MedCrave
Step into the World of Research
Journal of Applied Biotechnology and Bioengineering

Short Communication

Open Access
CrossMark

Importance of propagation techniques of fruit trees

Abstract

Fruit crops provide important nutrients like vitamins, fiber, minerals, and sugars that are essential for human health. To grow these crops, both sexual and asexual propagation techniques are used to produce seedlings. Understanding these techniques helps meet the needs of producers and ensure consistent fruit production. Sexual propagation is important in a fruit breeding program. Sexual propagation of fruit trees uses seeds to produce new seedlings, while sexual seedling production leads to genetic variation, which can affect tree productivity and fruit quality, making it less suitable for commercial fruit production. Asexual methods, such as grafting and rooting cuttings, are popular for their cost-effectiveness and simplicity. Asexual propagation techniques help produce plants by using their roots, branches, and leaves, producing seedlings that are true to the parent plants in traits. This method is vital for sustaining fruit production, ensuring selected varieties are preserved, speeding up fruit production, increasing disease resistance, and offering uniformity in orchards. Common techniques include budding, grafting, and tissue culture, which help produce large quantities of virus-free seedlings for numerous fruits like bananas, apples, mangoes, and citrus. Often, combined approaches like grafting micro-propagated plants onto seedling rootstocks are used in fruit crops, making methods like T-budding practical for nurseries.

Keywords: fruit production, sexual propagation, asexual propagation, grafting, budding, tissue culture

Volume 12 Issue 5 - 2025

Waleed Fouad Abobatta
Horticulture Research Institute, Agricultural Research Center, EgyptA

Correspondence: Waleed Fouad Abobatta, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt

Received: June 27, 2025 | **Published:** August 28, 2025

Introduction

Fruit crops, which are a precise source of multivitamins, fiber, minerals, and sugars, are very essential foods for our nutritional habits and body health. Fruit crop propagation involves both sexual and asexual techniques to produce fruit seedlings. Understanding the details of fruit propagation, input, and output of fruit propagation is important to meet producers' needs and sustain fruit production.[1]

Traditional methods are sexual propagation (seed propagation) or asexual techniques like grafting, budding, tissue culture, using nuclear embryos, and rooting cuttings. Fruit crop propagation involves both sexual and asexual methods. While grafting, budding, and tissue culture remain popular as asexual propagation methods for their affordability and ease of use. Sexual propagation is important in producing rootstocks and is a key tool in breeding programs. Sexual seedlings undergo cross-pollination due to genetic isolation, resulting in offspring with different characteristics from the mother plants, which causes variations in tree productivity and fruit quality.[2]

In sapling production, reproduction of numerous fruit species and rootstocks makes use of the economically significant production technique known as asexual or vegetative propagation. By utilizing the organs of plants, such as roots, branches, and leaves, vegetative production enables the replication of plants.

Seedlings are a vital part of the fruit production industry, and while the juvenile phase lasts a long time, plants need to be chosen carefully, and mass propagation methods must be used. Because seedy seedlings frequently display genetic diversity (as a result of cross-pollination) and may not retain the desired traits of the species, asexual propagation is essential for guaranteeing true-to-type propagation in fruits.

Asexual propagation techniques are essential for sustainable, high-yielding, and disease-free fruit production. It ensures the production of seedlings similar to the mother plants with desired properties.[3] Asexual propagation methods, such as grafting, cuttings, and tissue culture, produce distinctive vegetative structures that are changing the fruit industry by preventing diseases, shortening juvenility, accelerating fruiting, and ensuring high-quality fruit.

Furthermore, asexual propagation preserves choice varieties exactly, speeds up fruiting compared to seedy trees, enhances disease resistance & adaptability through rootstocks, and ensures uniformity in commercial orchards**.** Asexual propagation is an economically important production method used in the reproduction of many fruit species and rootstocks in sapling production. Asexual production, which is carried out by using the organs of plants such as bud-woods, branches, and leaves, allows plants to be produced as clones. Tissue culture and grafting are common asexual propagation techniques that are used to produce virus-free mass production of seedlings of banana, apple, mango, and citrus.[4]

Combined approaches, e.g., micropropagated plants grafted onto seedling rootstocks, are common in fruit crops like apples, mangoes, and citrus. For instance, T-budding of navel orange bud-wood on Carrizo citrange is considered a cost-effective method for commercial nurseries.[5]

This work explores the role of fruit propagation techniques in fruit production and breeding programs to produce tolerant rootstocks and scions for climate conditions, examines the significance of reproduction methods in different fruit cultivars, and the most popular techniques employed.

