7 Application of Fingered Citron Seedling Propagation and Orchard Establishment Techniques

7.1 Whole-process quality control of seedling propagation

Whole-process quality control in fingered citron seedling propagation should begin with a clear crop plan and standard operating procedures that monitor each production stage from source material and rootstock preparation to substrate management, grafting, grading, and dispatch. Citrus nursery production likewise treats rootstock propagation, attainment of buddable size, and subsequent grafting as linked quality-control steps rather than independent operations (Vashisth et al., 2020). Where seed-propagated citrus rootstocks are used for fingered citron grafting, seed pretreatment and seed maturity can influence emergence, vigor, and uniformity; studies using GA3 or different fruit-harvest stages illustrate these control points (De Carvalho et al., 2021). These findings should be used to guide quality control of the selected rootstock source, not as direct evidence that fingered citron itself requires the same seed treatment or harvest timing.

Substrate, containers, irrigation, and fertigation determine whether nursery plants reach the desired specification. Citrus studies show that substrate physical and chemical properties can influence seedling development through grafting, and inappropriate formulations may restrict growth (Liberato et al., 2021). Compost-containing potting mixes improved germination, biomass accumulation, and budding success in citrus rootstocks (Vashisth et al., 2020), while moderate N and P fertigation improved several nursery growth and physiological traits (Kaur et al., 2024). These results support the principle of balanced substrate and nutrient management, but study-specific formulations or nutrient rates should not be used directly as fingered citron prescriptions. Container type also affects root architecture, because enclosed containers can induce root circling while root-pruning containers can reduce deformation. Final release should therefore use explicit grading criteria. Citrus grading studies show that plant height, scion diameter, branch number, and root condition can be translated into operational quality classes (Xu et al., 2020), but fingered citron thresholds should be established from its own nursery and field performance.

7.2 Coordination between seedling quality and orchard establishment techniques

Seedling quality and orchard establishment techniques need to be coordinated because nursery traits influence post-planting survival, recovery, and early orchard performance, while field conditions determine which seedling traits are actually valuable. The target-seedling concept captures this relationship by linking nursery production to the conditions of the eventual planting site rather than defining quality only inside the nursery. In citrus, this coordination begins with choosing compatible propagation materials, since high-quality grafted seedlings form the foundation of stable, high-yield production and inappropriate rootstock-scion combinations can weaken stress resistance and delay fruiting (Wang et al., 2025). Rootstock choice is part of orchard establishment strategy because rootstocks affect scion growth, nutrition, fruit quality, and tolerance to biotic and abiotic stress, so the same seedling is not equally suitable for all planting environments (Vashisth et al., 2020).

Coordination also depends on transplant timing, root-system quality, and field readiness. A Cleopatra mandarin study showed that transplant age can influence survival, stem-diameter growth, and branching during the rootstock stage, demonstrating that transplant timing is an important nursery-to-field control point; however, the reported age should not be transferred directly to fingered citron. Root-system quality is central because successful field establishment depends on healthy roots, while containerized nursery systems can restrict root expansion and alter later growth. Propagation method also influences orchard-stage behavior, and citrus studies show that orchard growth depends on the combination of propagation method and rootstock rather than propagation method alone (Albrecht et al., 2020). Nursery certification further supports orchard establishment. In citrus systems, protected-environment production and certified seedling distribution have been used to reduce the spread of diseases such as HLB and CVPD. These are disease-management examples from citrus; for fingered citron, the transferable principle is to use verified healthy planting material and minimize pathogen introduction. Even after delivery, quality can decline through poor handling, transport, or planting, so standardized orchard establishment should include proper seedling handling and timely water support at the receiving site (Mufidah et al., 2021).