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## *Ulocladium populi* E.G. Simmons, G. Newcombe & A. Shipunov, *sp. nov.*

Conidia in cultura praecoci (1–2 d) conspicue longe ovoidea vel longe ellipsoidea, ad 30–40 × 8–12 µm, 3–6 transverse septata et 1–4 longiseptata. Conidia alia abunda, obovoidea vel sphaeroidea, ad 12–18 × 10–15 µm, 1–3 transverse septata et 1–2 longe vel oblique septata. Conidiophora plerumque 25–50 × 4–5 µm, 6–8 geniculata et conidiogena; interdum ad 150 µm longa, in maturitate multigeniculata et 15–20 conidiogena.

*Etymology.* Named after its host, *Populus trichocarpa*.

*Conidium production* begins readily and is abundant within the first 1–2 d of hyphal development in potato-carrot agar (PCA)<sup>1</sup> plates. The most conspicuous sporulation elements in young growth are alternarioid; they originate with a typical apiculate ulocladioid base but become long-ovoid to long-ellipsoid and remain so in a large proportion as they mature. Unlike other *Ulocladium* taxa with multiplex conidium morphology described<sup>1</sup> alternarioid conidia of *U. populi* constitute a high percentage of the 5–7 d sporulation population. Conspicuously obovoid and sphaeroid conidia that develop with a narrow, typically ulocladioid base are equally abundant but less conspicuous in 1–2 d growth. In older colonies these ulocladioid conidia dominate the population without obscuring the abundant alternarioid elements. Sporulation is extremely abundant on a turf of erect or inclined conidiophores which, however, are individually distinguishable at 50 × magn., each with an apical cluster of conidia. *Most conidiophores* are short, 25–50 × 4–5 µm. Each bears a solitary terminal conidium. Subsequently the conidiophore apex develops into a series of 6–8 short, consecutive, closely sympodial extensions, each with a solitary conidium. Longer conidiophores also arise at the agar surface. These are abundant but not dominant within the colony and are interspersed among the far more abundant short conidiophores. The longer conidiophores usually are branched, with each branch developing its own sympodial apical region of conidiogenous cells. The longer conidiophore complex is up to 150 µm long, commonly with a terminal cluster of 15–20 conidia. *Long-ovoid* and *ellipsoid conidia* become 30–40 × 8–12 µm with 3–6 transverse septa and a single longiseptum in each of 1–4 of the transverse segments; these alternarioid spores are smooth, rarely becoming inconspicuously ornamented in age. Obovoid and sphaeroid conidia become 12–18 × 10–15 µm with 1–3 transverse septa and 1 longitudinal or oblique septum in 1–2 of the transverse segments; the outer wall of these typically ulocladioid spores develop a densely pustulate ornamentation that often obscures internal septation in mature conidia. Conidium colour becomes a dilute dull brown, with ulocladioid conidia becoming a darker brown as ornamentation matures. Nearly all conidia remain

solitary. Within the extremely large population of conidia only a rare individual generates an apical or lateral short conidiophore with 1–4 conidiogenous sites. The *U. populi* colony on PCA at 5–6 d under a daily light/dark cycle of 8/16 h is c. 5 cm diam with 5 pairs of concentric rings of growth and sporulation. The colony is totally conidial, in that all surface hyphae produce abundant conidiophores; non-sporulating aerial hyphae are not present. Closest species is *U. atrum*.

*Typus.* USA, Idaho, in the stem of *Populus trichocarpa*; *holotypus*: CBS H-20385, a dried culture preparation ex E.G.S. 53.001 = CBS 123360, from George Newcombe isolate no. CIDU1, Lapwai Canyon, Idaho, USA, March 2, 2005. GenBank EF589900 and EF589845, MycoBank MB515393.

*Notes* — Following extensive sampling of endophytic isolates of *Ulocladium* and *Alternaria*<sup>2</sup> a phylogenetic tree was constructed that demonstrates the affinities of *U. populi* to a group of isolates and taxa associated with *U. atrum*. Our analyses support the monophyly of the *U. atrum* group. As in previous analyses<sup>3</sup>, a clade comprised of *U. chartarum*, *Alternaria cheiranthi*, and *Embellisia indefessa* was sister to the *U. atrum* complex. However, two isolates identified on the basis of morphology as representative of *U. atrum* were phylogenetically distinct: ATCC 18040 (AF229486, AY563318) shown as *U. atrum*, and EGS 30-188 that is identical to haplotype '068g'. Also problematic from a taxonomic point of view is the identity of the ex-type culture of *U. dauci* with one of the representative cultures of *U. atrum*, EGS 30-188. Apart from *U. populi*, described above, the resolution of other members of the complex appears to be poor. The paraphyly of *Alternaria* is clearly seen in the tree. There were at least four different clades. One comprised all *Lewia* (*Alternaria* teleomorph) sequences, *A. oregonensis*, *A. photistica*, and 12 endophytic haplotypes of *Alternaria* isolated from *Centaurea stoebe*. The second comprised *A. alternata*, *A. arborescens*, *A. tenuissima*, *A. longipes* and 15 of the endophytic haplotypes of *Alternaria* isolated from *C. stoebe*. The third (*A. crassa* and others) and fourth (*A. carotiincultae* and others) clades did not include endophytes obtained from *C. stoebe*. The '674n' haplotype from *C. stoebe* (close to *Alternaria malorum* sequences from GenBank) did not ally with the first *Alternaria* clade in MP trees (not shown); even on ML trees its branch was quite long. None of the 27 endophytic haplotypes of *Alternaria* and *Lewia* belonged to the *U. atrum* complex.

For phylogenetic tree and line drawing see MycoBank MB515393.

*Colour illustrations.* *Populus trichocarpa*, in Lapwai Canyon, Idaho, USA; *Ulocladium populi*, portion of conidiophore and ornamentation of conidia from different angles. Scale bars = 10 µm.

*References.* <sup>1</sup>Simmons EG. 1998. Multiplex conidium morphology in species of the *Ulocladium atrum* group. Canadian Journal of Botany 76: 1533–1539. <sup>2</sup>Shipunov A, Newcombe G, Raghavendra AKH, Anderson CL. 2008. Hidden diversity of endophytic fungi in an invasive plant. American Journal of Botany 95: 1096–1108. <sup>3</sup>Hong SG, Cramer R, Lawrence CB, Pryor BM. 2005. Alt a 1 allergen homologs from *Alternaria* and related taxa: analysis of phylogenetic content and secondary structure. Fungal Genetics and Biology 42: 119–129.

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