Sapodilla (*Manilkara achras* (Mill) Fosb., syn *Achras sapota* L.)

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**Abstract:** Sapodilla is a climacteric, chilling-sensitive fruit and the use of modified atmospheres and other methods of preservation are required for long-term storage and shipping. Some of the research needs for this fruit include the development of adequate maturity and harvesting indices. This chapter discusses the important physiological and handling aspects of the fruit.

**Key words:** *Manilkara achras*, sapodilla, postharvest, nutrition, diseases, insects, processing, respiration, ethylene.

### 17.1 Introduction

The sapodilla tree (*Manilkara achras* (Mill) Fosb., syn *Achras sapota*, L.) (see Plate XXXII(A) in the colour section between pages 238 and 239) is native to Mexico and Central America and has been introduced to many tropical areas of the world. Cultivated in the past mostly for its latex, called chicle, to make chewing gum, the sapodilla tree is now mainly cultivated for its fruit. Sapodilla fruit present a climacteric behavior and need special handling postharvest to prevent losses and to maintain quality (Yahia, 2004). Optimal harvesting time is the key for keeping quality of the fruit at ripeness. Fruit at different development stages are commonly present in a single tree which makes it difficult to establish a general maturity index. Compared to some other minor tropical fruits, sapodillas have been the subject of more extensive research on ways to extend their storage life and keeping quality.

#### 17.1.1 Origin, botany, morphology and structure

The sapodilla is also known as sapota, chiku, ciku, dilly, nasberry, sapodilla plum, chico zapote, zapote, chico, nispero, and sapota plum. It is native to Mexico (specifically the Yucatan Peninsula), Central and South America (Mickelbart,
and has been introduced throughout tropical America, the West Indies, the Bahamas, Bermuda, the Florida Keys and the southern part of the Florida Mainland, and the Philippines (Morton, 1987).

The tree is evergreen with an extensive root system, it reaches a height of more than 30m and a diameter of up to 1.5m (Orwa et al., 2009). The canopy is dense, generally with a rounded crown, ovate-elliptic to elliptic-lanceolate leaves, which are glossy and dark green and clustered at the tips of the branches (Mickelbart, 1996). The fruit is a fleshy berry, ellipsoidal, conical or oval, and contains one or several shiny black seeds. Its weight is about 70 to 300 g and its size ranges from 5 to 9 cm in diameter. Immature fruit are hard, gummy and very astringent (Morton, 1987). It has a dull brown color and thin skin and yellowish, light brown or red pulp with a grainy texture, and is prized for its pleasant aroma and sweet flavor once the fruit is ripe.

17.1.2 Worldwide importance and economic value
The white latex extracted from the sapodilla tree was traditionally the main ingredient of chewing gum. Countries like Mexico, Venezuela and Guatemala still use it to produce chicle, however, sapodilla is currently cultivated mainly for its fruit in areas such as India, the Philippines, Sri Lanka, Malaysia, Guatemala, Mexico and Venezuela, among others (Mickelbart, 1996). India is one of the largest producers of sapodilla in the world with a cultivated area of around 24000 ha (Chadha, 1992). Although the sapodilla fruit is not commonly seen in US markets, it is becoming popular as an exotic fruit in some restaurants (Mickelbart, 1996).

17.1.3 Culinary and other uses, nutritional value and health benefits
Sapodilla fruit (see Plate XXXII (B and C) in the colour section) is mainly consumed fresh as a dessert due to its pleasant sweet flavor and aroma. Sometimes the fruit is chilled prior to eating which improves its flavor. The flesh is sometimes used to make sherbets, ice cream or is eaten as dried fruit in India (Mickelbart, 1996). Some people make syrup and vinegar from the sapodilla juice and jams from the flesh (Garcia, 1988).

As mentioned above, for many years, the latex from the sapodilla tree called ‘chicle’ was the main ingredient of chewing gum. It contains 15% rubber and 38% resin and is tasteless. Steps to process the latex into chewing gum include drying, melting, elimination of foreign matter, mixing with other gums, sweeteners and flavors, and finally rolling into sheets and cutting into different sizes (Morton, 1987). Chicle has been increasingly substituted by synthetic gums, although countries like Mexico, Guatemala and Belize still use natural chicle.

