

At the same time, the industrial development of *T. hemsleyanum* remains constrained by resource scarcity, biological characteristics, and unstable production systems. Wild resources have been heavily overexploited and are now scarce or close to extinction in some regions, and the species has been described as endangered, rare, and precious because of its medicinal value and strict ecological requirements (Ji et al., 2021; Pang et al., 2024). The plant usually needs 3-5 years to form medicinally usable true roots, grows slowly, and is sensitive to habitat conditions such as shade and temperature, all of which limit rapid supply expansion (Zhu et al., 2020; Wang et al., 2023). Demand, however, continues to increase because the tuberous roots is the most valuable medicinal organ and the plant is already cultivated on a large scale in some areas, although its current planting modes are described as chaotic or inconsistent and the industry still lacks a scientific and measurable quality-control basis (Xia et al., 2023). Artificial cultivation has progressed over the past two decades, and greenhouse plus stereoscopic planting has been reported to improve biomass, flavonoid accumulation, yield, and overall herb quality relative to less optimized systems (Hu et al., 2023; Wang et al., 2025). Even so, the industry still faces the basic problem of producing enough uniform, high-quality planting material, which is a common bottleneck in medicinal crops and directly affects later yield, quality consistency, and resource conservation (Manohar et al., 2022; Muniandi et al., 2025).

The main propagation routes currently available for *T. hemsleyanum* include seed propagation, stem cutting, and tissue-culture-based rapid propagation, each with distinct practical advantages and limitations. Seed propagation offers a sexual route for population establishment, but in many medicinal plants it often produces heterogeneous offspring, and in *T. hemsleyanum* seed yield is already reported to be low, which limits its value for rapid industrial multiplication (Muniandi et al., 2025). Tissue culture and organogenesis can achieve high multiplication efficiency and disease-free material; for *T. hemsleyanum*, adventitious shoots have been regenerated from leaves and petioles, 100% rooting was achieved on media containing NAA or IBA, and acclimatized plantlets showed over 98% survival in peat:sand substrate (Pang et al., 2024). Axillary-bud rapid propagation and hairy-root systems also show strong biotechnological potential for mass propagation, conservation, and secondary metabolite production (Wang et al., 2023). However, tissue culture often requires specialized facilities, sterile operation, and higher costs, and in other medicinal plants it remains less accessible at farm level despite technical promise (Ioannidis et al., 2022). By contrast, cutting propagation preserves superior genotypes, enables relatively rapid and true-to-type multiplication, and is more compatible with nursery-scale and field-linked production systems. Species-specific evidence in *T. hemsleyanum* already shows that rooting reagent and cutting age significantly affect rooting, and that 2-3-year-old cuttings treated with 1 000 mg/L IBA for 10 s gave the best tested response, providing a direct technical basis for protocol development. More broadly, studies in medicinal species show that cutting success depends on mother-stock quality, cutting position, leaf retention, season, substrate, hormone treatment, and environmental regulation, which means that the value of cuttings lies not only in the method itself but in the possibility of standardizing it into a reproducible production chain (Zhang et al., 2025; Dumani et al., 2026; Vuong et al., 2026).

This article examines the construction of a standardized cutting propagation and seedling production system for *Tetrastigma hemsleyanum* by integrating research findings on elite mother-plant selection, cutting material selection and specification, rooting induction, environmental regulation, seedling quality grading, and whole-process quality traceability. On this basis, the effects of mother-plant and cutting quality, rooting substrates, plant growth regulators, temperature, humidity, and light conditions on rooting and seedling establishment will be systematically analyzed, and a standardized technical pathway covering propagation material selection, rooting regulation, seedling-stage management, quality grading, and nursery release will be developed. Establishing a relatively complete cutting-based seedling production system is expected to improve propagation efficiency and seedling uniformity, reduce nursery losses, and provide high-quality planting material for the stable multiplication of elite medicinal germplasm and large-scale artificial cultivation. In addition, this article address current problems such as inconsistent propagation parameters and the lack of unified seedling quality standards, and will propose future directions toward facility-based, standardized, and digitalized nursery production. These efforts will strengthen whole-process quality control from mother-plant origin to commercial seedlings, promote