

Cutting specification and planting layout should also be standardized, because rooting varies with shoot position, cutting size, node number, and likely with insertion geometry and crowding (Kumar et al., 2022). Mid or basal shoot portions often perform better than top portions, as shown in tea and moringa, although apical sections can perform best in some species such as chrysanthemum, confirming that positional effects are real but genotype-specific (Ghimire et al., 2022). Cutting size also shows a consistent trade-off: medium diameters gave the best overall efficiency in camellia, thicker cuttings improved rooting in one bamboo species, and moringa showed that larger cuttings favor shoot growth whereas smaller ones favor root initiation (Muniandi et al., 2025). Single-node cuttings can maximize propagation efficiency when stock is limited, as shown in tea and guava, provided leaf area and humidity are sufficient to avoid desiccation stress. Direct evidence on planting depth and density is limited in the supplied literature, but the same studies indicate that resource competition, leaf retention, and cutting stability affect rooting outcomes, so *T. hemsleyanum* should use shallow-to-moderate insertion of the basal node region in a loose substrate and a spacing density that prevents leaf overlap, preserves aeration, and facilitates uniform misting and disease control (Seo et al., 2023).

## 5 Environmental Regulation and Seedling Management during Cutting Propagation

### 5.1 Regulation of temperature, humidity, and water supply

During the rooting stage of *Tetrastigma hemsleyanum* cuttings, temperature, humidity, and water supply should be managed as an integrated environmental unit, because high survival before root emergence depends on limiting desiccation while maintaining metabolic conditions favorable to callus formation and adventitious root initiation (Table 1) (Rock et al., 2022; Hu et al., 2023). Studies across propagation systems show that high relative humidity consistently supports rooting by reducing transpiration from unrooted shoots; in rose, 98~100% relative humidity is recommended initially and then gradually reduced, while in cannabis high humidity promoted rooting across cultivars and in forest-tree mist chambers successful rooting was maintained near 85% relative humidity (Yang et al., 2022; Kim et al., 2025; Kamara et al., 2025). Fine misting or fogging is preferred because it maintains humid air and supplies moisture without heavy wetting, whereas excessive droplet retention raises the risk of rot and mortality (Shen et al., 2025). Substrate water status also requires moderation rather than saturation: lavender cuttings showed the highest survival at about -2.5 kPa, high rooting at -1.0 to -2.5 kPa, and mortality above 50% under the driest treatment, indicating that the rooting medium should remain evenly moist but aerated until roots are established.

Temperature control should aim at a warm and stable rooting zone while avoiding excessive heat, because both direct rooting responses and water relations deteriorate under thermal stress (De Almeida et al., 2017). In mulberry aeroponic propagation, maintaining 25~27°C together with 90~100% humidity increased rooting by 41.40%, callusing by 58.89%, and reduced mortality by 55.85% relative to non-regulated conditions (Shen et al., 2025). Juniper cuttings rooted best when the rooting table was maintained at (25±2)°C rather than (20±2)°C (Güney et al., 2021), and microcuttings of *Corymbia* and *Eucalyptus* performed best in controlled environments where mean temperatures remained moderate, with an estimated ideal maximum of 28.4°C and minimum of 20.3°C. Temperature effects also extend to donor-plant conditioning: reduced nighttime temperature lowered rooting in *Eucalyptus dunnii*, decreased soluble carbohydrates at the cutting base by about 25%, and reduced foliar nutrient status, showing that stable thermal management helps preserve the physiological quality of propagation materials before and after excision (Nión et al., 2026). Therefore, *T. hemsleyanum* cuttings should be kept under warm, humid, and finely misted conditions, with moderate substrate moisture and careful avoidance of prolonged leaf wetness or overheating (Rock et al., 2022).

### 5.2 Management of light, shading, and ventilation

Light regulation during cutting propagation should balance protection from excessive radiation with maintenance of minimum photosynthetic function, because both over-shading and excessive light reduce seedling vigor through different mechanisms (Huang et al., 2025). Moderate shading often improves seedling quality in shade-sensitive or heat-stressed nursery crops. In *Castanopsis hystrix*, 60% shade produced the highest quality index and improved root characteristics relative to no shade, while excessive shading restricted dry matter