Plant management also includes pinching, vine thinning, removal of diseased and weak branches and leaves, and regulation of vegetative growth. Vine guidance should be carried out in the early growth stage to prevent stems and vines from becoming too entangled to manage. For overly vigorous plants, vine overgrowth may be moderately controlled to promote nutrient allocation to underground tuberous roots. For plants with overly dense branches and leaves, weak branches, diseased branches, and excessive foliage should be removed in time to improve understory ventilation and reduce pest and disease risk. Reasonable vine management can help maintain coordination between aboveground growth and underground tuberous root development, making it an important technical measure for improving yield and quality in understory cultivation.

5.3 Water and fertilizer management and green pest and disease control of *Tetrastigma hemsleyanum*

Understory cultivation of *T. hemsleyanum* should follow the fertilization principle of using organic fertilizer as the main source and appropriate topdressing as a supplement. Understory environments are characterized by strong heterogeneity in soil nutrients and moisture. Although litter decomposition can provide a certain humus foundation, nutrient supplementation is still required during long-term cultivation to meet the needs of vine growth and tuberous root enlargement. Basal fertilizer should mainly consist of fully decomposed farmyard manure, compost, commercial organic fertilizer, or biochar-based organic fertilizer, combined with appropriate phosphorus and potassium fertilizers to improve root development and tuberous root fullness. Related studies have shown that when *T. hemsleyanum* is intercropped under moso bamboo forests, the application of biochar-based organic fertilizer can significantly increase plant biomass, improve soil pH and organic carbon content, and alter bacterial community composition (Zhang et al., 2019a).

Organic, slow-release, and ecological fertilization methods are more suitable for maintaining soil fertility and medicinal material quality in understory systems. Related studies have shown that biochar and organic fertilizer can increase root weight, plant height, total flavonoid content, and soil enzyme activity in *T. hemsleyanum*, indicating that improved soil fertility and enhanced rhizosphere activity help promote tuberous root formation and active compound accumulation. At the same time, excessive nitrogen input is associated with decreased flavonoid and phenolic contents, suggesting that the fertilization regime for *T. hemsleyanum* should be designed around medicinal material quality rather than simply pursuing maximum biomass or yield (Fu et al., 2019; Hu et al., 2021). Water management should follow the principle of “maintaining moisture while avoiding waterlogging”. Drainage should be strengthened during the rainy season, while drip irrigation, sprinkler irrigation, or organic mulching can be used for water supplementation and moisture retention during dry seasons.

In terms of pest and disease control, prevention should be prioritized, and a green control system combining agricultural, physical, biological, and low-risk chemical measures should be established. In high-humidity understory environments, *T. hemsleyanum* is prone to diseases such as root rot and leaf spot. Therefore, healthy seedlings, improved ventilation and light transmission, appropriate planting density, timely removal of diseased plant residues, and prevention of waterlogging should be used to reduce disease risk. For pests such as aphids and grubs, trapping, manual removal, biological agents, or low-toxicity and low-residue pesticides can be adopted. Studies have shown that endophytic fungi associated with the roots of *T. hemsleyanum* can promote root development and enhance plant vigor and stress resistance by secreting phytohormones and other substances. In the future, green understory management of *T. hemsleyanum* should integrate organic fertilizer and biochar-based fertilizer application, beneficial microbial utilization, rational density design, and low-residue control measures, so as to form an integrated ecological cultivation technology system that balances yield, medicinal material quality, and forest ecological environment protection (Li et al., 2025; Guo et al., 2026).

6 Effects of the Understory Environment on the Yield and Quality of *Tetrastigma hemsleyanum*

6.1 Effects of Light conditions on the plant growth of *Tetrastigma hemsleyanum*

Light is an important ecological factor affecting the understory growth of *Tetrastigma hemsleyanum*. Light intensity and light quality jointly determine plant morphogenesis, photosynthetic efficiency, and biomass allocation. *T. hemsleyanum* prefers shaded and humid conditions and is sensitive to strong light. In understory