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# HARNESSING ROOTSTOCK POTENTIAL FOR SUSTAINABLE FRUIT PRODUCTION IN WARM REGIONS

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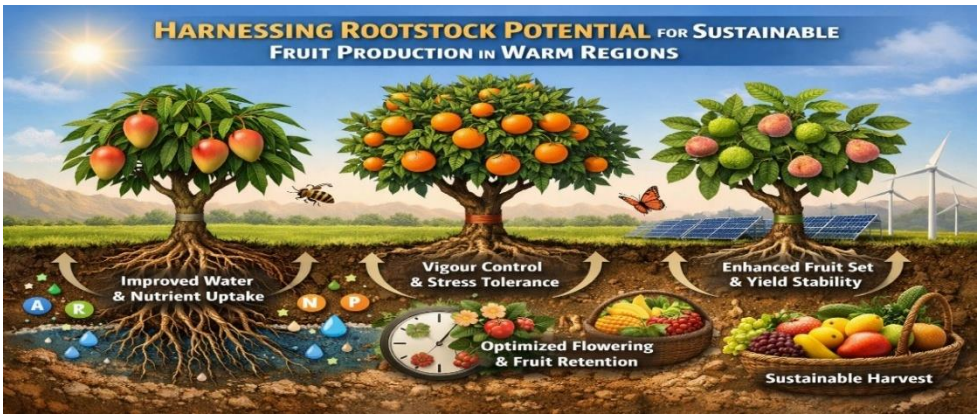
## 1. INTRODUCTION

Rootstocks are an integral component of fruit crop production systems, exerting profound effects on tree growth, fruit quality and overall orchard productivity. The significance of rootstock selection is underscored by its influence on tree vigour, precocity, yield efficiency and resilience to various soil and climatic conditions (Robinson et al., 2016). Effective rootstock selection is essential for optimizing orchard performance, enhancing sustainability and meeting the diverse needs of growers and consumers. In tropical and subtropical regions - where soils may vary from alkaline to saline and climatic conditions may shift from extreme heat to periodic drought- effective rootstock selection requires assessing adaptability to these environmental factors (Hancock et al. 2015). Strong rootstock–scion compatibility is essential for developing healthy graft unions and ensuring sustained orchard performance over many years. Rootstocks also provide resistance against soil-borne pathogens, insect pests and physiological disorders, reducing reliance on chemical inputs and supporting more sustainable fruit production systems. The role of rootstocks and its use in different fruit crops has significant impact on fruit crop production by influencing canopy architecture, nutritional uptake, flowering, yield and fruit quality.

## EFFECT OF STOCK ON SCION CULTIVARS




**List of resistant/ tolerant rootstocks in fruit crops:**

| Crop | Rootstock | Resistant traits |
|---|---|---|
| **Mango** | 13-1, Olour, Bappakai, Gomera-1, 13/3 | Tolerant to salinity |
| | Carabao | Tolerant to wilt |
| **Guava** | *Psidium friedrichsthalianum, P. cattleianum var. lucidum, Psidium guineense* | Resistance to root-knot nematode |
| **Avocado** | G755C13-1<br>Duke 7 and G6 | Salt tolerant<br>Resistance to *P. cinnamomi* |
| **Loquat** | Anger | Tolerance to Saline conditions |

## 2.1 How Rootstock help to induce Dwarfness

Dwarfing might be caused by water supply restrictions to the scion induced by anatomical characteristics of the rootstock (Beakbane, 1956: Aykinson et al., 2003). Dwarfing might be caused by partial incompatibility between the scion and the rootstock which may alter the transport of minerals and hormones (Webster, 2004).