The wood from the sapodilla tree is dark red, hard, heavy and durable and has been used for railway cross-ties, flooring, tool handles, etc. The sapodilla red heartwood is also valued for furniture, banisters, and cabinetwork (Morton, 1987; Garcia, 1998). The tree is grown as an ornament in some areas although its height may become a problem in some gardens. According to the food composition database from the USDA, the nutrient value of sapodilla fruit is shown in Table 17.1.
Table 17.1 Nutrient value of sapodilla fruit
(100 g of fruit)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Approximate value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content</td>
<td>78%</td>
</tr>
<tr>
<td>Calories</td>
<td>83</td>
</tr>
<tr>
<td>Protein</td>
<td>0.4 g</td>
</tr>
<tr>
<td>Fat</td>
<td>1.1 g</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0 mg</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>20.0 g</td>
</tr>
<tr>
<td>Total dietary fiber</td>
<td>5.3 g</td>
</tr>
<tr>
<td>Calcium</td>
<td>21 mg</td>
</tr>
<tr>
<td>Iron</td>
<td>0.8 mg</td>
</tr>
<tr>
<td>Magnesium</td>
<td>12.0 mg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>12.0 mg</td>
</tr>
<tr>
<td>Potassium</td>
<td>193.0 mg</td>
</tr>
<tr>
<td>Sodium</td>
<td>12.0 mg</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>14.7 mg</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>60 IU</td>
</tr>
</tbody>
</table>


Several medicinal properties have been ascribed to different parts of the sapodilla tree. For instance, the tannins in young fruit are used to stop diarrhea, tea is made from the young fruit and the flowers are used for pulmonary problems. Tea from old leaves is used to treat coughs, colds and diarrhea, crushed seeds are used as a diuretic, sedative, soporific and for kidney stones; the latex can be used to fill tooth cavities temporarily; and the bark can be used to make tea for treating fevers (Morton, 1987).

17.2 Fruit development and postharvest physiology

17.2.1 Fruit growth, development and maturation
The development of the sapodilla fruit is characterized by a single sigmoidal pattern (Sulladmath et al., 1979; Abdul-Karim et al., 1987). Three stages can be identified during fruit growth: the first, where cell division and maturation of the embryo occur; second, where growth is greatly reduced; and third, where cell enlargement occurs giving rise to another phase of rapid and maximum growth. This phase occurs between 5 and 7.5 months from fruit set (Lakshminarayana and Subramanyam, 1966). Carbohydrates and tannins are the main constituents of sapodilla fruit. Free sugars are in high concentration in the mature fruit, while starch is almost absent (Lakshminarayana and Subramanyam, 1966; Lakshminarayana, 1980; Selvaraj and Pal, 1984; Roy and Joshi, 1997).

The immature fruit is hard, with a high concentration of latex and tannins and the latter are responsible for the high astringency of immature fruits. The skin of the
fruit has a sandy brown texture that disappears once fully ripe. The flesh becomes soft and very juicy while the sugar content increases with maturity giving the fruit a sweet flavor that resembles that of a pear (Mickelbart, 1996). Sugar content greatly increases in particular during the last growth phase when fruit harvested at this stage have a higher quality, are soft and have a sweet aroma. The fruit can also be harvested after the first growth stage. It can take 4–10 months for the fruit to be fully ripe depending on the variety, climate, and type of soil (Mickelbart, 1996).

