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Propagation Techniques for Major Fruit Crops: An Overview

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Abstract

Propagation is a fundamental aspect of fruit crop cultivation, influencing plant uniformity, productivity, quality, and orchard establishment. Fruit crops are propagated through sexual (seed) and asexual (vegetative) methods. Although seed propagation is useful for rootstocks, breeding, and conservation, it often causes genetic variability, delayed bearing, and inconsistent fruit quality (Dhatt & Mahajan, 2022). Therefore, vegetative propagation is preferred for most commercial fruit crops to ensure true-to-type plants, uniform growth, and early fruiting (Hartmann et al., 2011; Singh et al., 2021). Common vegetative methods include cutting, layering, grafting, budding, and suckering, selected according to species-specific requirements. T-budding is widely used in citrus (Ladaniya, 2008), while veneer grafting is preferred for



mango and sapota (Naik et al., 2020). Banana and pineapple are propagated through suckers and slips, respectively (Kumar et al., 2022), whereas hardwood cuttings are suitable for fig, grape, and pomegranate. Modern techniques such as micropropagation, synthetic seed technology, somatic embryogenesis, and cryopreservation have further enhanced the rapid multiplication and conservation of elite, disease-free, and genetically uniform planting material. Micropropagation is particularly valuable in banana, strawberry, and kiwi (Hesami & Jones, 2020). Integration of traditional and modern propagation techniques is essential for nursery management, orchard establishment, germplasm conservation, improved fruit quality, and sustainable fruit production.

Propagation Methods for Different Fruit Crops

Classification of Propagation Methods

Propagation methods in fruit crops are primarily categorized into two types:

Sexual Propagation (Seed Propagation)	Asexual (Vegetative) Propagation
This method involves the use of seeds to raise new plants. It is commonly employed for rootstock production, breeding programs, and in crops where vegetative propagation is either difficult or not commercially viable.	Vegetative propagation includes all methods where parts of a plant (root, stem, leaf) are used to produce genetically identical progeny. It enables early fruiting, maintains varietal purity, and is essential for commercial orchards.
Though seed propagation results in greater genetic variability, it often leads to late bearing and non-uniform plant populations.	Artificial techniques such as grafting, budding, and tissue culture are widely adopted in horticulture.

Seed Propagation in Fruit Crops

Seed propagation plays a crucial role in species conservation and initial plant multiplication. However, due to its inherent genetic heterogeneity, it is mainly used in; -

- Papaya – Dioecious nature requires seed propagation; sex identification is vital.
- Jamun, Phalsa, and Ber – Still propagated by seed in traditional systems.
- Guava and Citrus – Seeds are used for raising rootstocks for subsequent grafting.



Challenges include prolonged juvenile phase, variability in traits, and delayed bearing. Pre-sowing treatments like seed soaking in GA₃, acid scarification, and seed priming improve germination.

Vegetative Propagation Techniques

1) Cuttings

Cuttings involve rooting detached plant parts such as stems or roots. Success depends on season, growth phase, and use of rooting hormones. IBA and NAA are frequently used to induce rooting.

Hardwood Cuttings	Grapes, pomegranate, fig, mulberry
Softwood/Semi-Hardwood Cuttings	Guava, lemon, hibiscus
Root Cuttings	Apple (for rootstock), fig

2) Layering

Layering encourages roots to form on a stem while it is still attached to the parent plant.

Air Layering	Litchi, guava, sapota
Mound Layering	Apple, pear, gooseberry
Serpentine Layering	Passionfruit It is useful for difficult-to-root crops and ensures higher success than cuttings

3) Grafting

Grafting involves joining a scion (desired variety) to a rootstock (established plant).

Veneer and Stone Grafting	Mango, sapota
Cleft and Wedge Grafting	Apple, pear
Softwood Grafting	Jackfruit, tamarind

4) Budding

Budding uses a single bud from a desired variety inserted into a rootstock.

T-Budding	Citrus, rose, plum
Patch Budding	Ber, rubber
Ring and Chip Budding	Apple, cherry

This method is commonly used in nurseries due to ease and high success rate.



5) Suckers, Runners, and Slips

Suckers	Banana (sword and water suckers)
Runners	Strawberry
Slips and Crowns	Pineapple

6) Division and Offsets

Used in herbaceous and monocotyledonous fruit crops like:

- Date palm – Offshoots
- Banana – Rhizome division
- Plantain – Sucker division,

Modern Propagation Technologies - Micropropagation (Tissue Culture)

- **Crops:** Banana, pineapple, strawberry, kiwi, date palm
- **Stages:** Initiation → Multiplication → Rooting → Hardening Synthetic Seeds and Somatic Embryogenesis
- Somatic Embryogenesis – Citrus, mango
- Synthetic Seeds – Encapsulated somatic embryos or shoot buds

Cryopreservation

Used for long-term storage of germplasm at ultra-low temperatures. Particularly beneficial for conservation of endangered or rare cultivars.

Propagation methods for different fruit crops

Crop	Method	Remarks
Mango	Veneer grafting	True-to-type, early bearing
Banana	Suckers, tissue culture	High multiplication rate, disease free
Citrus	T or Patch Budding	Used on rough lemon or trifoliate rootstocks
Grapes	Hardwood cuttings	High success in spring
Litchi	Air layering	Moisture critical for success



Factors Affecting Success of Propagation

- Physiological age of the stock and scion
- Season and temperature – best results in spring and monsoon
- Use of plant growth regulators (PGRs) – IBA, NAA for rooting
- Rootstock-scion compatibility – critical in grafting and budding

Recent Advances and Future Prospects

- Automation in nursery operations – mist chambers, rooting stations
- Use of biofertilizers and biostimulants – improves success in rooting
- Nanotechnology – controlled release of hormones and nutrients
- Molecular markers – for clonal fidelity and disease indexing

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