low-latitude evaluation systems, 'Meiju', 'Hang Baishao', 'Hongpan Tuojin', and 'Bo Baishao' consistently ranked as top-performing materials, with 'Hang Baishao' standing out as a local low-chilling germplasm with strong warm-winter adaptation and long cultivation history in subtropical China. Regional mismatch matters: cultivars can perform very differently across sites, so large-scale introduction should follow local multi-criteria evaluation rather than name-based transfer, and traits such as bud number, flowering earliness, upright stem habit, and cross-breeding value can all be used as practical screening indices for commercial deployment and breeding parent choice (Zhang et al., 2019a).

Standardized seedling propagation is needed because conventional breeding and division are slowed by double seed dormancy, long juvenile periods, and low multiplication efficiency (Mu et al., 2026). Mature-embryo and zygotic-embryo tissue culture now provide workable large-scale routes: optimized media achieved 91.11% embryo germination, 67.78% direct seedling formation, 96.67% multiple-shoot induction, 3.48 shoot proliferation, and 73.33% rooting, while an improved rooting system using 7 days dark plus 28 days light, doubled calcium, IBA, putrescine, coumarin, and porous perlite-vermiculite substrate raised rooting to 75% with 8.3 roots per shoot (Xin et al., 2025). For low-chilling 'Hang Baishao', embryo culture on half-strength MS with 6-BA, GA3, and PVP was effective, and transplant survival depended strongly on vascular bundle development; bio-nursery work further showed that 15/5℃ diurnal culture, 6 mmol/L calcium during rooting, and 20 ℃ acclimation after cold treatment improved post-transplant vigor and seedling supply stability (Figure 1) (Xin et al., 2025).

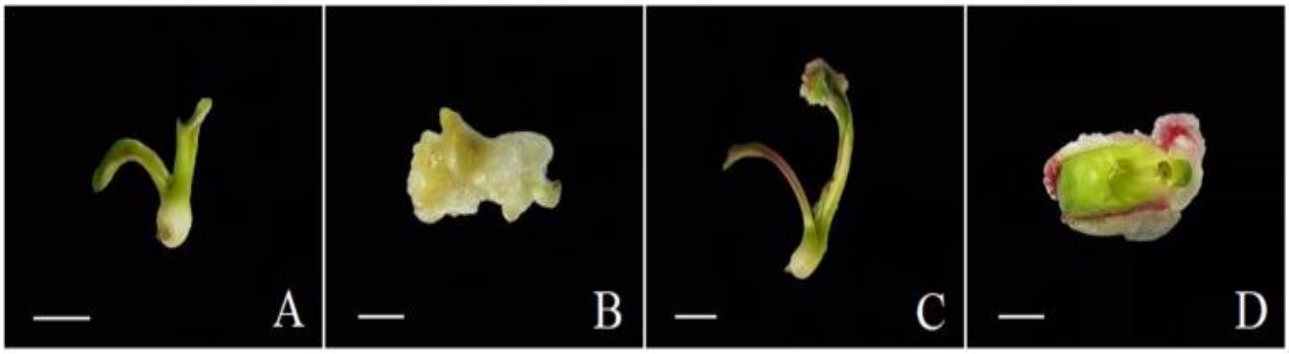


Figure 1 Effects of GA_3, NAA and 6-BA on embryo germination status of *P. lactiflora* (Adopted from Xin et al., 2025)
Image caption: The germination status of embryo in different medium: (A) 1.0 mg/L GA_3, (B) 1.0 mg/L NAA, (C) 1.0 mg/L GA_3+0.5 mg/L 6-BA, (D) 1.0 mg/L NAA+0.5 mg/L 6-BA. MS: Murashige and Skoog; GA3: gibberellin 3; NAA: 1-naphthaleneacetic acid; 6-BA: 6-benzyleaminopurine. Scale bars=0.5 cm (Adopted from Xin et al., 2025)

4.2 Soil quality maintenance and control technologies for continuous cropping obstacles

Soil quality maintenance in continuous perennial *P. lactiflora* production should focus on preventing replanting obstacles rather than assuming all long-term cultivation is equally harmful. In peony, replanting at original sites reduced growth and flowering, worsened quality, increased pests and diseases, and eventually caused plant death, while sequencing studies showed that five years of replanting lowered pH, available nutrients, enzyme activities, and bacterial and fungal diversity, and increased harmful microorganisms such as *Gibberella* while reducing beneficial *Bacillus* (Li et al., 2023). Root-soil studies refine that picture: seven years of continuous planting did not produce obvious adverse soil factors, but four years of replanting shifted soil from a bacterial high-fertility state to a fungal low-fertility state, decreased pH, organic matter, nutrients, enzymes, and bacterial abundance, and increased benzoic acid, which is a plausible autotoxin contributor.

Control technologies therefore need to combine soil improvement, microbial regulation, and system-level cropping design. Broader medicinal-plant reviews agree that continuous-cropping obstacles are mainly driven by altered microbial communities, nutrient imbalance, and allelopathic effects, and that effective mitigation includes soil amendments, crop rotation, intercropping, and management aimed at rebuilding beneficial microbiota and soil fertility (Haq et al., 2023; Liao and Xia, 2024). This systems view also matters because not all continuous-cropping systems develop obstacles; some can enrich beneficial microorganisms and become disease-suppressive, so management should target microbial food-web structure and plant-soil-organism