17.2.2 Respiration, ethylene production and ripening

Sapodilla is a climacteric fruit (Yahia, 2004) and can be picked from the tree both when fully mature and before it is ripe (Broughton and Wong 1979; Selvaraj and Pal 1984; Abdul-Karim et al., 1987; Brown and Wong 1987; Yahia, 2004). The fruit requires very special postharvest handling attention to reduce losses (Sastry 1966a, 1966b; Joshi and Paralkar, 1991; Joshi and Sawant, 1991; Yahia, 2004). Its respiration rate at 24–28 °C was 16 mg CO\textsubscript{2} kg\textsuperscript{-1} hr\textsuperscript{-1}. Preharvest spraying with isopropyl n-phenylcarbamate (IPC) at 100 ppm retarded the respiration rate, while maleic hydrazide at 500–1000 ppm accelerated it (Lakshminarayana and Subramanyam, 1966). For the cv. ‘Kalipatti’ the climacteric peak was seen on the fifth day after harvest (Rao and Chundwat, 1988). However, Selvaraj and Pal (1984) found a reduction in the respiration rate two days after harvest followed by an increase on the third day. An additional reduction was observed on the sixth day for the ‘Oblong’ cultivar and on day eight for ‘Cricket ball’. When the fruit is harvested at the appropriate maturity stage, it ripens in 5–7 days at ambient temperature, but fruit harvested before the optimum stage will have a poor quality when ripe. On the contrary, fruit harvested later than the optimum maturity stage will have a shorter postharvest life (Roy and Joshi, 1997). Ethylene production was 3 nmoles gfw\textsuperscript{-1} day\textsuperscript{-1} at 15 °C, and 6.5 at 25 °C (Broughton and Wong, 1979). Treatment of sapodilla fruit with etherel at 1000–3000ppm accelerated ripening, reduced pectins, phenolic contents, total soluble solids, sugars, and vitamin C (Shanmugavelu et al., 1971; Das and Mahapatra, 1976; Ingle et al., 1982), while removal of ethylene was reported to delay ripening by 23 days (Chundawat, 1991). Roy and Joshi (1997) reported an increase in ethylene production during ripening that peaked after 144 hours, followed by a decline.

17.3 Maturity and quality components and indices

It takes from 120 (Purseglove, 1968) to 245 (Sulladmath et al., 1979) days from fruit set to maturity depending on the climate and cultivar. However, the erratic flowering habit of sapodilla, and the presence of fruit at all stages of development on the tree makes it difficult to determine the optimum harvesting time of the fruit. Visual signs of physiological maturity include shedding of the brown scaly external material which gives the peel a smooth texture (Lakshminarayana, 1980) and fruit with a smooth surface, shining brown potato color and rounded styler end are
considered mature (Kute and Shete, 1995). In addition, fruit ready for harvest will not show a green tissue or latex when scratched with the fingernail and the fruit will separate easily from the stem without leaking latex. This is because the latex content of mature fruit is reduced to almost zero (Sulladmath and Reddy, 1990). Other maturity indices have been proposed for sapodilla. For instance, Sundararajan and Rao (1967) suggested using total soluble solids while others have found that fruit size (length and width) are better indices of maturity (Abdul-Karim et al., 1987).

Flesh-to-peel ratio increases during ripening (Pathak and Bhat, 1953) and flesh sugar concentration ranges from 12 to 14%. Sucrose presents the greatest increase during ripening, followed by glucose and fructose (Lakshminarayana and Subramanyam, 1966), however when the fruit is overripe, the sucrose content is lower than glucose and fructose. Total and reducing sugars also increase during ripening reaching up to 16.7 and 26.0%, respectively, when the fruit is ready to eat (Lakshminarayana and Subramanyam, 1967). The concentrations of alcohol-insoluble solids and starch decrease during ripening in cvs. ‘Cricket Ball’ and ‘Oblong’ (Selvaraj and Pal, 1984).

Flavor quality depends on the soluble solids content (13–26%) and acidity (0.2–0.3%) (Kader, 2009). Total soluble solids (TSS) increase during ripening and Shende (1993) found that for the cultivar ‘Kalipatti’, TSS ranged between 23.80 and 24.16°Brix when the fruit was fully ripe, but declined steadily towards the end of the shelf life.

Titratable acidity goes from a high concentration (0.48–1.36%) in the early stages of fruit development to a very low level (0.11–0.41%) when the fruit is fully ripe (Lakshminarayana and Subramanyam, 1967). This reduction in acidity during ripening and storage of sapodilla fruit is irrespective of the variety (Suryanarayana and Goud, 1984; Shende, 1993). Ascorbic acid content in sapodilla fruit decreases during ripening. For instance, Lakshminarayana and Subramanyam (1966) report that ascorbic acid went from 27.2 to 3.2 mg 100 g⁻¹ fresh weight in mature and fully ripe sapodilla, respectively. Selvaraj and Pal (1984) found that not only vitamin C but also vitamin A decrease with ripeness.

