

PRE HARVEST AND POST HARVEST OPERATIONS FOR SEA SHIPMENT OF MANGO

1. Pre harvest survey:

- 1.1 An orchard survey must be undertaken to determine the right stage of harvest of fruit for export.
- 1.2 Mangoes normally take 120-150 days from fruit set to maturity
- 1.3 Internally the fruit should have light yellow tinges to the flesh and slightly more yellow coloration round the stone.
- 1.4 Fruit should be firm but not hard.

Harvesting :

- 1.5 Pick only clean and healthy looking fruit i.e. no signs of damage by insect pests or diseases or by other means
- 1.6 All fruit must be of consistent maturity
- 1.7 Fruits should be harvested leaving 10 cm of stalk using mango harvestors and a smooth net pouch for holding the harvested fruit
- 1.8 Harvested fruit should be lowered and placed with stem upwards in clean and disinfected plastic crates
- 1.9 Crates should not be placed directly on the soil
- 1.10 Each crate should be labeled indicating the orchard name, variety date and time of harvesting

2. Maturity indices for harvesting:

- 2.1 For long distance markets, fruits should be harvested at early maturity. However, fruits should not be immature. In order to ascertain appropriate levels of maturity of the fruits, following parameters should be carefully observed to avert spoilage :
 - i) Fruit should be harvested at light green colour stage of mango peel (skin)

- ii) Fruit should be harvested with a specific gravity of 1.0 or slightly less. The incidence of spongy tissues increases with an increase in specific gravity.
- iii) Total soluble solids (TSS) of mango fruit is recommended to be between 7 to 8%
- iv) Fruit acidity recommended : pH 4.0
- v) The fruits of uniform characteristics (as listed above) should be harvested and packed to ensure uniform ripening
- vi) Consignment lot should comprise of fruits harvested at the same period

Harvesting should be planned keeping in view the above factors.

3. **Time of Harvesting** : the fruits should be harvested in the morning (before 10 AM) or evening (after 5 PM) . Harvesting after 10 Am and before 5 PM should be avoided in order to ensure reduction of field heat in the fruits. Harvesting should be performed 48 hours in advance of shipping .

4. **Method of harvesting** :

4.1 For harvesting of the fruits, specially designed mango harvesters (stalk clippers) should be used to improve the quality and shelf life of the fruit. Traditional `jerk harvesting' should not be adopted.

4.2 It is recommended that after harvesting, the fruits should be immediately kept under shade at safe and clean place until it is transported to the packhouse. Further, for ensuring the quality and shelf life of the fruit, it is advisable that fruits be air/potable water cooled under the shade till harvesting is completed. This will minimize the effect of high temperature on the fruit and would decelerate the ripening process. As far as possible, the cold chain should be maintained from harvesting stage itself.

5. Transportation to the packhouse :

5.1 The fruits should be quickly transported in fully covered vans preferably in the refer vans to packhouse. Efforts should be made to pack the fruits in the nearest packhouse to minimize the delay and to avoid damage to the fruit during transit.

6. Post Harvest Process :

6.1 De-sapping (Optional):

- (a) Desapping is a process of removing the sap from mango fruit
- (b) The sap from the fruit is removed by cutting the stalk of the fruits at a length of 5-10 mm from the base of the fruit with the help of a sharp edged scissor/harvester
- (c) At the time of stalk cutting, the fruit should be held upside down so as to avoid the flow of sap on the skin of fruit
- (d) It is advisable that whole sap from the fruit should come out during the de-sapping process. However, to reduce the process time, fruits should be placed upside down atleast for 45 minutes .
- (e) This process should be undertaken by only trained/skilled workers of the packhouse so that skin of the fruits is not damaged
- (f) It would be appropriate if fruits are washed with water by applying a forced jet system of spraying. This will considerably hasten the process of desapping and ensure proper coverage of the fruit by the spraying water

6.2 Cleaning and washing of fruit :

- (a) After de-sapping, the fruits should be washed carefully for 2-3 minutes to remove any patches of sap . During washing, fruits should also be cleaned with soft brushings. The washing is recommended to be done with only fresh potable water of temperature lower than that of the fruit. Neutral detergents like Teapol, Sandovit or Indtron at 0.1% (1 ml of detergent per litre of water) may be mixed with water to help remove latex (sap).
- (b) It is recommended that the Alphonso mango shall be subject to specific gravity test for removal of fruits affected by the internal disorder – spongy tissue disorder. This may be done by transferring the fruit to a tank containing 2.5% salt solution. The mangoes which sink down are over mature and are likely to be affected by spongy tissue disorder. The mangoes which float in the salt solution are at the right stage of maturity for export.