Sexual propagation (seed-based reproduction)

Sexual propagation offers simplicity, low cost, and reliability, making it a practical choice for small-scale farmers and even some commercial growers. However, its suitability depends on the crop and farming goals.

Sexual propagation is common in some fruit crops but problematic in others due to genetic variability, which fluctuating productivity and fruit characteristics.[6]

Main practices for growing fruit seedlings by sexual propagation include selecting high-quality seeds, pre-treating seeds for better germination, providing optimal growing conditions, and monitoring growth. There are some fruit crops propagated mostly by sexual methods, including papaya (Carica papaya), pomegranate (Punica granatum), guava (Pseudomonas palustris), acid lime (Citrus aurantifolia), and mangosteen (Garcinia mangostana).

Producing fruit seedlings through sexual propagation requires several key practices to produce healthy fruit seedlings and ensure vigorous plant growth, as follows:

1. High-Quality Fresh Seed Selection
2. Pre-treating seeds for better germination includes cleaning, drying, treating with fungal agents, and soaking in growth regulators.
3. Sowing seeds in small pots or polyethylene plastic bags.
4. Providing optimal growing conditions such as moisture, temperature, and light.
5. Seedling care, which includes monitoring growth, thinning, fertilization, pest & disease control, and hardening off.
6. Transplanting in the field.

Sexual propagation (seeds) is required for major cases, like the following:

1. Breeding new varieties.
2. Introducing genetic diversity for resilience.
3. Plants that are difficult to propagate vegetatively.

Advantages of sexual propagation in fruits

1. Low cost (seeds are cheaper than grafted plants).
2. Genetic diversity (can produce disease-resistant or climate-adapted varieties).
3. Useful for breeding new cultivars.
4. **Rootstock production** (e.g., sour orange, mango, and peach)

Disadvantages

1. Poor fruit quality (inferior fruit).
2. Longer time to fruiting and maturity (e.g., avocado seeds take 5–13 years vs. 3–4 years for grafted trees).
3. Some varieties are without seeds or produce sterile seeds (e.g., bananas, navel oranges, and seedless grapes).

Sexual propagation techniques involve several key steps, as follows:

1. Selecting ripe, healthy, and disease-free fruit from a parent tree.
2. Extract and clean the seeds, drying them if necessary, except for certain seeds such as mango or lychee, which should be planted fresh.
3. Pre-treatment for seeds, i.e., scarification for hard-shells, seeds like tamarind and date palm, stratification for temperate fruits like apple, peach, and plum, or soaking for faster germination.
4. Cultivate seeds in containers or boxes, or cultivating seeds directly in polyethylene sheets.
5. Well-draining soil is required to prevent seed spoilage, and seeds must planted at the appropriate depth, covered lightly, and watered gently.
6. Watering should be accurate to avoid waterlogging, and it is preferable to use a plastic mulch to retain moisture until germination.
7. After germination, early care of the seedlings is required by placing them in a warm, bright location and keeping them properly moist until they have 2–4 true leaves.
8. Seedlings be hardened off before transplanting in the field.

Asexual propagation

Asexual propagation ensures true-to-type propagation in fruits, and it is critical because seedy seedlings often exhibit genetic variation and may not retain the desired characters of the species, furthermore, they ensure consistency and quality in fruit production. Modern asexual propagation techniques, such as biotechnology and tissue culture, offer disease-free seedlings, speed up breeding, improve production efficiency, and ensure consistent, high-quality fruit, which is crucial for sustainable harvesting.

