearoa species through their collective possession of an elongate botryum (de Lange 2014). From *K. amathicola*, however, *K. triregensis* differs by its homophyllous growth habit, lanceolate to narrowly lanceolate leaves, and by the peculiar ability of the inflorescence to produce, albeit infrequently, additional lateral elongate or reduced corymbiform botrya from the base and terminus of the main botryum (de Lange 2014). Another oddity is that, admittedly from a limited sampling, *K. triregensis* is the only Aotearoa *Kunzea* that is self-incompatible (de Lange et al. 2005, de Lange 2014). Occasionally some viable seed is produced, though seedlings raised from this seed display reduced vigour, and die within two to three years of germination. Nevertheless, *Kunzea triregensis* does readily form fully fertile hybrids (as staminate and pistillate parent) with other Aotearoa *Kunzea* (de Lange et al. 2005). Based on its cytology, morphology, molecular evidence and experimental hybridisations, it is likely that *K. triregensis* arose from past hybridisation between *K. linearis* (Kirk) de Lange & Toelken and *K. amathicola*, species from which it is now geographically isolated (de Lange & Murray 2004, de Lange et al. 2005, de Lange et al. 2010).

As an endemic to Manawatāwhi, *Kunzea triregensis* is uncommon in cultivation in Aotearoa. For the *Kunzea ericoides* revision (de Lange 2014), plants procured from Manawatāwhi by the then Northland Conservancy of the New Zealand Department of Conservation were used. At the conclusion of the research, some of the plants were planted within the Auckland Botanic Gardens, Manurewa, and in private collections; and one sapling that had been grown from a cutting by Geoff Davidson, the owner of the former Oratia Native Plant Nursery, Oratia Valley, West Auckland, was planted on a street verge at Jesmond Terrace, Mt Albert, Tāmaki Makaurau / Auckland (-36.877694°S, 174.725783°E) in 2005. That tree, now 20 years old, is 8 metres tall and flourishing. In common with the species in its wild habitat, the tree flowers throughout the year, though with distinct peaks in spring and late summer.

Adventitious Roots in *Kunzea triregensis*

In September 2023 we noted the production of adventitious roots (Figure 1) from the base of the main trunk of the Mt Albert specimen above the axils where the larger branches meet with the trunk. These roots, in common with those described for *Metrosideros* by Simpson (2005), were darkly red-pigmented, presumably an anthocyanin like those produced by *Metrosideros excelsa* (Solangaarachchi & Gould 2001), with a prominent root cap at their apex (Figure 1A), otherwise deeply ribbed behind, the ribbing arising from the remains of successive root caps. The largest of these roots measured 30 mm long; notably none observed at this time were branched, each arising from splits within the bark (Figure 1A). Roots were either in clusters of three or more (Figure 1A) or solitary (Figure 1B). On 12 January 2025 a further inspection found many of the roots seen in 2023 had branched from the base (Figure 2A), and that larger, branched roots (these up to 50 mm long) were present in the branch–trunk axils where organic matter had accumulated and rain water pooled (Figure 2B). During this inspection, a voucher of the roots was made (*P.J. de Lange 15824 & T.J.P. de Lange*, UNITEC 14799).

Adventitious roots in the Myrtaceae are well documented for plants raised from cuttings; indeed it is this propensity for their production that enables many Myrtaceae, selected lines or otherwise, to be commercially propagated or grown for conservation purposes (Darby et al. 2021, Ross et al. 2021, Bettoni et al. 2024). It is possible that the occurrence of adventitious roots in the cultivated *Kunzea triregensis* is the result of that tree's cutting-grown origin. Zúñiga-Feest et al. (2017) also noted that waterlogging of Myrtaceous species encourages the production of adventitious roots, something that is quite evident in the endemic *Syzygium maire*, which grows in waterlogged soils, and which, uniquely amongst Aotearoa Myrtaceae, develops pneumatophores and, frequently, aerial roots, sprouting from the trunk and branches. This, however, is unlikely to have been the stimulus for adventitious root production in the planted *Kunzea triregensis*, as the tree is located on usually free-draining soil overlying fractured basalt lava. While 2023 was an extremely wet year for Tāmaki Makaurau / Auckland, with much flooding and protracted ponding of surface water, this did not affect the soil in which the *Kunzea* had been planted. What was evident, though, is that in 2023 water ponded for several weeks in the branch axils where many of the larger, branched adventitious roots were located.

