

Fruit Science**Canopy Management in Sapota (*Manilkara zapota*): Enhancing Productivity, Efficiency, and Fruit Quality**

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Abstract: -

*Sapota (*Manilkara zapota*) is an evergreen tropical fruit crop characterized by continuous vegetative growth and dense canopy development, which often restricts light penetration and reduces productivity. Effective canopy management plays a crucial role in optimizing tree architecture, improving yield, and enhancing fruit quality. This article critically examines various canopy management strategies in sapota, including high-density planting, training and pruning, rejuvenation techniques, use of plant growth regulators, and irrigation and nutrient management. These practices collectively address key production constraints such as excessive vegetative growth, poor fruit set, and harvesting difficulties. The integration of scientific canopy management approaches ensures better resource utilization, increased economic returns, and sustainable orchard management.*

Keywords: *Sapota, canopy management, pruning, high-density planting, fruit yield, orchard sustainability etc.*

Introduction:

Sapota (*Manilkara zapota*) is a commercially important fruit crop widely grown in tropical and subtropical regions due to its adaptability and nutritional value. Being an evergreen tree, sapota exhibits continuous growth, resulting in the formation of a dense canopy, particularly in the upper layers. This

dense canopy structure limits sunlight penetration into the inner and lower portions of the tree, thereby reducing photosynthetic efficiency and fruit production in those regions (Gopu and Balamohan, 2015). Another major challenge associated with unmanaged sapota trees is their excessive height, which

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complicates harvesting operations and increases labor costs. Additionally, issues such as prolonged juvenile phase, low fruit set, and flower and fruit drop further limit productivity. These constraints highlight the importance of adopting effective canopy management strategies. Canopy management involves regulating tree architecture through training, pruning, spacing, and other cultural practices to optimize light interception, improve aeration, and enhance fruiting potential. A well-managed canopy ensures better distribution of resources within the plant and facilitates efficient orchard operations (Rao *et al.*, 2018).

Importance of Canopy Management in Sapota

Canopy management is essential for maintaining a balance between vegetative growth and reproductive development. In sapota, flowering occurs on terminal shoots; therefore, improper pruning can negatively affect yield. However, controlled canopy manipulation improves light distribution, enhances photosynthetic activity, and promotes the development of productive branches. Furthermore, proper canopy architecture reduces pest and disease incidence by improving air circulation within the tree. It also facilitates intercultural operations such as spraying, pruning, and harvesting. Thus, canopy management is a key determinant of

both productivity and fruit quality in sapota orchards.

Approaches to Canopy Management in Sapota

1. High-Density Planting (HDP)

Traditional sapota orchards are planted at wider spacing (8×8 m), which results in lower plant population and inefficient land utilization. High-density planting (HDP) is an effective approach to increase productivity per unit area by accommodating more plants. Research indicates that closer spacing significantly improves yield. For example, sapota cv. Kalipatti planted at 5×5 m spacing recorded higher yields compared to wider spacing systems (Patel *et al.*, 2001). Similarly, double hedge row systems ($8 \text{ m} \times 4 \text{ m} \times 4 \text{ m}$) have been reported to enhance both yield and economic returns compared to conventional planting methods (Rajangam *et al.*, 2022). The success of HDP depends largely on the use of compact or dwarf varieties and rootstocks. Dwarfing rootstocks such as *Manilkara kauki* help reduce tree size and promote early bearing (Mishra and Goswami, 2016). Improved cultivars like PKM 4 and CO 3 exhibit compact canopy architecture, making them suitable for high-density systems (Anonymous, 2010). These innovations enable efficient canopy management and facilitate mechanization in orchards.