Reports on the content of pectin in fruit of sapodilla indicate levels from 0.5 to 3.9% with a decline during storage (Shanmugavelu and Srinivasan, 1973; Das and Mahapatra, 1976; Shende, 1993). Polyphenols, the main compounds responsible for the astringency in immature fruit, were found to decrease during fruit ripening and this change was independent of the storage condition (Paralkar, 1985; Sawant, 1989). Lakshminarayana and Subramanyam (1966) reported a reduction from 2.4% at harvest to 1.8% at ripeness. The content of minerals such as calcium, potassium, phosphorus, iron and manganese was found to decline during ripening, while zinc and copper contents increased (Selvaraj and Pal, 1984; Paralkar, 1985).

The protein content at the eating-ripe stage has been reported to vary from 0.52 to 0.76%. Proteins and soluble amino acids decrease during ripening as well as the activity of several enzymes such as amylase, invertase, inulase and phosphatase (Selvaraj and Pal, 1984). On the other hand, enzymes such as catalase, pectinesterase, peroxidase, polyphenoloxidase and adenosintriphosphatase increased their activities (Rao and Chundawat, 1988).
The moisture content of the sapodilla fruit at maturity ranges from 69 to 80% depending on the climate conditions and variety (Lakshminarayana et al., 1967, Lakshminarayana and Rivera, 1979; Thapa, 1980). According to Morton (1987), the seed kernel, which makes up 50% of the whole seed, contains 1% saponin and 0.08% of a bitter compound, sapotinin. Morton considers that abdominal pain and vomiting are likely if more than six seeds are consumed.

17.4 Preharvest factors affecting fruit quality

Fruit harvested later than optimum time usually soften very rapidly and become very difficult to handle. Fruit harvested earlier than physiological maturity may not soften, contain pockets of coagulated latex that lower the quality of the fruit and are usually low in sweetness and high in astringency when ripe, with a rather unappealing alcoholic aftertaste. Unripe fruit are highly astringent and contain large amounts of leucoanthocyanidins (Mickelbart, 1996).

17.5 Postharvest handling factors affecting quality

17.5.1 Temperature management

Optimum storage temperature is 14°C ± 1°C and 90–95% relative humidity according to Kader (2009) and Yahia (2004). Under these conditions sapodilla fruit can be kept for 2–4 weeks (Yahia, 2004). Lower temperatures can cause chilling injury which lowers fruit quality, producing poor flavor, shriveling, wrinkling, dark-brown spots on the peel and failure to ripen (Broughton and Wong, 1979; Salunkhe and Desai, 1984; Morton, 1987; Yahia, 2004). Therefore, temperatures from 15 to 20°C are suggested to be used if longer periods of storage are required (Morton, 1987). Short-term holding of fruit for less than 10 hours at 4°C before storage at 20°C was reported to extend the storage life of the fruit for up to 24 days with satisfactory quality (Broughton and Wong, 1979).

17.5.2 Physical damage

Fruit harvested after the optimum stage of maturity very quickly becomes soft and more prone to physical damage. Therefore it is very important to identify optimum harvesting indices and harvest the fruit at the ideal stage (Yahia, 2004).

17.5.3 Water loss

High temperatures increase fruit water loss (Yahia, 2004), and low temperatures (4°C) cause chilling injury, which can result in shriveling and wrinkling (Morton, 1987; Yahia, 2004).
17.5.4 Atmosphere
Storage life of sapodilla is extended by the use of modified atmospheres and removal of ethylene (Broughton and Wong, 1979; Yahia, 1998). Storage of sapodilla under high CO\textsubscript{2} concentrations (but less than 20%), and low ethylene concentrations prolonged the storage life of the fruits (Brown and Wong, 1987). Shelf life at room temperature increased from 13 to 18 days when 5% CO\textsubscript{2} was added to the atmosphere, to 21 days when 10% CO\textsubscript{2} was added, and to 29 days when 20% CO\textsubscript{2} was added. However, the latter fruit failed to ripen. A concentration of 20% CO\textsubscript{2} is found to be deleterious. ‘Kalipatti’ fruit treated with 6% Waxol or 250 or 500ppm Bavistin, or hot water (50°C for 10 min), and wrapped in 150 gauge polyethylene film with 1% ventilation, ripened later than those of the control, but fungal rot was high (Bojappa and Reddy, 1990). Fruit treated with 6% wax emulsion and packed in 200-gauge polyethylene covers containing ethylene and CO\textsubscript{2} absorbents were reported having a shelf life of 45 days at 12°C, 10 days later than the control (Chundawat, 1991). ‘Jantuang’ fruit were stored in modified atmosphere packaging (MAP) for four weeks at 10°C or for three weeks at 15°C, one week longer than fruit without MAP (Mohamed et al., 1996).

