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Popular Article

INVITRO GRAFTING: A Potential Propagation Technique for Fruit Crops

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Introduction

Conventional agricultural practices are depleting essential natural resources such as land, water and soil. Simultaneously, the growing global population is directly escalating the demand for food. To address these demands, technology becomes crucial for enhancing both the quantity and quality of food production on a global scale. Notably, horticulture production in India has recently exceeded that of traditional agriculture, opening up broader opportunities. Recognizing that multiple inputs are necessary for crop production, it is crucial to emphasize the significance of high-quality planting material as a fundamental and critical factor in horticulture. The insufficient availability and low quality of planting material pose significant constraints in this regard.

Propagation involves increasing the number of plants within a specific species or cultivar. Grafting, a commonly employed horticultural method, is utilized to propagate several commercially significant fruit crops, including apple, peach, citrus, apricot, cherry, plum and almond. The concept of artificial grafting may have been inspired by natural grafts, where the roots or stems of different plants come into contact under pressure due to growth or physical constraints. In artificial grafting, parts from two or more plants, often of different varieties, are combined and then grow as a unified plant. Consequently, when achieving true breeding is not feasible, grafting serves as an alternative method.

In the late 1990s, a novel plant grafting method known as "*in-vitro* grafting" was introduced, exhibiting distinctions from field grafting in several aspects. A notable contrast lies in the reduced size of both the scion (upper plant part) and rootstock (lower plant part),

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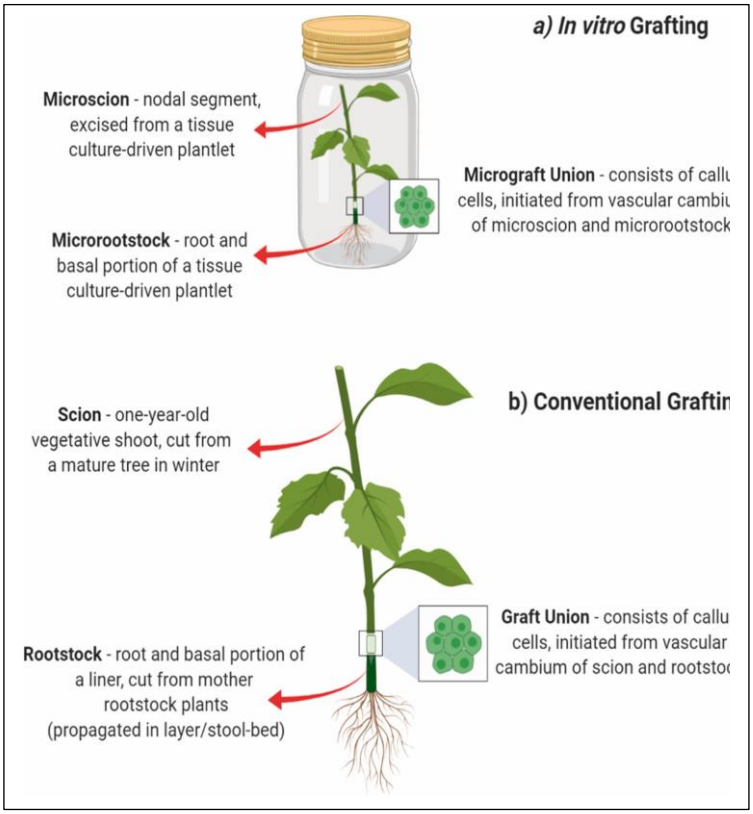
alongside the maintenance of aseptic conditions. As we enter the 21st century, the use of *in-vitro* grafting holds the potential to introduce new dimensions to the commercial horticulture sector, particularly in the propagation of fruit crops.

***In vitro* grafting**

It was initially introduced by Morel and Martin in 1952 in order to produce virus-free dahlia plants. The first successful application of micrografting in Citrus was achieved by Murashige *et al*. in 1972. *In-vitro* grafting approach has the potential to merge the benefits of *in-vitro* multiplication with increased productivity arising from grafting, utilizing superior combinations of scion and rootstock in aseptic conditions. The major difference from traditional grafting technique is faster multiplication, production of disease-free planting material, require less space, aseptic condition is maintained, small size scions and young rootstocks are used (Chilukamarri *et.al*.,2021)



Advantages of *in vitro* grafting technique

Virus and Viroid elimination: The apical shoots typically stay virus free since the meristem grows faster than the spread of the virus within the plant. Hence, virus free plants are produced.

Development of plants resistant to pest and diseases: Micrografting serves as a method for eradicating pest and diseases in fruit crops. It has proven successful across various horticultural plants, emerging as an approach to obtain resistant plants to soil-borne pathogens.

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Analysis of graft incompatibility: Indications of graft incompatibility are frequently noticed years later in the field, but *in vitro* grafting and *in vitro* callus fusion techniques enable early detection. This method is employed to examine the histological, histochemical and physiological dimensions of graft incompatibility.

Mass multiplication: Micrografting has the potential to blend the benefits of quick *in vitro* multiplication and grafting arising from superior combinations of scion and rootstock (Gebhardt and Goldbach, 1988)

Indexing viral diseases: Grafting is employed to identify latent viral diseases associated with plants. In this process, a plant (known as the indicator plant) which is susceptible to the specific disease under investigation, is grafted onto the suspected plant. If the plant suspected is indeed infected, the characteristic symptoms caused by the virus become evident on the indicator plant.

Safe germplasm exchange: Small and disease-free plants can be exchanged between countries with minimum quarantine risks.

***In vitro* grafting protocol**

Raising of rootstock: Rootstocks are selected from *in vitro* or *in vivo* germinated seedlings or rooted or unrooted micro propagated shoots. The seedlings can be placed on an agar medium for support. Alternatively, they may be placed on a permeable substrate, like sterile vermiculite, which facilitates the development of a branched roots.

Scion preparation: Apical shoots can be selected from *in vivo* or *in vitro*. After establishment, micro shoots are moved to a shoot proliferation medium, leading to an increase shoot numbers through the development of new axillary shoots. Micro shoots of the ideal thickness, age and length are used as scions.

Grafting *in vitro*: Take the decapitated rootstock and scion (0.1-0.3 mm). Make incision by 1 mm long vertical cut and 1mm horizontal cut at the bottom of vertical cut end at 1-2 cm above rootstock. Shoot tip is placed inside the incision with its cut surface in contact with the rootstock.

***In vitro* culture:** Grafted plants are cultured in MS medium. Cultures are kept at 27 ± 2°C. After 4-5 weeks successful grafts are obtained.

Acclimatization: Grafts are transplanted into the pot with sterilized soil: sand: vermiculite (1:1:1). Pots are enclosed in polyethylene bags. After week bags are removed and placed in greenhouse condition.

Factors affecting graft success: scion origin, scion length, pretreatment of scion, rootstock age, grafting method, availability of nutrients

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Conclusion

In vitro grafting has great potential for improvement of fruit crops and mainly used for the production of virus free plants. It aids in predicting incompatibility between grafting partners, conducting histological studies and performing virus indexing, safe germplasm exchange between countries and multiplication of difficult to root plants. This safe technique can be used for year-round commercial plant production under controlled environmental conditions.

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