6.3 Hot-Water Treatment (Mandatory for USA):

- (a) After de-sapping and washing, mango fruits should be passed through hot water treatment tanks fitted with thermostat control sensors to maintain the desired temperature of 52⁰ C. The hot water should be treated with disinfectant such as sodium hypochlorite/prochloraz etc at 200 ppm concentration for 3-4 minutes.
- (b) After hot water treatment fruits are passed through the drying table to remove the moisture. The fruits are then cleaned/wiped by a soft muslin cloth/automatic sponge system and transferred to sorting/grading table.

6.4 **Sorting and Grading :**

Over-sized/under-sized /blemished /diseased/damaged fruits shall be removed at sorting table. Though maturity indices are observed at harvesting stage as mentioned at point 2(i) to (vii) it is advisable to observe the maturity index at this stage as well. The fruits falling in uniform criteria shall be graded and packaged accordingly. Fruits should be handled carefully and placed gently into the packing boxes to avoid bruising/injury.

Fruits shall be graded as per size, weight, shape and colour or as per the market requirements.

The grading shall also be done by following the grade requirements as notified by Directorate of Marketing and Inspection, Government of India.

7. **Pre-cooling** : Immediately after packing, the packed fruits shall be transferred to pre cooling chamber . The recommended temperature of pre cooling chamber is 12-13^o C.

8. **Packaging and palletization :**

- 8.1 It is advisable that packaging should be carried out on tables instead of floor for maintaining proper hygiene
- 8.2 Fruits shall be placed into soft, expandable polystyrene , netted sleeves to prevent bruising before placing into the final packaging boxes
- 8.3 Mango fruits should be packed in single layer within the self locking fibreboard carton boxes . The bursting strength requirement of the packages should be more than 260 lb/in².
- 8.4 The packing material should have water proof coating to prevent damage to the fruits

- 8.5 Adequate ventilation (openings) shall be provided in the boxes and such ventilators (openings) in the box shall be covered with an insect proof screen of 30 mesh per liner inch **(Mandatory for USA and Japan)**.
- 8.6 Packing material of only food grade quality shall be used for packing of fruits
- 8.7 Carton labelling shall be done in accordance with the market requirement
- 8.8 After packaging, palletization is very essential in case of sea shipments to reduce the fruit damage due to multiple handling. The pallet size should be 1200 x 1000 mm.
- 8.9 The pallets should be secured with horizontal plastic straps and stacking operation should be done carefully.
- 8.10 Stacked packages shall be immediately loaded into the container maintaining a temperature of 12⁰C with a relative humidity of 90-95%

9. **Container loading :**

- 9.1 Process of shipping shall be carried out within 48 hours of harvesting. In this regard it is advisable that a complete plan preferably by a port chart should be made as per the expert guidance, in advance of export.
- 9.2 Before loading the consignment, temperature of the fruit should be brought down to 12⁰ C.
- 9.3 Temperature of the loading bay should also be maintained at 12⁰ C.
- 9.4 Air flow movement should be provided by stacking the cartons properly
- 9.5 The temperature of the container should be maintained at 12⁰ C.
- 9.6 The Relative Humidity (RH) should be 90-95%.

10. **In-Transit processes :**

- 10.1 The temperature during transport should be monitored meticulously
- 10.2 The temperature of 12⁰ C shall be maintained throughout the transit period
- 10.3 It would always be advisable if data loggers are placed inside the container to monitor the temperature and RH throughout the transit period. This will provide information in case of any spoilage of fruit during transportation.
- 10.4 To avoid the breaking of cool chain at destination, consignment should be immediately transferred to the cold store (maintained at 12⁰ C.) till fruits are supplied to the market.

PRECAUTIONARY NOTES :

1. Avoid the incidence of disease development by applying management measures at the earliest
2. Avoid complete or advance stage of maturity of fruit
3. Avoid the retention of field heat for longer durations
4. Avoid the delays in entering the cool chain
5. Avoid breakage of cool chain
6. Avoid temperature fluctuation
7. Avoid sending damaged fruits or fruits with black spots , sap coated or insect damages

NOTE 1 : FOR SHIPMENT OF MANGOES TO USA , IT IS MANDATORY TO GET THE CONSIGNMENT IRRADIATED AT AN APPROVED FACILITY . CURRENTLY , KRUSHAK AT LASALGAON IS THE ONLY APROVED FACILITY FOR THE PURPOSE.

NOTE 2 : FOR SHIPMENT OF MANGOES TO JAPAN, IT IS MANDATORY TO GET THE CONSIGNMENT VAPOUR HEAT TREATED , CURRENTLY THE APPROVED FACILITIES FOR VAPOUR HEAT TREATMENT (VHT) EXIST AT MSAMB, VASHI, MAHARASHTRA; AP STATE AGRO INDUSTRIES DEVELOPMENT CORPORATION AT TIRUPATHI AND NUZVID, A.P.; UP MANDI PARISHAD, SAHARANPUR, UP AND GALLA FOODS LIMITED, CHITTOOR , AP, NIKKO NAMDHARI FOODS LTD, NASIK, MAHARASHTRA