17.6 Physiological disorders

17.6.1 Chilling injury
Sapodilla fruit is highly susceptible to chilling injury (CI) (Yahia, 2004). Symptoms include poor taste and flavor, dark-brown spots on the peel, failure to ripen, and increased deterioration after storage at higher temperatures. Storage of fruit at temperature of 6–10°C causes irreversible damage and produces fruit with poor taste and flavor (Broughton and Wong, 1979; Salunkhe and Desai, 1984). CI also occurred in fruit stored for 21 days at 10°C. However, fruit which have been waxed with a fatty acid sucrose ester (using a dip containing 5–10g L\textsuperscript{−1} ‘sempefresh’ or 250 g L\textsuperscript{−1} ‘sta-fresh’) were reported to be kept for 40 days at 10°C (Yahia, 2004). Kader (2009) reports chilling injury after exposure to temperatures lower than 5°C for more than ten days.

17.7 Pathological disorders
Some of the factors that contribute to the development of postharvest diseases in sapodilla fruit are their high moisture and nutrient content. If the fruit on the lower branches of the tree come into contact with water in areas with high temperatures and relative humidity, symptoms of fruit rot may appear as a result of Phytophthora palmivora (Butler) infection (Balasubramanian et al., 1988). Some other common disorders include sour rot (Geotrichum candidum), Cladosporum rot (Cladosporum oxysporum), and blue mold rot (Penicillium italicum) (Mickelbart, 1996). Other species of Pestalotiopsis and Phomopsis can also cause fruit rot. Some species of bacteria are associated with fruit latex (Pathak and Bhat, 1952). Kader (2009)
reported that anthracnose caused by *Colletotrichum gloeosporioides* can be a serious problem in areas with high relative humidity. Bakar and Abdul-Karim (1994) reported benlate (methyl-N-1-butylcarbomoyl) as a good control for fungal and bacterial pathogens in sapodilla fruit.

### 17.8 Insect pests and their control

Some of the most important pests that infest sapodilla fruit are the Mediterranean fruit fly (*Ceratitis capitata*) and the Mexican fruit fly (*Anastrepha ludens*). Larvae of Trypetidae, which infest the ripe fruit, can be a major problem in some areas (Orwa et al., 2009). Another insect known to attack the sapodilla fruit is *Nephopteryx engrapheincta* Rag. (Kute and Shete, 1995). Leaf miner and stem borer do not constitute a major problem in sapodilla fruits (Balasubramanian et al., 1988; Yahia, 2004).

### 17.9 Postharvest handling practices

#### 17.9.1 Harvest operations

Ladders and baskets may be used during harvest and the peduncle is cut with a knife or scissors. Selection can be based on size and maturity of the fruits. Any fruit presenting deterioration or mechanical injury are discarded (Polania, 1986; Yahia, 2004).

#### 17.9.2 Packinghouse practices

The fruit is commonly cell packed in fiberboard or wood flats, 25–49 counts, 4.5 kg capacity (McGregor, 1987). Fruit weight should not exceed 20 kg per box to avoid injuries (Polania, 1986).

#### 17.9.3 Control of ripening and senescence

Both wax coating and 2,4-dichloro-phenoxy acetic acid (2,4-D) have been shown to retard the ripening process in sapodilla fruit, while 2-chloroethyl phosphonic acid (ethrel) (Ingle et al., 1982; Suryanarayana and Goud, 1984) and ethylene (Sastry, 1970) greatly accelerate ripening. Polyethylene bags can also reduce weight loss in sapodilla fruit by about 50% (Kumbhar and Desai, 1986). Reduction of ethylene production and thus delaying of ripening has been reached by applying *GA*$_3$ (300 ppm), kinetin (100 ppm) or silver nitrate (40 ppm) for 20 minutes. The treatment also stimulated a reduction in catalase and pectin methyl esterase activities (Gautam and Chundwat, 1990). Gibberellic acid extends the shelf life of sapodilla fruit, delays rotting, and reduces fruit softness and fruit skin shrinkage (Kumbhar and Desai, 1986).

