

## **POST-HARVEST PROFILE OF MANGO**



**2013**  
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**(DEPARTMENT OF AGRICULTURE & COOPERATION)**  
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## **P R E F A C E**

Approximately 50% of all tropical fruits produced worldwide are mangoes. Mango (*Mangifera indica* Linn) is an important fruit crop in India and popularly called the 'king of fruits'. Mango is the most widely cultivated fruit in India. India is the major Mango growing country, contributing nearly 49.62 per cent of world's area and 42.06 per cent of world's production respectively. Area under Mango crop in Andhra Pradesh is the highest in the country. The fruit is very popular with the masses due to its wide range of adaptability, high nutritive value, richness in variety, delicious taste and excellent flavour. The fruit is consumed in both forms raw and ripe. Every part of the Mango is utilised in some form or another. Bark, leaves, skin or pit, all have been concocted into various types of treatments or preventatives down through centuries. The Inter-Ministerial Task Force on Agricultural Marketing Reforms (May, 2002), suggested several measures for strengthening agricultural marketing system in the country for benefiting the farming community to enhance the share of farmers in the ultimate price of their produce as well as for various market functionaries in the new liberalized global market opportunities and to foster true competition among the market players. This profile has been prepared on the recommendation of the Inter-Ministerial Task Force with a view to enable the farming community to scientifically manage the post-harvest operations and to widening awareness for better marketing of the Mango. The profile covers almost all aspects of the marketing, such as post-harvest management, marketing practices, quality standards, grading, packaging, transportation, storage, SPS requirements, marketing problems, marketing information, etc.

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The Government of India should not be regarded as assuming responsibility for any of the statements contained in this profile.

--Sd--

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Dated : 00/03/2012

Agril.Marketing Adviser to the  
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# **POST- HARVEST PROFILE OF MANGO**

## **CONTENTS**

Page No.

### **1.0 INTRODUCTION**

- 1.1 Botanical description**
- 1.2 Mango nutrition**
- 1.3 Economic Importance**
- 1.4 Facts about mango**

### **2.0 PRODUCTION**

- 2.1 Major producing countries in the world**
- 2.2 Major Mango producing states in India**
- 2.3 Varieties**

### **3.0 POST-HARVEST MANAGEMENT**

- 3.1 Pre-harvest factors influencing the post-harvest management**
- 3.2 Maturity of Mango**
- 3.3 Harvesting**
- 3.4 Post-harvest operations**
- 3.5 Grading of Mango (AGMARK)**
- 3.6 Codex Standards for Mango**
- 3.7 Codex Standard for Canned Mango**
- 3.8 Packaging**
- 3.9 Storage**
- 3.10 Transportation**
- 3.11 Preparation for the Market**
- 3.12 Post-harvest Losses**
- 3.13 Post-harvest Treatment**
- 3.14 Post-harvest Diseases**

### **4.0 MARKETING PRACTICES AND CONSTRAINTS**

- 4.1 Assembling**
- 4.2 Arrivals**
- 4.3 Dispatches**
- 4.4 Constraints and problems in marketing of Mangoes**
- 4.5 Marketing Channels**
- 4.6 Efficient marketing**

### **5.0 MARKETING COSTS AND MARGINS**

- 16.1 Marketing Costs**
- 16.2 Marketing Margins**

### **6.0 EXPORT AND IMPORT**

- 6.1 National Trade**
- 6.2 Requirements for exporting Mangoes from India to the United States**
- 6.3 Export Potential**
- 6.4 Financial Assistance**

**6.5 Agri-Export zones**

**6.6 Benefits of agri export zones**

**6.7 Export Specificaion for Mangoes**

## **7.0 PROCESSING AND USES**

**7.1 Raw Mango Products**

**7.2 Ripe Mango Products**

**7.3 Waste Utilisation**

**7.4 Fragrance**

**7.5 Gum and charcoal**

**7.6 Mango -Traditional medicine**

**7.7 Mango - Western medicine**

**7.8 Other medicinal uses**

**7.9 Toxicity**

**7.10 Problems in Indian Mango Industry**

**7.11 Drawbacks of processing**

**Annexure I GUIDELINES FOR EXPORT OF INDIAN MANGO TO USA**

**Annexure II GUIDELINES FOR EXPORT OF INDIAN MANGO TO JAPAN**

## 1. INTRODUCTION

Mango is the national fruit of India, known as the 'King of Fruits'. It is one of the most important and popular Asian fruits. Cultivation of Mangoes is deeply embedded in Indian history. Mangoes are mentioned in early Atrialkrit literature. Mangoes are widely available year-round, as fresh fruit and in frozen and processed foods. Mangoes thrive in tropical regions, and are cultivated throughout India and even in home yards, along field boundaries and roadside avenues.



It is believed that Mangoes originated in northeast India, northwestern Myanmar and Bangladesh. They, later spread to the rest of Asia by themselves and with the help of humans. They have been cultivated, praised and revered since ancient times.

### 1.1 Botanical description:

Mango (*Mangifera indica*), family Anacardiaceae, is a large, branched perennial erect tree with wide evergreen crown which attains a great height. Flowers appear in large terminal inflorescences producing fruit. The skin of the fruits may be green, yellow, or red, depending upon the variety of the fruit. The fruits have a small point at one end, known as the beak. The seed within the fruit is large and flattened.

