

3.2 Selection of cutting types, positions, and specifications

The second key step is to standardize cutting type, position, and specifications, because rooting capacity varies greatly with tissue maturity, node number, stem diameter, and topophytic origin (Figure 1) (Mohammed et al., 2020). Across many species, softwood or semi-hardwood cuttings often outperform older hardwood material. In *Tecoma stans*, softwood cuttings showed greater sprouting and rooting than hardwood cuttings (Singh et al., 2021). In kiwifruit, semi-hardwood cuttings produced better root traits than hardwood cuttings (Choudhary et al., 2024), and in plum rootstocks, semi-hardwood cuttings reached 100% rooting in one genotype (Seleshi et al., 2021). However, this is not universal: prairie willow rooted better from dormant hardwood than semihardwood cuttings (Schrader et al., 2026). For *T. hemsleyanum*, the most defensible target is physiologically juvenile but partly matured shoots, rather than highly lignified old wood or excessively succulent tissues (Saini et al., 2025). Position within the shoot also matters. Terminal stems often root faster (Singh et al., 2021), but upper-branch softwood cuttings performed best in *Picea crassifolia*, and basal cuttings in *Prunus subhirtella* produced more extensive root systems even when rooting percentage was similar to terminal cuttings. These differences reflect hormone and stress gradients after severance, so the selected cutting position should be defined empirically rather than assumed (Kunc et al., 2026).

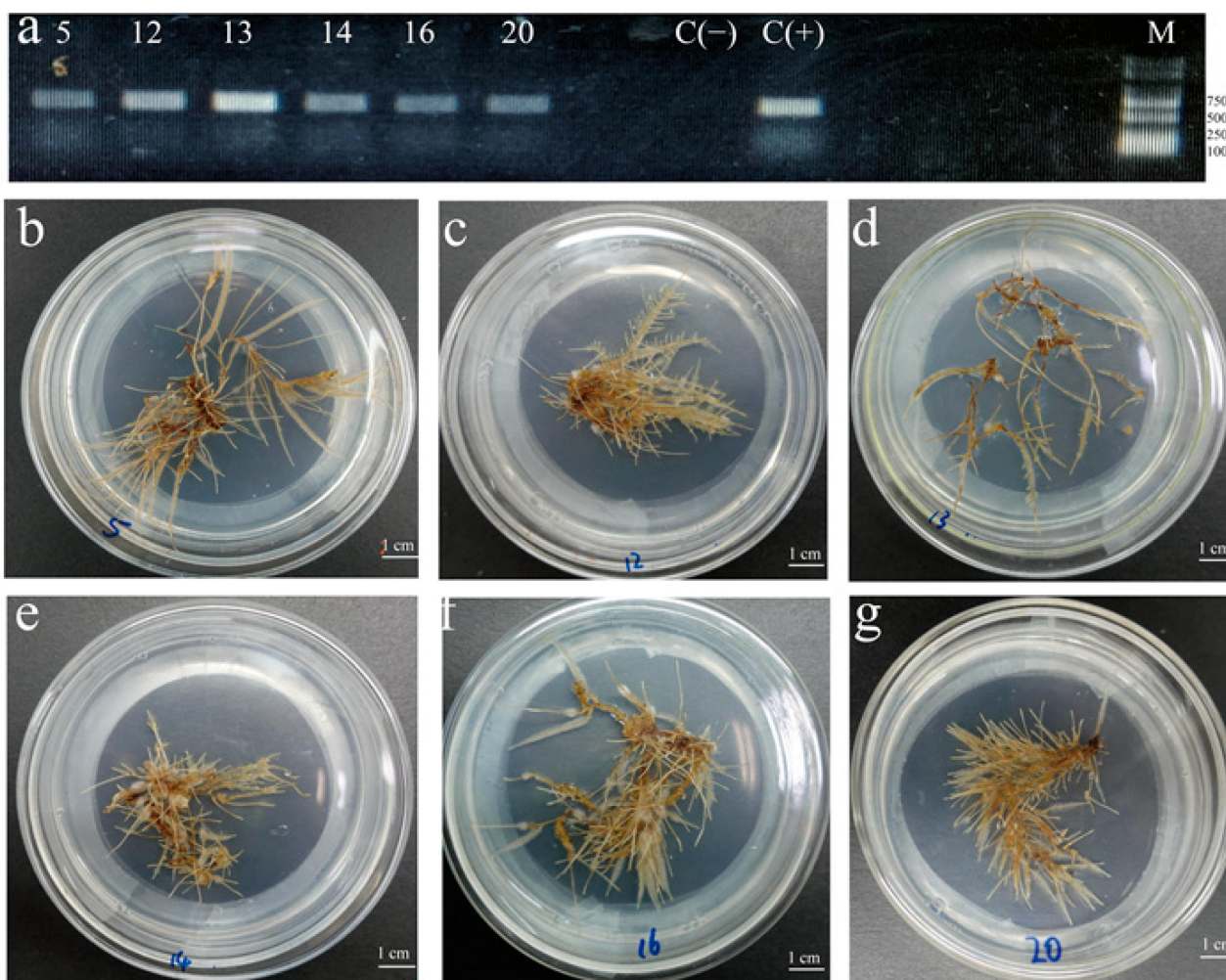


Figure 1 PCR analysis and phenotypes of 6 *T. hemsleyanum* hairy root lines (Adopted from Wang et al., 2023)

Image caption: (a) PCR analysis of the *rolB* gene in the hairy root line of *T. hemsleyanum* [lane M, marker; L1-L6, the hairy roots lines induced by *A. rhizogenes* Ar Qual, named HR4, 5, 12, 13, 14, 16, and 20; C (+), plasmid DNA from *A. rhizogenes* Ar Qual (positive control); C (-), roots from a non-transformed control plant (negative control)]. (b) HR5, (c) HR12, (d) HR13, (e) HR14, (f) HR16, and (g) HR20 (Adopted from Wang et al., 2023)