

## Post-Harvest Management Protocols

# PAPAYA

Papaya has emerged as a commercial fruit crop in tropical regions of India grown for both fresh and processing purposes. Its short juvenility, thus quick and high returns encourages the growers to take up its cultivation. However, it is highly perishable fruit and susceptible to heavy postharvest losses because of faulty handling practices employed during harvesting, field handling, storage, transport and marketing. The fruit skin in papaya is delicate in nature and is easily susceptible to physical damage that leads to excessive weight loss and disease infections. Adopting better postharvest management practices helps in reduction of losses and enhancing the quality of fruits at ripe stage in the destination markets. A shelf-life of four to six days under tropical ambient conditions and up to three weeks at low temperature storage can be achieved with the correct harvest maturities, handling techniques, disease control measures and storage conditions. **Total Production for the year 2019-20 was -6086 ('000 MT).**



## MATURITY INDICES OF PAPAYA

Harvesting at appropriate maturity is important for development of excellent eating quality and better consumer acceptance of papaya fruit. Fruit harvested before optimum maturity fail to ripen properly, with unacceptable skin and flesh colour, lower sugars and rubbery texture. Papaya fruits should be harvested when the colour of the skin changes from dark green to light green and when one yellow streak starts developing from the base upwards. Fruits harvested in this condition will ripen normally and is considered as the optimum maturity for long-distance transport. For local markets, fruit harvesting may be delayed till the fruit surface is  $\geq 50\%$  yellow. The postharvest life of fruit declines with the on-tree advancement of fruit maturity. The maturity can be judged based on the following indices.

- Change of skin color from dark-green to light-green with some yellow at the blossom end (colorbreak).
- Papayas are usually harvested at color break to  $\frac{1}{4}$  yellow for export or at  $\frac{1}{2}$  to  $\frac{3}{4}$  yellow for local markets.

- When the latex of the fruit becomes almost watery the fruit is considered ready for harvest



Immature Papaya



Mature Papaya Fruits

Mechanical injury is one of the major causes of post harvest losses in papaya. Fruit with 60% or more colour are susceptible to impact injury causing internal bruising

### Important papaya varieties cultivated in different states of India are

State	Varieties grown
Andhra Pradesh	Honey Dew, Coorg Honey Dew, Washington, Solo, Co-1, Co-2, Co-3, Sunrise Solo, Taiwan
Jharkhand	Ranchi selection, Honey Dew, Pusa Delicious & PusaNanha
Karnataka & Kerala	Coorg Honey Dew, Coorg Green, Pusa Delicious & PusaNanha
West Bengal	Ranchi selection, Honey Dew, Washington, Coorg Green
Orissa	Pusa Delicious, PusaNanha, Ranchi selection, Honey Dew, Washington, Coorg Green

# HARVESTING

Papayas should be harvested during the coolest part of the day, which is typically in the morning and avoid harvesting in the afternoon. Papayas are harvested manually by hand, with a knife, or with a specialized cutting blade. When harvesting by hand or with a knife, the fruit is either snapped off or cut off the tree.

Care is necessary to prevent staining of the fruit surface from the exudation of latex out of the cut stem end which can possibly affect the appearance quality.

When the fruits are inaccessible by hand due to tree height, a specialized implement (comprises of a long pole, a small circular ring at the top, a small mesh bag attached to the ring, and a horizontal blade above the ring and the bag) can be used for harvesting the fruits. The blade is positioned below the peduncle of the fruit and the pole moved upwards; the fruit is detached from the tree and then drops gently into the mesh bag below the ring at the top of the pole.

Papaya fruit is very sensitive to bruising and must be handled gently at all times. Fruits should not be allowed to drop to the ground, as this will soften and damage the pulp and scar the skin. Postharvest deterioration of dropped fruits will be rapid and brown spots will develop on the skin surface, lowering the market quality

After harvest, the fruit are placed in single layers into shallow plastic field crates, preferably containing a foam layer for cushioning. The field container should not hold more than 10-15 kg of fruit.

All stems should be trimmed after harvest to ensure that no stem to fruit rubbing occurs during transport to the packing facilities. Individual fruits are wrapped in news paper to avoid abrasion injury during transport.

Fruit should never be thrown or dropped. Field crates containing the fruit should be left in shaded conditions protected from the sun and rain, while awaiting collection for delivery to a packing facility.

Mesh bags, sacks or baskets are unacceptable for papaya transport due to the high susceptibility to bruising and skin injury. A better field container is a durable plastic container.

Care should be taken during transport in field crates to minimize the movement of fruit.

Field containers which have a rough or uneven inside surface will scar the skin, especially when there is movement or vibration.

This will result in uneven coloration of the skin as the fruits ripen and accelerate water loss. The fruit at ripe stage show some sunken areas that fail to degreen, called green islands, are primarily produced by mechanical injury.