Tree is medium to large in height, evergreen with symmetrical, rounded canopy ranging from low and dense to upright and open. Bark is usually dark grey-brown to black, rather smooth, superficially cracked or inconspicuously fissured, peeling off in irregular, rather thick pieces. The leaves are alternately arranged, lanceolate shaped, 6 to 16 inches (15 to 40.6 cm) in length and leathery in texture. They are pinkish, amber or pale green-coloured when young, and become dark green at maturity. Seedling trees live much more than 100 years whereas grafted ones live only 80 years or less.



Mangoes vary in shape (nearly round, oval, ovoid-oblong), size and color, depending upon the variety. Ripe Mangoes may be greenish, greenish-yellow, yellow, red, orange, or purple and weigh from a few ounces to more than 5 pounds (2.3 kg). The skin is smooth and leathery, surrounding the fleshy, pale-yellow to deep-orange edible portion. The fruits possess a single large, flattened, kidney-shaped seed that is enclosed in a woody husk.

## 1.2 Mango nutrition:

The fruit contains nearly 81 per cent moisture, 0.4 per cent fat, 0.6 per cent proteins, 0.8 per cent of fibers. It also contains nearly 17 per cent of carbohydrate. The fruit is rich with important minerals contains important minerals like Potassium, magnesium, Sodium, Phosphorus, and Sulphur

**Table No. 1**

**Nutritional value of Mango**

| Moisture % | Fat % | Protin % | Fiber % | Carbo-hydrate % | Minerals mg/100g |    |     |    |    | Vitamins mg/100g |    |
|------------|-------|----------|---------|-----------------|------------------|----|-----|----|----|------------------|----|
|            |       |          |         |                 | K                | Na | Mg  | P  | S  | Carot-ene        | C  |
| 1          | 2     | 3        | 4       | 5               | 6                | 7  | 8   | 9  | 10 | 11               | 12 |
| 81         | 0.4   | 0.6      | 0.8     | 16.9            | 205              | 26 | 270 | 16 | 17 | 2743             | 16 |

**Source: FAO**

In addition to sumptuous tropical flavor, Mangos deliver a host of nutrients and make healthy eating a delightful sensory experience. Mangoes are an excellent source of vitamins A and C, both important antioxidant nutrients. Vitamin C promotes healthy immune function and collagen formation. Vitamin A is important for vision and bone growth.

Mangoes are a good source of dietary fiber, therefore, it is associated with a reduced risk of some types of cancer, protecting against heart disease and cholesterol build up. Mangoes contain over 20 different vitamins and minerals.

## 1.3 Economic Importance:

The fruit is very popular with the masses due to its wide range of adaptability, high nutritive value, richness in variety, delicious taste and excellent flavour. The fruit is consumed in both forms raw and ripe.

Raw fruits of local varieties of Mango trees are used for preparing various traditional products like raw slices in brine, amchur, pickle, murabba, chutney, panhe

(sharabat) etc. Raw fruit of local varieties of Mango are used for preparing pickle and raw slices in brine on commercial scale while fruits of Alphonso variety are used for squash.

The wood is used as timber, and dried twigs are used for religious purposes. Mango kernel also contains about 8-10% good quality fat, which can be used for saponification. Its starch is used in confectionery industry.

Mango also has medicinal uses. The ripe fruit has fattening, diuretic and laxative properties. It helps to increase digestive capacity.

#### 1.4 Facts about mango:

- The name 'Mango' is derived from Tamil word 'mangkay' or 'man-gay'.
- When Portuguese traders settled in Western India, they adopted its name as 'manga'.
- The Mango is known as the 'king of fruit' throughout the world.
- Mangos originated in North-East India, Burma and Andaman Islands and bordering Bay of Bengal.
- Around 5th century B.C., Buddhist monks are believed to have introduced Mango to Malaysia and eastern Asia.
- Persian traders took the Mango into the Middle East and Africa, from there Portuguese brought it to Brazil and West Indies.
- Mango cultivars arrived in Florida in the 1830's and in California in the 1880's.
- The Mango tree plays a sacred role in India. It is a symbol of love and some believe that the Mango tree can grant wishes.
- In the Hindu culture, hanging fresh Mango leaves outside front door during Ponggol (Hindu New Year) and Deepavali is considered a blessing to house.
- Mango leaves are used at weddings to ensure the couple bears plenty of children
- Hindus also brush their teeth with Mango twigs on holy days.
- Many Southeast Asian kings and nobles had their own Mango groves; with private cultivars being sources of great pride and social standing.
- Burning of Mango wood leaves and debris releases the toxic fumes, which can cause serious irritation to eyes and lungs.
- Mangos are bursting with protective nutrients. The vitamin content depends upon the variety and maturity of the fruit, when the Mango is green, amount of vitamin C is higher, as it ripens the amount of beta carotene (vitamin A) increases.
- The fruit of the Mango is called a Drupe - consisting of the *mesocarp* (edible fleshy part) and *endocarp* (large woody, flattened pit).
- Mango is a member of the Anacardiaceae family. Other distant relatives include the cashew, pistachio, Jamaica plum, poison ivy and poison oak.
- Dermatitis can result from contact with resinous latex sap that drips from stem end when Mangos are harvested. Mango fruit skin is not considered edible.
- Every part of the Mango is utilised in some form or another. Bark, leaves, skin or pit, all have been concocted into various types of treatments or preventatives down through centuries. A partial list of many medicinal properties and purported uses attributed to the Mango tree are as follows: anti-viral, anti-parasitic, anti-septic, anti-tussive (cough), anti-asthmatic, expectorant, cardiogenic, contraceptive, aphrodisiac, hypotensive, laxative, stomachic (beneficial to digestion).