**Rootstocks for Dwarfing and High-Density Planting**

| | |
|---|---|
| **Mango (*Mangifera indica*)** | Vellaikolamban (Vellai Kulamban), Olour, Ambelavi, Kalapady |
| **Citrus (*Citrus spp.)*** | Flying Dragon *(Ponciru trifoliata orange var. monstrosa*) |

| | |
|---|---|
| **Guava** | *Psidium pumilum*, Pusa Srijan, Aneuploid-82 |
| **Sapota / Chikoo** | Khirni *(Manilkara hexandra)* |

**2.2 Tree Size and Vigour**

Tree size and vigour are important factors determining orchard productivity. Rootstocks influence plant growth by affecting root system development, water absorption and nutrient uptake. Dwarfing rootstocks reduce canopy size and vegetative growth, making them suitable for high-density planting systems. In contrast, vigorous rootstocks develop extensive root systems that enhance drought tolerance and nutrient absorption. In fruit crops such as mango, citrus and guava, rootstock selection significantly influences tree architecture and yield efficiency. For example, *Poncirus trifoliata* is commonly used in citrus because it controls tree size and improves tolerance to environmental stresses.

**2.3 Precocity in Flowering and Fruiting**

Precocity in flowering and fruiting refers to the early initiation of reproductive growth in fruit crops due to the influence of suitable rootstocks. In warm regions, vigorous vegetative growth often delays flowering, but appropriate rootstocks help shorten the juvenile phase and promote early fruiting. Dwarfing and semi-dwarfing rootstocks regulate plant vigor, improve nutrient and water uptake and maintain hormonal balance, encouraging early floral bud differentiation. In crops like Mango, Guava and Citrus, grafting onto suitable rootstocks ensures earlier bearing, higher productivity and quicker economic returns, supporting sustainable fruit production systems.

**2.4 Fruit set and yield**

Rootstock-scion interactions play an important role in determining fruit set and yield in grafted fruit crops, especially under warm climatic conditions. Grafting modifies physiological and hormonal communication between the rootstock and scion, influencing flowering and fruit development (Goldschmidt, 2014). Rootstocks also regulate water and nutrient uptake, tree vigour and canopy architecture, which directly affect floral initiation, fruit retention and final yield. In warm regions, where excessive vegetative growth may reduce fruit set, dwarfing or semi-vigorous rootstocks help maintain a balanced vegetative–reproductive growth, thereby improving yield efficiency (Webster, 2004). The physiological and historical basis of stock–scion interactions has been extensively described by (Mudge et al.,2009). Hence, selecting appropriate rootstocks is

essential for improving fruit set and achieving sustainable yields in warm-region fruit production systems.

**2.5 Nutrient Status of Scion**

The nutrient status of the scion is strongly influenced by the rootstock onto which it is grafted. Rootstocks regulate the uptake and translocation of water and essential nutrients from the soil to the scion, thereby affecting plant growth and productivity. Rootstocks differ in their ability to absorb and transport nutrients such as nitrogen, phosphorus, potassium, calcium and magnesium, which influence scion growth, flowering and fruiting (Hartmann et al., 2018). Dwarfing rootstocks can modify mineral nutrition and improve yield efficiency and fruit quality (Webster, 2004). Additionally, variations in rootstock genotype affect nutrient accumulation in leaves and fruits, ultimately influencing productivity and sustainability in fruit crops (Zhang et al., 2016).

**Conclusion**

Rootstocks play a crucial role in improving productivity and sustainability in fruit crops grown in tropical and subtropical regions. They influence tree size, canopy structure, nutrient uptake, flowering behaviour, yield and fruit quality. By improving tolerance to environmental stresses such as drought and salinity, rootstocks help plants perform better under challenging conditions. Disease-resistant rootstocks also reduce dependence on chemical control measures, making fruit production more environmentally friendly. Furthermore, dwarf and semi-dwarf rootstocks enable high-density planting systems that improve orchard management and productivity. However, rootstock performance may vary depending on local environmental conditions. Therefore, careful evaluation of rootstocks under regional conditions is essential before large-scale adoption. Future research should focus on developing rootstocks with improved stress tolerance, better compatibility with scion cultivars and suitability for modern orchard systems.

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