

2.2.2 Operational procedures and variable control

Cutting size, timing (mid-March to before the plum rain season in June), and routine management practices were standardized across treatments. Container seedlings were maintained under shaded conditions with substrates kept moist but well-drained. Field cuttings received equivalent irrigation management. No additional growth regulators were applied, ensuring that treatment differences primarily reflected nursery mode effects.

2.3 Field establishment experiment design

2.3.1 Plot arrangement

From April to June 2022, container-grown seedlings produced in 2021 were transplanted into four forest stand types. The site conditions were as follows:

Plot 1: Moso bamboo forest, canopy closure 0.5, quasi-wild establishment;

Plot 2: Chinese fir forest (*Cunninghamia lanceolata*), canopy closure 0.6, quasi-wild establishment;

Plot 3: *Metasequoia glyptostroboides* stand, canopy closure 0.7, cultivation in biodegradable planting bags;

Plot 4: Natural broadleaf forest, canopy closure 0.8, quasi-wild establishment.

For quasi-wild establishment, plant spacing was 0.3 m × 0.5 m. Each plot included 100 seedlings per replicate, with three replicates, totaling 1 200 seedlings.

2.3.2 Measurement of canopy closure

Canopy closure was determined by averaging measurements from multiple sampling points within each plot. At least five evenly distributed points were established per plot. Canopy cover proportion was visually estimated at each point, and the mean value was calculated as the canopy closure index for that plot.

2.4 Survival assessment and indicator definition

Survival in the cutting experiment was defined as successful root formation accompanied by resumption of new shoot growth. Establishment survival in the field was defined as seedlings maintaining normal aboveground growth without mortality until October of the same year.

Survival rate was calculated as: Survival rate (%) = (Number of surviving individuals / Total number of individuals surveyed) × 100%.

2.5 Data analysis and statistical models

2.5.1 Comparison of survival rates

Differences in survival rates among nursery modes and forest stand treatments were analyzed using contingency table chi-square (χ^2) tests. When overall differences were significant, pairwise comparisons were performed using Fisher's exact test, with Bonferroni correction applied for multiple comparisons.

2.5.2 Effect size estimation

Effect size of survival differences between treatments was quantified using Relative Risk (RR), and 95% confidence intervals were calculated to evaluate the magnitude of treatment effects.

2.5.3 Analysis of canopy closure response trends

To analyze the response pattern of survival rate to canopy closure, a quadratic polynomial model was constructed for descriptive fitting between canopy closure and survival rate. Curve visualization was used to evaluate the presence of a unimodal response pattern and to delineate the canopy closure range associated with higher survival. All statistical analyses were conducted using proportional data, with a significance level set at $\alpha = 0.05$.

3 Results and Analysis

3.1 Differences in cutting survival among nursery modes

The survival performance of *Tetrastigma hemsleyanum* cuttings under the three nursery modes is presented in Figure 1. Each mode included 50 cuttings. Mode I had an average of 47 surviving individuals, corresponding to a