Asexual propagation, which produces plants typically identical to the parent plant and retaining all of its beneficial characteristics (such as fruit quality, disease resistance, and growth pattern), is a fundamental goal of the whole fruit orchard sector. Many asexual propagation techniques are used in the fruit orchard sector, including grafting, budding, air layering, cuttings, tissue culture, and clonal propagation, which are key to reliable, high-quality fruit propagation for improved fruit production and sustaining reliable characteristics.[7]

Asexual propagation helps fruit growers produce high-quality crops and increases their profits. Traditionally, commercial fruit trees were propagated by cultivating seeds or seedy seedlings in the field and, later, by budding or grafting budwood onto rootstock grown from seeds. In the past, fruit trees were propagated by budding or grafting them onto rootstock grown from seeds. Today, clonal rootstocks, which are genetically similar and offer advantages like pest and disease resistance, are widely used to address adaptation challenges. These clonal rootstocks also tolerate different soil conditions and extreme weather.[8]

Key benefits of asexual propagation for fruit trees

1. Preservation of Superior Genetics
2. Early and Consistent Fruit Production
3. Control canopy size.
4. Disease Resistance & Hardiness by grafting with Tolerant Rootstocks
5. Maintaining Hybrid Varieties
6. Rejuvenation of Old or Damaged Trees.

Common asexual propagation techniques for fruit trees

1. Grafting (T-budding, cleft, whip), which is used in Apples, Pears, Citrus, mangoes, and Avocado
2. Air layering (marcotting) is used in guava, lychee, and pomegranate.
3. Stem cuttings, such as fig, grape, olive, and pomegranate.

4. Suckers & Offshoots (Natural Cloning Method), such as in banana, date palm, and pineapple.
5. Tissue Culture (micropropagation) is commonly used to produce banana, strawberry, and apple seedlings.

Asexual propagation has several advantages, as follows:

1. Used for propagated fruit crops that do not produce viable seeds, like bananas.
2. Produces true-to-type plants.
3. Allows for earlier fruit-bearing.
4. Using grafting with particular rootstocks can give plants resistance to insects and diseases.
5. Additionally, asexual propagation assists in controlling tree size.
6. Different fruit varieties can be grown through grafting, and poor-quality plants can be improved.

Limitations and considerations of asexual propagation

There are some limitations and considerations for asexual propagation techniques, including:

New varieties cannot be created.

Genetic Mutations

Plants produced by asexual propagation may be affected by the same pests, diseases, and viruses.

Disease transmission is spreading through the vegetative parts.

Lack of Genetic Diversity.

The process could be expensive and requires special skills. Propagation is labor-intensive.

Rootstock Limitations

Asexually propagated plants have a shorter lifespan.

Conclusion

Fruit crops can be propagated through two main methods: sexual and asexual propagation. Sexual propagation involves using seeds, which can create new plants that differ genetically from their parents and may affect the productivity and fruit quality, while it plays a vital role in breeding programs to produce new varieties and rootstocks. Asexual methods, including grafting, budding, cuttings, and tissue culture, are key for producing high-yield, disease-free fruits. These techniques help sustain consistent production, prevent diseases, promote faster growth, and ensure fruit quality by preserving desirable traits in parent plants. Often, combined approaches like grafting micro-propagated plants onto seedling rootstocks are used in fruit crops to enhance fruit production and increase disease resistance, making methods like T-budding practical for nurseries.

Acknowledgements

None.

Conflict of interest

Authors declare that there is no conflict of interest.

References

1. Ak BE, Hatipoglu IH, Dikmetas B. Propagation of fruit trees. *Recent Headways in Pomology. Editor, M. Pakyurek Chapter*. 2021;3:55–92.
2. Petrén H, Thosteman H, Stift M, et al. Differences in mating system and predicted parental conflict affect post–pollination reproductive isolation in a flowering plant. *Evolution*. 2023;77(4):1019–1030.
3. Paul M. Breeding techniques for asexuality propagated crops. *Fundamentals of Plant Breeding*. 2024. 154 p.
4. Awotedu BF, Omolola TO, Akala AO, et al. Vegetative propagation: A unique technique of improving plants growth. *World News of Natural Sciences*. 2021;35:83–101.
5. Lal M, Jamwal M, Sood Y, et al. Micropropagation of fruit crops: A review. *Plant Science Today*. 2023;10(1):108–117.
6. Sattar MN, Iqbal Z, Al–Khayri JM, et al. Induced genetic variations in fruit trees using new breeding tools: food security and climate resilience. *Plants.* 2021;10(7):1347.
7. Pundir D, Singh S, Saxena AK. Asexual methods of plant propagation in horticultural crops. *Practices Research on Horticulture*. 2024. P. 1–17.
8. Tang L, Syed AUA, Otho AR, et al. Intelligent rapid asexual propagation technology—a novel aeroponics propagation approach. *Agronomy*. 2024;14(10):2289.