## 2.0 PRODUCTION:

### 2.1 Major producing countries in the world:

Mango is commercially grown in more than 80 countries. Main Mango producing countries are Brazil, China, Egypt, India, Indonesia, Mexico, Pakistan, Phillipines, Thailand and Vietnam .

#### 2.1.1 Area, Production and Productivity:

Area, Production and Productivity of important Mango producing countries are given in table no.2. India is the major Mango growing country, contributing nearly 46.74 per cent of world's area and 40.48 per cent of world's production respectively. The share of China in world's area and production is 9.4 per cent and 11.72 per cent while the share of Thailand in world's area and production is 6.29 per cent and 6.87 respectively. These three important countries contribute more than 56 per cent of world area and production. In case of productivity, Brazil ranks first i.e. 15.83 tonnes/hact., followed by Pakistan and Indonesia i.e., 10.6 and 9.78 tonnes/hact. Though, India is the major Mango producing country, but its productivity is only six tonnes/hact only.

**Table.2**

#### Major producing countries of mango in the world (2010)

| COUNTRY                    | AREA<br>(‘000ha) | PRODUCTION<br>(‘000 tons) | PRODUCTIVITY<br>(tons/ha) | %age SHARE IN<br>WORLD TOTAL<br>PRODUCTION |
|----------------------------|------------------|---------------------------|---------------------------|--|
| <b>India</b>               | 2312.30          | 15026.70                  | 6.50                      | 40.48                                      |
| <b>China</b>               | 465.337          | 4351.29                   | 9.35                      | 11.72                                      |
| <b>Thailand</b>            | 311.048          | 2550.60                   | 8.20                      | 6.87                                       |
| <b>Pakistan</b>            | 173.7            | 1845.50                   | 10.62                     | 4.97                                       |
| <b>Mexico</b>              | 174.97           | 1632.65                   | 9.33                      | 4.40                                       |
| <b>Indonesia</b>           | 131.674          | 1287.29                   | 9.78                      | 3.47                                       |
| <b>Brazil</b>              | 75.111           | 1188.91                   | 15.83                     | 3.20                                       |
| <b>Bangladesh</b>          | 170.8            | 1047.85                   | 6.13                      | 2.82                                       |
| <b>Philippines</b>         | 189.437          | 825.68                    | 4.36                      | 2.22                                       |
| <b>Nigeria</b>             | 114.9            | 790.20                    | 6.88                      | 2.13                                       |
| <b>Other<br/>Countries</b> | 827.04           | 6578.07                   | 7.95                      | 17.72                                      |



**World**                      4946.314                      37124.74                      7.51

Source: FAO

## **2.2 Major Mango producing states in India:**

Mango is grown in India in tropical and subtropical regions from sea to an altitude of 1500 meters. It is grown almost in all states of India. However, it is mainly cultivated in, Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal.

### **2.2.1 State-wise growing and potential belts:**

The state-wise growing and potential belts are as under.

**Table No. 3**  
**Major Mango producing states in India**

| <b>State</b>    | <b>Growing belts</b>   |
|-----------------|--|
| Andhra Pradesh  | Krishna, East and West Godavari, Vishakhapatnam, Srikakulam, Chittoor, Adilabad, Khamman, Vijaynagar |
| Chhattisgarh    | Raipur, Bastar   |
| Gujarat         | Bhavnagar, Surat, Valsad, Junagarh, Mehsana, Khera   |
| Haryana         | Karnal, Kurushetra   |
| Jammu & Kashmir | Jammu, Kathwa, Udhampur  |
| Jharkhand       | Ranchi, Sindega, Gumla, Hazaribagh, Dumka, Sahibganj, Godda.   |
| Karnataka       | Kolar, Bangalore, Tumkur, Kagu   |
| Kerala          | Kannur, Palakkad, Trissur, Malappuram  |
| Madhya Pradesh  | Rewa, Satna, Durg, Bilaspur, Bastar, Ramnandgaon, Rajgari, Jabalpur, Katni, Balagha                  |
| Maharashtra     | Ratnagiri, Sindhudurg, Raigarh   |
| Orissa          | Sonepur, Bolangir, Gajapati, Koraput, Rayagada, Gunpur, Malkanpuri, Dhenkanal, Ganjam, Puri          |
| Punjab          | Gurdaspur, Hoshiarpur, Ropar   |
| Tamil Nadu      | Dharmapuri, Vellore, Tiruvallur, Theni, Madurai  |
| Uttaranchal     | Almora, Nainital, Dehradun, Bageshwar, UdhamSingh Nagar, Haridwar                                    |

|               |   |
|---------------|---|
| Uttar Pradesh | Saharanpur, Bulandshahar, Lucknow, Faizabad, Varanasi |
| West Bengal   | Malda, Murshidabad, Nadia                             |

**Source: DMI Survey**

### 2.2.2 Area:

During 2010-11, total area under Mango cultivation was **2296.80** thousand hectares. During this period, area of Mango in Andhra Pradesh was the highest in the country i.e. 17.02 per cent (391.09 thousand ha.), followed by Uttar Pradesh 11.63 per cent (267.22 thousand ha.), and 8.27 per cent in Orissa (190.08 thousand ha.). More than forty per cent of acreage of the Mango was under these three states. State-wise area under Mango for the years 2008-09, 2009-10 and 2010-11 is given at table no. 4