Figure 1. Adventitious roots on a 20-year-old cultivated *Kunzea triregensis* de Lange (Myrtaceae) tree growing on a street verge, in Jesmond Terrace, Mt Albert, Tāmaki Makaurau / Auckland. **A.** Side view of eight roots emerging from split in bark near main trunk / branch axil. **B.** Looking down on four solitary (not clustered) roots arising from split in bark just above main trunk / branch axil in a location where water and organic matter ponds. Photos: T. J. P. de Lange, 9 September 2023.

Simpson (2005) suggests that adventitious roots in *Metrosideros excelsa* may provide a way for the tree to obtain extra nutrients and water, either from epiphytes on the tree itself or possibly from sites where water and organic material accumulates in the branch axils or trunk. Other possibilities suggested include that they help anchor the tree, allowing for expansion of the tree across a surface, or enable a tree to survive partial burial (such as trees growing in dune systems where burial by sand is an ever-present risk), or to harvest water pooled on the tree from fog. In the case of *Kunzea triregensis*, we speculate that the most plausible explanation is that adventitious root production would enable the *Kunzea* to take advantage of water and nutrients accumulating on the tree itself. It is unknown whether adventitious roots are present in wild *Kunzea triregensis*.

As far as we are aware, the climate of Manawatāwhi has not been documented in any detail. Hayward (1987) offers some unquantified generic statements that the

Figure 2. Well-developed adventitious roots growing into leaf litter held in the branch / trunk axil of a planted *Kunzea triregensis* de Lange (Myrtaceae) on a street verge, Jesmond Terrace, Mt Albert, Tāmaki Makaurau / Auckland. During heavy rain, water pools in the branch / trunk axil and may be retained for several days after rain has ceased. Photos: P. J. de Lange, 12 January 2025.

islands are rocky, dry and warm, and that freshwater sources are limited on most of the islands. Burns et al. (2012) state that the islands have a subtropical climate, with an annual precipitation of 1800 mm and average seasonal temperature of 17° C. Those working on the islands, including the senior author, have also noted that they are drought prone. Only one island (Manawatāwhi / Great Island) has a near-permanent stream, and aside from precipitation, it is the frequent sea fogs that most likely provide a reliable source of water for those plants able to capture it. During field work on those islands in December 1996, when the islands were beset by a thick sea fog, the senior author noted that water droplets were readily trapped in the vegetation and pooled in the branch axils of the larger trees and shrubs, as well as soaking into their bark. Gardner & de Lange (2002) observed that lenticels are a feature of some of the endemic plants of Manawatāwhi, perhaps helping to capture moisture as well as facilitating better gas exchange. Furthermore, some endemics, such as *Brachyglottis arborescens* W.R.B.Oliv., produce a conspicuous phellogen, which readily traps moisture (P. J. de Lange, personal observation). *Kunzea triregensis* also, over time, produces a deeply furrowed, thick corky bark, somewhat like the phellogen produced by *Brachyglottis arborescens*. This led us to speculate that the need to trap water stimulates adventitious root production in *Kunzea triregensis*. Field work on Manawatāwhi is needed to refute or confirm this.

In the interim, we can now add one species of *Kunzea* to the list of arborescent Aotearoa indigenous Myrtaceae known to produce adventitious roots.

Author Contributions

Peter J. de Lange: Conceptualisation (lead); data curation (lead); validation (lead); visualisation (lead); writing – original draft (lead); writing – review and editing (lead).

Theo J. P. de Lange: Conceptualisation (equal); validation (equal); visualisation (equal); writing – original draft (equal); writing – review and editing (equal).

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We thank Nick Singers for observing, after images of the adventitious roots had been posted on Facebook (9 September 2023), that "[it – i.e., *Kunzea triregensis*] looks like it's acclimatizing to the exceptionally wet season." This got us thinking about why this *Kunzea* had adventitious roots and, in some respects, we think Nick could be right – it might be a response to excessive moisture in many Myrtaceae. However, only experimentation and field work will tell if it is the cause for adventitious root production in *K. triregensis*. Irrespective, we appreciate the comment as it led to this paper. Otherwise, we thank Gillian Crowcroft for tolerating a street planting she never wanted, and Bee for helping obtain the images. Comments received from Campbell James and Rachel Klein helped improve the manuscript of this paper prior to submission. We thank two anonymous reviewers for their helpful comments on the submitted manuscript of this paper.

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