A Comparative Approach to Understanding Adventitious Root Induction in Recalcitrant Species

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Adventitious roots (ARs) are plant roots that form from tissues other than roots via an organogenic process. For numerous plants, AR formation is crucial for successful vegetative propagation. However, many species, such as American chestnut (*Castanea dentata*) and golden camellia (*Camellia nitidissima*) are recalcitrant to adventitious root formation, imposing a major limitation in the clonal propagation of elite germplasms. The AR formation is a complex process affected by numerous factors. With auxin induction, stem cuttings of American chestnut and golden camellias could form ARs in six weeks, albeit the rooting rate was low. Calli were often found in American chestnut cuttings, while this was not the case for golden camellia cuttings. Compared to easy-to-root poplar (*Populus* × *euramericana*), American chestnut cuttings and golden camellias had a low level of indole-3-acetic acid (IAA) and a high level of cytokinin (CK), abscisic acid (ABA), salicylic acid (SA), jasmonic acid (JA), and oxylipin 12-oxo-phytodienoic acid (OPDA). Hormone distribution between leaves and stems in American chestnut and golden camellias also differed from poplar. For example, IAA showed an almost even distribution between poplar leaf and stem, while American chestnut and golden camellia had a much higher IAA in stem and leaf, respectively. American chestnut and golden camellia showed a much higher JA level in stem than poplar, when compared to leaf. For cytokinin, American chestnut and golden camellia had the opposite leaf/stem distribution as poplar did. For ABA, American chestnut and golden camellia had a lower stem/leaf ratio than poplar. When secondary metabolites that are known for promoting AR formation were compared, American chestnut cuttings had zero being up-regulated and six being downregulated, and golden camellia cuttings showed two being up-regulated and six being downregulated. Poplar cuttings also contained seven AR-promoting secondary metabolites that were not found in American chestnut and golden camellia. Our results indicate that the unfavorite endogenous hormone and secondary metabolite profiles may contribute to American chestnut and golden camellia cuttings' recalcitrance to rooting.