**Table No. 4**  
**Area of Mango (2008-09, 2009-10 and 2010-11)**

Area in 000'ha.

| Sl. No. | State/UT       | 2008-09        | 2009-10        | 2010-11        |
|---------|----------------|----------------|----------------|----------------|
| 1       | Uttar Pradesh  | 271.20         | 276.42         | 267.22         |
| 2       | Andhra Pradesh | 497.70         | 480.41         | 391.09         |
| 3       | Karnataka      | 141.29         | 153.80         | 161.57         |
| 4       | Bihar          | 144.07         | 146.03         | 147.01         |
| 5       | Gujarat        | 115.69         | 121.52         | 130.10         |
| 6       | Tamil Nadu     | 148.84         | 132.68         | 148.04         |
| 7       | Orissa         | 164.25         | 177.63         | 190.08         |
| 8       | West Bengal    | 85.971         | 88.14          | 89.53          |
| 9       | Jharkhand      | 31.848         | 15.10          | 38.90          |
| 10      | Kerala         | 76.70          | 63.75          | 62.20          |
| 11      | Maharashtra    | 45.70          | 474.50         | 47.70          |
| 12      | Others         | 585.72         | 182.32         | 6623.36        |
|         | Total          | <b>2308.98</b> | <b>2312.30</b> | <b>2296.80</b> |

**Source: National Horticulture Board.**

### 2.2.3 Production:

During 2010-11, production of Mango in country was 15188.38 thousand tonnes. Production of Mango in Uttar Pradesh was the highest i.e. 23.85 per cent (3623.22 thousand tonnes) in country. Andhra Pradesh, Karnataka, Bihar and Gujrat were the other important Mango producing states. Their share in production was 22.14 per cent, 11.71 per cent, 8.79 per cent and 6.0 per cent respectively. Production of Mango in the country is given in table no. 5.

**Table No. 5**  
**Production of Mango (2008-09, 2009-10 and 2010-11)**

Area in 000' tonnes.

| Sl. No. | State/UT       | 2008-09         | 2009-10         | 2010-11         |
|---------|----------------|-----------------|-----------------|-----------------|
| 1       | Uttar Pradesh  | 3465.95         | 3588.00         | 3623.22         |
| 2       | Andhra Pradesh | 2522.00         | 4058.35         | 3363.40         |
| 3       | Karnataka      | 1284.42         | 1694.00         | 1778.75         |
| 4       | Bihar          | 1329.80         | 995.94          | 1334.87         |
| 5       | Gujarat        | 299.82          | 856.74          | 911.30          |
| 6       | Tamil Nadu     | 821.41          | 636.29          | 823.74          |
| 7       | Orissa         | 449.71          | 577.48          | 642.01          |
| 8       | West Bengal    | 548.92          | 578.00          | 620.17          |
| 9       | Jharkhand      | 91.52           | 254.30          | 427.94          |
| 10      | Kerala         | 445.40          | 373.17          | 380.86          |
| 11      | Maharashtra    | 712.80          | 597.00          | 331.00          |
| 12      | Others         | 778.02          | 817.42          | 951.12          |
|         | <b>Total</b>   | <b>12749.77</b> | <b>15026.69</b> | <b>15188.38</b> |

Source: National Horticulture Board.

Most of the commercial varieties of north India, namely, Dashehari, Langra and Chausa are biennial bearers i.e., alternate or irregular bearing, which is the tendency of Mango trees to bear a heavy crop in one year (On year) and very little or no crop in the succeeding year (Off year). South Indian varieties like Totapuri, Bangalora, and Neelum are known to be regular bearers. When a tree produces heavy crop in one season, it gets exhausted nutritionally and is unable to put forth new flush thereby failing to yield in the following season. This problem has been attributed to the causes like genetical, physiological, environmental and nutritional factors. By deblossoming, the problem of biennial bearing can be overcome. Proper maintenance of orchard by way of effective control of pests and diseases and regular cultural operations may also result in better production of the tree every year.

### 2.2.4 Productivity:

Productivity of Mangoes depends mainly upon three factors i) selection of cultivar, ii) the age of the tree and iii) adoption of pre-harvest technology. Uttar Pradesh ranked second in case of area coverage of Mangoes, but stood first in production and productivity, having production and productivity 3623.22 thousand tones and 13.56 tonnes per hectares, respectively during 2010-11. Andhra Pradesh was having highest area, but productivity is only 8.60 tonnes per hectares. State-wise productivity of Mango for years 2008-09, 2009-10 and 2010-11 is given in table No. 6.

