

tissue-culture-based production chain (Khan et al., 2025). For large-scale *P. sibiricum* production, tissue culture is therefore best positioned as the rapid multiplication platform, while field rhizome division remains the lower-cost method for mother-stock maintenance and local nursery expansion.

4 Rhizome Formation and Harvest Standards

4.1 Selection of mother plants and quality control of rhizome sources

Mother-plant selection for *Polygonatum sibiricum* rhizome propagation should prioritize stable agronomic performance, strong rhizome development, and high levels of functional constituents, because *Polygonatum* materials differ substantially in yield, polysaccharide content, saponin content, and related morphological traits under common-garden conditions. Provenance also matters, since the formation of plant genetic traits differs among source populations and is affected by climatic conditions at the place of origin. In practical selection, stem diameter can serve as an auxiliary field indicator because it is positively correlated with yield and has been proposed as an indicator for harvest-oriented variety screening. Mother plants should therefore be chosen from vigorous, disease-free stands with consistent aboveground growth and strong rhizome expansion, while avoiding mixed or poorly adapted germplasm that can reduce uniformity in subsequent seedling production (Figure 2) (Liao et al., 2023).

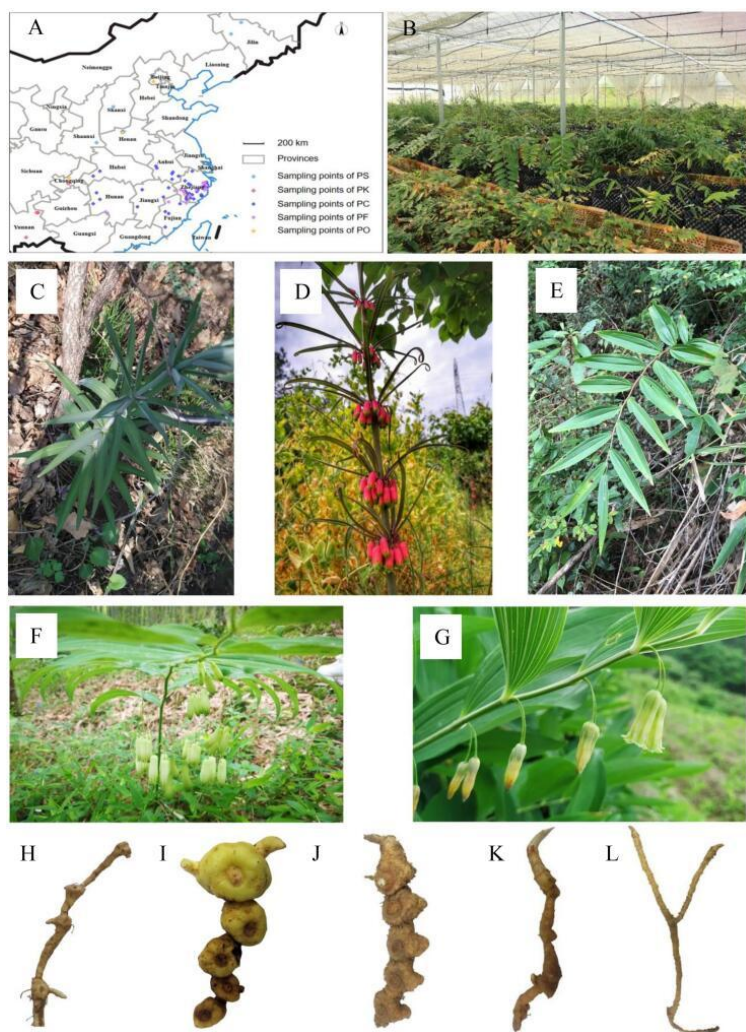


Figure 2 The sampling distribution and morphology of five species from *Polygonatum* genus (Adopted from Liao et al., 2023)
Image caption: (A) Sampling distribution of 5 different species from *Polygonatum* genus populations in map of China (partial); (B) The common garden in Zhejiang, China; (C) The aerial part of *Polygonatum sibiricum* Red. (PS); (D) The aerial part of *P. kingianum* Coll. et Hemsl. (PK); (E) The aerial part of *P. cyrtoneura* Hua (PC); (F) The aerial part of *P. filipes* Merr. (PF); (G) The aerial part of *P. odoratum* (Mill.) Druce (PO); (H) The rhizome morphology of PS; (I) The rhizome morphology of PK; (J) The rhizome morphology of PC; (K) The rhizome morphology of PF; (L) The rhizome morphology of PO (Adopted from Liao et al., 2023)