[c]Department of Plant Biology, University of California at Davis, Davis, CA 95616, USA

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*For correspondence (e-mail fhchu@ntu.edu.tw).

SUMMARY

Taiwania cryptomerioides **is a monotypic gymnosperm species, valued for the high decay resistance of its wood. This durability has been attributed to the abundance of terpenoids, especially the major diterpenoid metabolite ferruginol, with antifungal and antitermite activity. Specialized diterpenoid metabolism in gymnosperms primarily recruits bifunctional class-I/II diterpene synthases (diTPSs), whereas monofunctional class-II and class-I enzymes operate in angiosperms. In this study, we identified a previously unrecognized group of monofunctional diTPSs in *T. cryptomerioides*, which suggests a distinct evolutionary divergence of the diTPS family in this species. Specifically, five monofunctional diTPS functions not previously observed in gymnosperms were characterized, including monofunctional class-II enzymes forming labda-13-en-8-ol diphosphate (LPP, *Tc*CPS2) and (+)-copalyl diphosphate (CPP, *Tc*CPS4), and three class-I diTPSs producing biformene (*Tc*KSL1), levopimaradiene (*Tc*KSL3) and phyllocladanol (*Tc*KSL5), respectively. Methyl jasmonate (MeJA) elicited the accumulation of levopimaradiene and the corresponding biosynthetic diTPS genes, *TcCPS4* and *TcKSL3*, is consistent with a possible role in plant defense. Furthermore, *Tc*CPS4 and *Tc*KSL3 are likely to contribute to abietatriene biosynthesis via levopimaradiene as an intermediate in ferruginol biosynthesis in *Taiwania*. In conclusion, this study provides deeper insight into the functional landscape and molecular evolution of specialized diterpenoid metabolism in gymnosperms as a basis to better understand the role of these metabolites in tree chemical defense.**

Keywords: diterpene metabolism, cupressaceae, diterpene synthase, biochemical enzyme characterization, plant specialized metabolism, methyl jasmonate, gymnosperms, *Taiwania cryptomerioides*.

INTRODUCTION