**Table No. 6**  
**Productivity of Mango (2008-09, 2009-10 and 2010-11)**  
Tonnes/hectare

| Sl. No. | State/UT       | 2008-09 | 2009-10 | 2010-11 |
|---------|----------------|---------|---------|---------|
| 1       | Uttar Pradesh  | 12.78   | 12.98   | 13.56   |
| 2       | Andhra Pradesh | 5.07    | 8.45    | 8.60    |
| 3       | Karnataka      | 9.09    | 11.01   | 11.01   |
| 4       | Bihar          | 9.23    | 6.82    | 9.08    |
| 5       | Gujarat        | 2.59    | 7.05    | 7.00    |
| 6       | Tamil Nadu     | 5.52    | 4.80    | 5.56    |
| 7       | Orissa         | 2.74    | 3.25    | 3.38    |
| 8       | West Bengal    | 6.38    | 6.56    | 6.93    |
| 9       | Jharkhand      | 2.87    | 16.84   | 11.00   |
| 10      | Kerala         | 5.81    | 5.85    | 6.12    |
| 11      | Maharashtra    | 1.56    | 1.26    | 0.70    |
| 12      | Others         | 1.33    | 4.48    | 0.14    |

Source: National Horticulture Board.

### 2.3 Varieties:

More than thousand varieties of Mangoes are grown in India. However, only about 30 varieties are grown on commercial scale in different states. Important Mango varieties, cultivated in different states of India are summarised as under.

**Table No. 7**

### State-wise varieties of Mangoes

| States         | Important Varieties  |
|----------------|--|
| Andhra Pradesh | Banganpalli, Bangalora, Cherukurasam, Himayuddin, Suvarnarekha, Thothapuri, Kesar, Dhasseri, Himayat, Peddarasam, Chinnarasam, Manjeera, Neeleshan, Amarapali, Mallika, Ratana, Arkapuneet, Sindhu, K.M.H.-1 |
| Bihar          | Bombai, Langra, Fazri, Himsagar, Kishen Bhog, Sukul, Bathua  |
| Goa            | Fernandin, Mankurad, Alphonso  |
| Gujarat        | Alphonso, Kesar, Rajapuri, Vanraj  |
| Haryana        | Dashehari, Langra, Bombay Green  |
| Karnataka      | Alphonso, Bangalora, Mulgoa, Neelum, Pairi, Totapuri, Raspuri, Baneshan, Kesar, Mallika, Dasher, Sindhura, Hybrid 10, Hybrid 13  |
| Kerala         | Mundappa, Olour, Pairi, Neelum, Nadassala, Suvarnarekha, Muthalamookkam  |
| Madhya Pradesh | Alphonso, Bombai, Langra and mostly seedling types   |
| Maharashtra    | Alphonso, Kesar, Mankurad, Mulgoa, Pairi, Rajapuri, Neelum, Totapuri   |
| Orissa         | Baneshan, Langra, Neelum, Suvarnarekha and mostly seedling types   |
| Punjab         | Dashehari, Langra, Chausa  |
| Tamil Nadu     | Banganpalli, Bangalora, Neelum, Rumani, Mulgoa, Alphonso, Kalepad, Sendurga, Malguavo, Immampasant, Kallmai  |
| Uttar Pradesh  | Bombay Green, Dashehari, Fajri, Langra, Safeda Lucknow, Chausa, Ratual, S.Saurabh, Amarpalli, Malihabadi, Bombay yellow  |
| West Bengal    | Bombai, Himsagar, Kishan Bhog, Langra  |

**Source: DMI Survey**

Based on time of ripening, the varieties of Mangoes may be classified as under:

|                    |  |
|--------------------|--|
| Early variety      | Bombai, Bombay Green , Himsagar, Kesar, Suvarnarekha   |
| Mid-season variety | Alphonso, Mankurad, Bangalora, Vanraj, Banganapalli, Dashehari, Langra, Kishen Bhog, Zardalu, Mankurad |
| Late variety       | Fazli, Fernandin, Mulgoa, Neelum, Chausa   |

#### 2.3.1 Characteristics of important Indian varieties

### Alphonso (Happus)

Fruit is medium in size, ovate oblique in shape, orange yellow in colour. Juice is moderate-abundant, excellent keeping quality, good for pulping and canning. Mainly exported as fresh fruit. Flesh develops spongy tissue.



### Bangalora (Totapuri)

The fruit is medium-large, oblong shaped with pointed base with golden yellow colour. Good keeping quality; used for processing; heavy and regular bears variety, Susceptible to bacterial spot.

### Banganapalli (Baneshan, Safeda)

Fruit is large sized, obliquely oval in shape, golden yellow in colour, good keeping quality, and good for canning, biennial in habit. Variety suited for dry areas

### Bombai (Malda)

Variety is alternate bearer. Fruit is medium, ovate and yellow in colour. Keeping quality is medium.

### Bombay Green

Fruit size is medium, shape ovate oblong with spinach green colour. Keeping quality is medium. Early seasoning variety. Biennial in habit highly susceptible to both vegetative and floral malformation.

### Dashehari

Best varieties of the country. Fruit size is small-medium, shape is elongated with yellow fruit colour. Flesh is fibreless. Good keeping quality. Mainly used for table purpose.

### Fernandin

Fruit shape is oval to obliquely oval and yellow in colour with a blush of red on shoulders. Medium keeping quality. Mostly used for table purpose.

### Himsagar

Fruit is medium sized ovate fruit with yellow colour. Good keeping quality. Early season variety and mostly used for table purpose.

### Fajri:



Fruit is very large, obliquely oval in shape. Fruit colour is light chrome. Fruit quality and keeping quality are medium. This is a late season variety.

#### Kesar

Fruit is medium oblong with a red blush on the shoulders. Good keeping quality. Ideal for pulping and juice concentrates. Early season variety.



#### Kishen Bhog

Fruit is medium oval oblique with yellow colour. Keeping quality is good. Bearing heavy.