2. Training and Pruning

Training and pruning are fundamental components of canopy management in sapota. Since the tree can grow up to 20 meters in height, proper training during the early stages is essential to develop a strong framework. Young plants are typically headed back at a height of 60–70 cm to encourage lateral branching. Three to four well-spaced scaffold branches are selected to form the primary structure of the tree (Singh, 2010). The central leader system or umbrella-shaped canopy is commonly adopted for better light interception and structural stability (Mahala *et al.*, 2020). Pruning in sapota is generally minimal due to its bearing habit, as flowers and fruits develop on terminal shoots. However, selective pruning practices such as removal of dead, diseased, and overcrowded branches are essential. Moderate pruning, including the removal of about 50% of side growth and maintaining 3–4 canopy tiers, has been shown to improve yield and fruit quality. Center opening of mature trees enhances light penetration and reduces shading of lower branches, thereby improving productivity. Additionally, pruning helps regulate vegetative growth and reduces apical dominance, encouraging the development of lateral fruiting shoots (Rao *et al.*, 2018).

3. Rejuvenation of Old Orchards

Old and senile sapota orchards often exhibit reduced productivity due to poor

canopy structure and reduced vigor. Rejuvenation techniques aim to restore productivity by removing unproductive branches and stimulating new growth. One effective method involves clipping terminal shoots, which are the primary fruit-bearing regions. The application of plant growth regulators such as NAA (50 ppm) in combination with pruning has been shown to significantly improve yield in rejuvenated trees. These practices help in restoring canopy balance and enhancing fruit production.

4. Use of Plant Growth Regulators (PGRs)

Plant growth regulators play a significant role in canopy management by influencing vegetative growth, flowering, and fruit set. They are particularly useful in overcoming physiological constraints such as poor fruit retention and excessive vegetative growth. Spraying SADH (100 ppm) before anthesis and one month later has been reported to improve fruit set and retention in sapota. Similarly, CCC (400 ppm) applied at the fruit bud development stage promotes flowering and suppresses excessive vegetative growth (Agrawal and Dikshit, 2008). NAA applications at flowering and early fruit development stages further enhance yield by reducing fruit drop. Although growth retardants like paclobutrazol have been evaluated, their effects on yield under high-density conditions are variable (Anonymous, 2006). Nonetheless,

PGRs remain an important tool for optimizing canopy growth and productivity.

5. Irrigation Management

Efficient irrigation management is crucial for maintaining optimal canopy growth and reducing physiological disorders. Both excess and inadequate irrigation can adversely affect plant growth and fruit development. Excess irrigation may lead to flower and fruit drop, while water stress can limit vegetative growth. Drip irrigation is widely recommended for sapota, with an application rate of 20–30 liters per tree per day, depending on tree age and climatic conditions. Proper irrigation scheduling ensures balanced canopy growth and improved fruit quality.

6. Nutrient Management

Nutrient management plays a vital role in supporting canopy development and maximizing yield. Sapota, being an evergreen tree, requires a continuous supply of nutrients throughout the year. Balanced fertilization, including nitrogen and potassium, has been shown to significantly increase yield (Rao *et al.*, 2018). Organic manures such as vermicompost improve soil health and enhance plant growth. Fertigation using water-soluble fertilizers improves nutrient use efficiency and reduces input costs by 20–25%. Pre-harvest nutrient applications, such as calcium sprays, improve fruit firmness and shelf life, while

gibberellic acid treatments enhance fruit quality attributes (Bhalerao *et al.*, 2010; Choudhury *et al.*, 2003).

7. Intercropping

Intercropping is an effective practice for improving soil fertility and maximizing land use efficiency in sapota orchards. Leguminous crops such as greengram, cowpea, and soybean fix atmospheric nitrogen and enhance soil organic matter (Rao *et al.*, 2018). Intercropping also helps in weed suppression, soil conservation, and additional income generation for farmers. Seasonal crops can be selected based on climatic conditions and orchard management practices.

Conclusion

Canopy management is a critical factor influencing productivity, fruit quality, and sustainability in sapota cultivation. Practices such as high-density planting, proper training and pruning, rejuvenation of old orchards, and the use of plant growth regulators significantly improve orchard performance. Efficient irrigation and nutrient management further support optimal canopy development. Moderate pruning and well-designed canopy architecture enhance light penetration and promote fruiting, while high-density planting systems maximize land productivity. An integrated approach combining these strategies is essential for achieving higher yields, better

fruit quality, and long-term economic viability in sapota orchards.

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