Exposure of mature sapodilla fruit to 100 ppm ethylene for 24 hours at 20°C speeds up their ripening (Kader, 2009). Treatments with either 100 ppm 2,4-D, 500
to 1000 ppm malic hydrazide or 25 ppm 2,4,5-T have been shown to slow down the ripening of sapodilla fruit (Lakshminarayana et al., 1967; Lakshminarayana and Subramanyam, 1966).

Exposure of sapodilla fruit to gamma irradiation at 0.1 KGY extended their storage life by 3–5 days at 26.7°C and 15 days at 10°C without any negative effect on ascorbic acid (Salunkhe and Desai, 1984). Morais et al. (2008) treated sapodilla fruit with 1-MCP (an ethylene antagonist) at 300 nL L⁻¹ for 12 hours followed by a storage period under a modified atmosphere at 25°C for 23 days. They found a significant slowdown of fruit softening of sapodilla fruit for 11 days.

17.9.4 Recommended storage and shipping conditions
The shelf life of sapodilla fruit depends on the storage conditions (relative humidity (RH), temperature, and atmosphere), the respiration rate, cultivar and ripeness stage (Yahia, 2004). These variables may be manipulated in order to extend the storage period. Singh et al. (1963) and Singh (1969) claimed that firm fruit can be kept at 3–5°C and 85–90% RH for up to eight weeks, but if the fruit are already ripe, a temperature of 2–3°C will keep them for six weeks, but this may cause chilling injury. Kader (2009) suggests a temperature of 14°C ± 1°C and 90–95% RH at which the fruit can be stored for 2–4 weeks.

Levels of 5–10% CO₂ delay ripening as well as the removal of ethylene from the storage environment (Yahia, 1998). Higher CO₂ concentrations may damage the appearance and taste of the fruits and thus are not recommended (Broughton and Wong, 1979; Yahia, 1998).

The use of perforated plastic bags or box liners for packing sapodilla fruit can help reduce water loss at relative humidities lower than 90–95% (Kader, 2009). Polyethylene bags with permanganate silica gel, an ethylene absorbent, were effective in extending the storage period by 10–12 days at room temperature or 12°C (Banik et al., 1988).

17.10 Processing
As mentioned previously, sapodilla fruit are generally eaten fresh as a dessert. Some people use the skin, which is not eaten, as a ‘shell’ in which to serve a dessert, since it remains firm enough. In some areas, the juice is boiled and preserved as syrup or the flesh used to make jam (Morton, 1987).

Ripe sapodillas have been successfully dried after pretreatment with a 60% sugar solution. Osmotic dehydration for five hours gave a product with acceptable quality for two months (Morton, 1987). Dried sapodilla fruit is consumed in India and sterilization of canned sapodilla slices has been achieved by using a combination of heat and radiation. After removing the fruit peel, sapodillas were sliced and canned with sucrose syrup. Treatment at 70°C and 10 min and irradiation with 4 × 10⁵ rads at room temperature produced an acceptable product (Dharkar et al., 1966).
Sapodilla fruit were also processed into a powder and added to traditional Indian recipes. The flavor, aroma and natural color of sapodillas were conserved after processing and added to milk shakes, coconut burfi and banana shikarani (Devadattam et al., 2005).

17.11 Conclusions

Sapodilla is a climacteric fruit that requires careful handling after harvest in order to maintain quality, extend shelf life and allow transport to markets outside the area of production. If this can be achieved, sapodillas, together with other tropical fruits, could potentially become known in other areas. The use of controlled/modified atmospheres and other methods of preservation become important when dealing with highly perishable produce such as sapodilla fruit. Storage temperature is another key factor in conserving sapodillas, since these fruit are chilling sensitive and special care must be taken when cold storage is used. Finally, the presence of fruit at different stages of development on the tree makes it difficult to determine the optimum harvesting time, and therefore it is necessary to develop appropriate maturity indices that would facilitate the identification of fruit ready to be harvested. This would increase homogeneity of fruit quality.

17.12 References


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