#### Langra

Fruit is medium, ovate in shape with lettuce green colour. Poor keeping quality. Skin is very thin and pulp is very sweet. Alternate bearing variety mostly used for table purpose.

#### Mankur

The variety develops black spots on the skin in rainy season. Fruit is medium ovate and yellow in colour. Fruit quality is very good but keeping quality is poor.

#### Mulgoa

Fruit is large roundish-oblique in shape and yellow in colour. High fruit quality and good keeping quality.

#### Neelum

Fruit is medium ovate-oblique in shape and saffron yellow in colour. Good keeping quality. High yielding and regular bearing. Ideal variety for transporting to distant places. This variety is mostly used for table purpose.

#### Chausa

Fruit is large, ovate to oval oblique in shape and light yellow in colour. Flesh is fibrous. Medium keeping quality. Extremely sweet in taste. Alternate bearing variety. It is mostly grown for table and processing purposes.

#### Suvernarekha

Fruit is medium ovate oblong fruit, green in colour with prominent red blush on the shoulders. Good keeping quality. Bearing is heavy.

#### Vanraj

Fruit is medium, ovate oblong in shape with a blush of jasper red on the shoulders; good keeping quality.

#### Zardalu:

Fruit size is medium, oblong to obliquely oblong and golden yellow in colour. Fruit quality is very good. Keeping quality is medium. It is a mid season variety.

### 2.3.2 Hybrid Varieties:

#### Malika (Neelum X Dashehari)

Fruit is large, oblong elliptical yellow in colour. Keeping quality is good and is mostly used for table purpose

#### Amrapali (Dashehari X Neelum)

Dwarf, regular bearing and late maturing variety. Suitable for high density planting. Flesh is fibreless. Average yield.

#### Ratna (Neelum X Alphonso)

Tree moderately vigorous, precocious. Fruits are medium sized, attractive in colour and free from spongy tissue

#### Sindhu (Ratna back-crossed with Alphonso)

Fruits are medium sized, fibreless, free from spongy tissue with high pulp to stone ratio and very thin and small stone.

#### Arka Aruna (Banganapalli X Alphonso)

Plants are dwarf regular bearing. Fruit is oblong and skin are thin, rough and dull yellow in colour with slight red blush. Pulp is soft, pale yellow in colour. Free from spongy tissue and fiber. The keeping quality is moderate and is mostly used for table purpose.

#### Arka Neelkiran (Alphoso x Neelum)

Tree is semi-vigorous in nature. Fruit is elliptical, medium size golden yellow in colour, average weight 270-280g. Free from fiber and spongy tissue. Keeping quality is good.

#### Arka Puneet (Alphoso x Banganpalli)

It is a hybrid between Alphonso and Banganpalli. It is regular and prolific bearer. Fruits are medium sized having attractive skin colour with red blush and free from spongy tissue. Excellent keeping quality.

#### Arka Anmol (Alphoso x Janardhan Pasand)

This hybrid is from a cross of Alphonso and Janardhan Pasand. It is regular bearer and good yielder. Fruits are medium sized having uniform yellow peel colour, excellent keeping quality and free from spongy tissue.

#### Au Rumani (Rumani x Mulgoa)

It is from a cross of Rumani and Mulgoa. It is precocious, heavy and regular bearing with large fruits having yellow cadmium skin colour.

#### Manjeera (Rumani x Neelum)

This hybrid is from a cross of Rumani and Neelum. It is dwarf, regular and prolific bearer with firm and fibre less flesh.

Some of the other hybrid varieties are Alfazali, Sundar Langra, Sabri, Jawahar, Neelphonso, Neeleshan, Neeleshwari and PKM2.

### 2.3.3 Some of the most popular mangos varieties, grown in the world:

#### Kent mango:

The fruit is a regular oval shape, large 20 - 26 ounces, with plump cheeks, greenish-yellow color with red shoulder. Very rich and sweet with fiber-free flesh (slices clean to the pit - like butter when ripe!)



#### Tommy Atkins mango:

Mango cultivar is developed and grown for commercial export. The fruit is a regular oval, medium to large sized, 12 to 24 ounces, yellowish-orange with deep red to purple blush, thicker skinned, juicy but firm with medium fiber.



#### Haden Mango:



The fruit is a regular oval, large, 16 - 24 ounces, yellow almost entirely washed over with an orange-red color, mild in flavor with a small amount of fiber

#### Ataulfo Mango:

Indonesian type - originated from a Hawaiian seedling strain, direct descendant of the Manila mango seedling race common in Veracruz State, Mexico. - The fruit is a small, flat, oblong shape, 6 - 12 ounces, greenish yellow to deep golden when ripe; delicious, very sweet, rich in flavor and close to fiber free.



#### Keitt:

Indian strain thought to have originated, like the Haden, from a seedling of Mulgoba 1945, Homestead, Florida. The fruit is a large (20-26 oz.) ovate tapering with slight nose-like protuberance above its tip. Green to orange-yellow as it ripens; firm flesh with a piney sweetness and minimal fiber surrounding the seed area. It is a late fruiting mango, often available into fall.



### **3.0 POST-HARVEST MANAGEMENT:**

Post-harvest management means the handling of an agricultural product after harvest to prolong storage life, freshness and an attractive appearance. In order to deliver a quality product to the market and ultimately to the consumer to command buyer attention and gives the grower a competitive edge, proper post-harvest management is the need of the hour.