## POST-HARVEST OPERATIONS

Various steps should be followed in preparing papayas for market. These involve cleaning, grading, and packing. These operations should be carried out in an easily accessible and shaded area

### WASHING

On arrival in the packing facility, fruit should be washed in water to remove latex, dust and fungicideresidue. The wash water should be clean and properly sanitized to reduce the microbial load on the fruit surface. A mild detergent containing chlorine as an active ingredient may be added to the wash water to improve cleaning efficiency. It is advised to wear hand-gloves during washing and packing operations as the nails inflict serious injuries which become very prominent at ripe stage. Another reason is to avoid contact of latex with skin as it may be an allergen for a few people. Washing, treatment can be carried out using mechanized or manual systems, depending on the volumes of fruits.

### GRADING

An essential step in market preparation is fruit selection or grading according to the standards required by the market. Fruits should be carefully graded according to size, shape, and external color. All fruits within the same market container should be uniform in size, shape, and skin color. The quality standards for export grade fruits are considerably higher and more stringent than domestic grade fruit. Export quality fruits must be free of bruises, latex burn, skin blemishes, insect damage, physical injury, surface scars, and disease. Count grading is generally followed for export purpose. The following weight range is used for a 4 kg net weight carton:

Small **12 to 15 fruits**  
**260 to 330 g**

Medium **8 to 12 fruits**  
**360 to 500 g**

Large **4 to 8 fruits**  
**570 to 1000 g**

Weight grading for local market depending on variety: Big = 2kg and above; Medium= 1.5 to 2.0 kg; Small = below 1.5kg

## PACKING

Fruit should be packed in a single layer in a one-piece self-locking or two-piece full telescopic fiber board cartons with a bursting strength 200 to 250 lb/in<sup>2</sup>. Packing fruits in weak cartons that do not stack will result in substantial surface scarring and eventual postharvest decay. A thin cushion of foam or shredded papers can be used as a cushioning material in the base of the carton to minimize surface abrasion and vibration injury during transport.

Individual fruits are often wrapped in soft tissue paper or foam net to minimize surface abrasion during transport and fascinate the buyers. Export market fruits should be packed in strong, well-ventilated fiberboard cartons. Individual labels can be attached to the fruit for market recognition and brand establishment. Carton net weights are dependent on the importer, ranging from 3.5 to 5 kg and must not be overfilled during packing.

## STORAGE

Temperature management is one of the efficient methods for extension of shelf of papaya. The optimum temperature for storage of papaya depends on its stage of maturity and ripeness. The optimum storage temperature for mature green to 1/4th yellow papayas is 15- 18°C and partially ripe (1/4 to 1/2 yellow) papaya is 13-15°C and the optimum RH is 90-95%. However, for maximum shelf life the ideal storage temperature is 13°C. But, the prolonged storage beyond 20 days at 13°C lead to the development of chilling injury symptoms on fruit surface. Above this temperature the fruits will ripen more quickly and below this temperature the fruits will not ripen properly and suffer from chilling injury

Fruit harvested and placed to ripen at the recommended harvest stage (one yellow stripe) will ripen to 60 to 70% yellow colouration within four to six days under ambient tropical conditions (25° to 28°C). Fruit transferred to low temperature storage, when harvested at the one-stripe stage, will store successfully for 14 to 21 days if post-harvest disease incidence can be controlled. When harvested at more advanced stages of ripening, the storage life will be significantly reduced.

Recommended Temperature  
(degree Celcius)

**7**



Recommended Relative  
Humidity (%)

**85-90**



Shelf Life

**1 to 3 weeks**



Product Loading Density (in Pound/cu.ft)	-
Initial Freezing Point (in degree Celsius)	<b>-0.8</b>
Specific Heat Above Freezing Point in (kJ/Kg.K)	<b>3.81</b>
Specific Heat Below Freezing Point (in kJ/Kg.K)	<b>1.98</b>
Latent Heat of Fusion (in kJ/Kg)	<b>304</b>

### Thermal properties of Papaya

Initial Freezing Point (in degree celcius)	<b>-1.1</b>
Specific Heat Above Freezing Point in (kJ/Kg.K)	<b>3.65</b>
Specific Heat Below Freezing Point (in kJ/Kg.K)	<b>1.89</b>
Latent Heat of Fusion (in kJ/Kg)	<b>278</b>

## RIPENING

A temperature of ~25°C is considered ideal for fruit ripening in papaya. Higher ripening temperature increases weight loss and external abnormalities in fruit. Though ethylene treatment is not recommended commercially because it limits the marketing period it may be used to ensure uniform and rapid fruit ripening to regulate marketing at the retail level. Exposure to 50 ppm ethylene for 18- 24 hours results in faster and more uniform ripening of papayas picked at color break to 1/4 yellow stage.