

On the perils of mycorrhizal status lists: the case of *Buddleja davidii*

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Abstract One observation in a mycorrhizal check-list that *Buddleja davidii* is nonmycorrhizal has been perpetuated in subsequent citations and used in a number of analyses of mycorrhizal ecology and evolution. Direct observation of *B. davidii* from New Zealand and the UK shows extensive arbuscular mycorrhizal fungal structures inside *B. davidii* roots. The suggestion that *B. davidii* is nonmycorrhizal is therefore not supported. The use of mycorrhizal checklists for analysis of plant traits and evolution needs to be undertaken with care to ensure the validity of underlying data.

Keywords *Buddleja davidii* · Mycorrhizal status · Plant traits

In 1987, Harley and Harley (1987) published a well-known and oft-cited compendium of the mycorrhizal status of British flora. Mycorrhizal infection of *Buddleja davidii* Franchet (Buddlejaceae) was recorded as “absent” in that compendium, based on personal observation (a collection by J. Hodgson examined by the authors, with no statement of plant age, location of collection, method of examination, or number of samples examined). The statement that *B. davidii* is nonmycorrhizal has been perpetuated without independent confirmation in other publications and used in analysis of mycorrhizal evolution and ecology (Cornelissen

et al. 2001; Peat and Fitter 1993; Wang and Qiu 2006). It is interesting to note that the fact that the mycorrhizal status of *B. davidii* was based on personal observation with no supporting data is lost in subsequent citations, such that the initial observation gains credibility with time. The non-mycorrhizal claim is in conflict with an earlier citation showing clear arbuscular mycorrhizal fungi (AMF) infection of *B. davidii*, including a strong positive growth response to AMF infection (Stevenson 1964).

We are aware of only three primary observations of the mycorrhizal status of other *Buddleja* species. Gemma and Koske (1990) and Koske et al. (1992) reported arbuscular mycorrhizal infection in seven out of nine *Buddleja asiatica* Lour. collected on Hawaiian lava flows. Matson (1990) also reported “preliminary data” suggesting arbuscular mycorrhiza in *B. asiatica* in Hawaii. Camargo-Ricalde and colleagues (2003) reported arbuscular mycorrhizal infection of an unidentified *Buddleja* sp. from Mexico. One additional study found hyphal colonization of *Buddleia* [sic] *salviifolia* (L.) Lam. in South Africa; however, no arbuscules were noted (Laughton 1964).

Understanding the nutrient acquisition of *B. davidii* is important, as it is a major invasive plant in primary and secondary successions (Owen and Whiteway 1980). In New Zealand, it appears to accumulate P in foliage and cause elevated soil P, with potential effects on succession of native plant communities (Bellingham et al. 2005). We collected roots of *B. davidii* from naturally established plants on dry floodplain terraces of the Hapuku (42°18'S, 173°41'E; 128 m) and Puhi Puhi rivers (42°16'S, 173°43'E; 142 m), near the Seaward Kaikoura Range, eastern South Island of New Zealand. Roots were collected from areas where *B. davidii* was the only vegetation present and traced back to confirm connection to *B. davidii* plants. We stained for arbuscular mycorrhizal infection using standard protocols:

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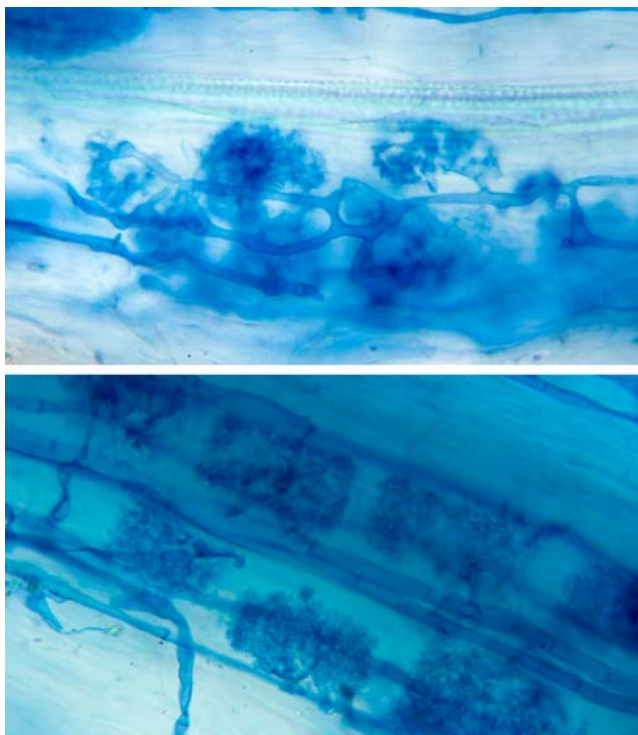


Fig. 1 Hyphae and arbuscules in *Buddleja davidii* from New Zealand (top) and UK (bottom). Photos by M.M. Thomas

15 min clearing in 100° KOH and 24-h staining in 50% glycerol, 5% acetic acid, and 0.01% trypan blue (Dickie et al. 2001). Based on ten collections, we found root colonization in all samples, with $97.1 \pm 1.2\%$ (mean and SE) of root length infected and extensive arbuscules ($74.5 \pm 7.2\%$ of root length; Fig. 1).

To resolve the discrepancy of our results with the Harley and Harley observation, we obtained *B. davidii* roots collected from Juniper Hall, Surrey, UK ($51^{\circ}15'24.4''\text{N}$, $0^{\circ}18'52.8''$; 55 m) and Hopesay Hill, South Shropshire, UK ($52^{\circ}26'30.0''\text{N}$, $2^{\circ}53'25.2''\text{W}$; 120 m) courtesy of L. Spence. All 13 of the British samples were heavily infected by AMF, with $68.6 \pm 9.0\%$ of root length infected and $53.3 \pm 10.1\%$ of root length with arbuscules (Fig. 1). We also obtained a single sample from a garden in Corvallis, OR, courtesy of D. Luoma. This sample also contained extensive arbuscules (not shown), but infection was not quantified because of poor root clearing.

We conclude that *B. davidii* is heavily mycorrhizal in New Zealand and in Britain and most likely in North America. Given the paucity of support for the original

statement that *B. davidii* was nonmycorrhizal, we have to assume that the Harley and Harley observation was either incorrect or of an atypical specimen. Elevated foliar and soil P in patches of mature *B. davidii* in New Zealand (Bellingham et al. 2005) are most likely related to arbuscular mycorrhizal-mediated P uptake. More generally, we conclude that the use of mycorrhizal checklists for analysis of plant traits and evolution needs to be undertaken with care to insure the validity of underlying data.

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