Nearly, 20-25 per cent of fruits are wasted due to faulty Post-harvest practices during harvesting packaging, storage, grading etc. This wastage can be reduced to some extent through proper and scientific methods

Post-harvest management can be considered as second production operation to add values to the products and the basic means for effective marketing. Post-harvest management operations are quite diversified, consisting of collection, curing, pre-treatment, grading, packaging, pre-cooling, low temperature storage, pallet loading, transporting, and depending upon various crops.

Like post-harvest management, the pre-harvest and subsequent harvesting of the fruits also plays an important in role in enhancing the shelf life and quality of the fruits.

#### **3.1 Pre-harvest factors influencing the post-harvest management:**

The pre-harvest cultural practices like use of fertilizers, pest control, growth regulators, climatic conditions like wet and windy weather and tree conditions influence the fruit potentiality for storage by modifying physiology, chemical composition and morphology of fruits.

The spray of calcium is found useful in delay in ripening of Mangoes improves the storage life and increased the marketability. Similarly, pre-harvest spray of fungicide like Dithane M-45 (0.2%), Bavistin 0.1%, Topsin-M (0.1%) and Captan (0.2%) is effective in controlling storage disease due to anthracnose and stem end rot in Mango varieties.

#### **3.2 Maturity:**

External colour, appearance, pulp colour and soluble solids content are the reliable indicators for judging the fruit maturity. At the time of maturity, stone becomes hard and pulp colour changes from white to cream. In few varieties, at maturity stage, fruits sink in water (Langra, Chousa).

##### **3.2.1 External Colour:**

As the Mangoes mature, the skin colour changes from green to yellow. Normal size fruit that have started to turn yellow are ripe and ready for immediate harvest.

### **3.2.2 Fruit Appearance:**

The shoulder area swells and rises above the stem end. This is accompanied by the stem end sinking and forming a small pit around the stem.

### **3.2.3 Internal Pulp Colour:**

The pulp colour of Mango fruit at maturity changes from light yellow to deep yellow.

### **3.2.3 Soluble Solids Content:**

Mangoes are ready for harvest when the soluble solids content (sugars) of mature fruit is at least 10%.

### **3.2.4 Maturity Indices:**

The maturity indices are as under

- I) Color change from green to yellow.
- II) Development of "shoulders" on the stem end of the fruit.
- III) Fruit flesh turns from white to yellow starting at the endocarp and progressing outward to the skin during maturation.
- IV) Stone becomes hard and pulp colour changes from white to cream.
- V) In few varieties fruits sink in water (Langra, Chousa)
- VI) In case of Alphonso Mangoes, the fruit is considered mature when the shoulder outgrows the stem and the external colour becomes light green with a yellowish red blush.
- VII) The harvest maturity in Dashehari and Langra cultivars reaches 12 weeks after fruit set. In Chausa and Mallika it takes about 15 weeks.

The best way to observe maturity in mango is the colour of the pulp, which turns cream to light yellow on maturity and hardening of stone.

### 3.2.5 Few facts about the maturity of Mango:

- Mango fruits need 120 to 140 days after fruit set to mature
- When a few semi-ripe fruits fall from tree –traditionally it is considered as maturity stage
- Picking fruits when their specific gravity is 1.01-1.02 gives good quality fruits
- Sinking of fruits in water indicates full maturity
- Fruits dipping in water have Sp Gr. >1.02
- Fruits dipping in 2.5% salt solution but floating in 5% salt solution: Sp Gr 1.02-1.04
- Fruits dipping in 5% salt solution have Sp Gr >1.04 and are over matured
- Four Maturity stages:
  - a. Fruit shoulders are in line with stem end and the colour is olive green
  - b. Shoulders outgrow the stem-end and colour is olive green
  - c. Shoulder outgrow-stem end and colour becomes light
  - d. Flesh becomes soft and blush develops
- Fruits harvested at any of the above stages ripen well but those harvested at second and third stage give best taste and flavour
- When a few semi-ripe fruits fall from the tree, it is traditionally considered that the fruits are mature for harvest.

If immature Mangoes are picked, fruits develop white patches or air pockets and this affects taste and flavour, whereas over-mature fruits lose their storage life. Such fruits present numerous problems during handling.

It is desirable to pick the fruits at the correct stage of maturity to facilitate ripening, distant transportation and maximum storage life, and thus to increase their quality and market value.



### 3.3 Harvesting

Harvesting is the most important factor, governing the post-harvest management. The harvesting of the fruit is done, either by hand picking, or plucking with a harvester at green mature stage. When the Mangoes are fully-grown and ready for picking, the stem will snap easily with a slight pull. If a strong pull is to be applied, then fruit is still somewhat immature and should not be harvested. A long-poled picking bag, which can hold nearly four fruits, is also used for plucking of the fruits. During harvesting precaution should be taken so that the fruit is held in the pouch and between the divider and knife and as the device is pulled, otherwise the blade may cut the stalk. This process avoids the falling of the fruits. Low fruits are generally harvested with the help of clippers. At the time of harvesting, precaution is to be taken to leave a four-inch stem to avoid the spurt of milky/resinous sap that exudes if the stem is cut close. Such fruits are less prone to stem-end rot and other storage diseases. Therefore, proper care should be taken to harvest the fruit cleanly and be kept as clean as possible.

It is a common practice to harvest fruits early in the season (premature stage) to capture early market. But, fruits should be harvested, when there is some yellow colour on the tree on the fruits. If immature fruits are harvested then white patches or air pockets are developed and effects the taste and flavour, whereas over-mature fruits lose their storage life. Such fruits present numerous problems during handling.

For export market, fruit should be harvested, when firm and at the mature-green colour stage. Fruits harvested at the mature green stage ripe quite rapidly after harvest and begin to turn yellow within 3 to 5 days at ambient temperature, while fruits harvested immature green will not ripen properly, having poor taste and shrivel soon.

Fruits should also not be harvested by stick, which may cause injury / bruises due to impact, resulting in decay, poor quality and attract low price. For efficient harvesting of Mangoes a simple, low cost and portable Mango harvesting device has been designed and developed at the **Central Institute for Subtropical Horticulture, Lucknow**. Mango fruits are taken into the pouch and held between the divider and knife and as the device is pulled the blade cuts the pedicel. Then the fruits are conveyed through a nylon chute to collecting boxes without bringing down the device every time. This saves time and protects fruits from mechanical damage due to impact. It also protects operator's hand from the sap, which oozes out from the point of detachment. On an average, a man can harvest about 800 to 1000 fruits per hour with the help of this device, depending on the skill of the worker, fruiting and height of the tree. It consumes 50 per cent less energy as compared to local methods. Harvested Mangoes should be placed in field containers of not more than 25 kg capacity for movement to the packing shed. The harvested fruits should be kept in the shade and handled carefully at all times.



The harvesting of Mangoes is best done in the late morning, because in the early morning, the oil glands of the fruit are full, causing immediate discolouration of the peel, if they are accidentally pressed or bumped. A torn skin will expose the fruit to microorganism attack and result in rapid decay. Harvesting, under wet conditions should

also be avoided, since wet fruits are more susceptible to microbial growth and soil particles may cling to wet crops, exposing them to soil-borne rot organisms.

The harvesting time of Mangoes varies with the distance to the market and local consumption. Nevertheless, the factors such as market price, market glut, etc., should also be considered while harvesting the Mango fruits.

After harvesting, fruits are generally heaped under the tree on the ground. Bruised and injure fruits should be removed from the heap, as they might cause damage to adjacent fruits. Post harvest losses in Mangoes have been estimated in the range of 25-40% from harvesting to consumption stage.

### **3.3.1 Precautions during harvesting:**

The following precautions should be taken during harvesting.

- i) Harvesting should be done by using appropriate instruments like clippers or by carefully twisting and pulling the fruit from the tree.
- ii) The harvesting under wet conditions should be avoided, since wet fruits are more susceptible to microbial growth and soil particles may cling to wet crops, exposing them to soil-borne rot organisms.
- iii) Harvesting of fruits is best in the late morning, because the oil glands of these fruits are full in the early morning, causing immediate discolouration.
- iv) Stems left on the fruit should be cut off closely because they can puncture other fruit, causing post harvest decay and fruit spoilage.
- v) The tree should never be shaken to harvest the fruits. The fruits should not be allowed to fall on the soil to avoid the mechanical injury that makes fruit more prone to decay.
- vi) After harvesting, the fruits should never be left in direct sunlight and must be kept in the shade.
- viii) The contact of fruits with the soil should be avoided and should be kept carefully into padded field crates, well-ventilated plastic containers, or picking bags.
- ix) Picking bags either should strapped around the waist or put over the shoulder.
- x) Picking bags should be designed to empty from the bottom so that fruits can roll out of the sack onto the bottom of a larger field container or atop fruits already present.

The states-wise season of harvesting and method of harvesting of Mangoes is given in table No 8.

**Table No. 8**  
**Season of harvesting and method of harvesting**

| Sl. No. | State  | Starting month  | Ending month                                       | Method of harvesting  |
|---------|--|---|--|---|
| 1       | 2  | 3   | 4  | 5   |
| 1       | Andhra Pradesh                                 | ii) 15 <sup>th</sup> April<br><br>ii) 15 <sup>th</sup> May<br>(Thothapuri and other late varieties) | 15 <sup>th</sup> June<br><br>15 <sup>th</sup> July | Hand-plucking, Pole and sickle, Dapoli harvester  |
| 2       | Gujarat  | Beginning of April  | Middle of June                                     | Hand-picking, Pole and sickle   |
| 3       | Jharkhand                                      | May   | July to Early August                               | Traditional methods   |
| 4       | Karnataka                                      | Mid April   | Mid July   | Plucking with help of pole and sickle, Shaking the branches and made to fall on soft bed of grass |
| 5       | Kerala   | January   | May-June   | Manual (Traditional methods)  |
| 6       | Maharashtra                                    | February<br><br>April (end)   | 15 <sup>th</sup> May<br><br>10 <sup>th</sup> June  | Hand plucking, Bamboo patti, Clippers, Poles and bamboo   |
| 7       | Orissa   | Mid March   | June last  | Manual  |
| 8       | Uttar Pradesh                                  | May<br><br>June   | June/July<br><br>August                            | Manual (Hand plucking), Shaking the branches, Poles and bamboo                                    |
| 9       | Uttaranchal                                    |   |  |   |
| 10      | Tamil Nadu<br>i) Main season<br>ii) Off season | April<br><br>November   | July<br><br>January                                | Hand plucking, Net harvesting, Tree branch shaking, Bamboo with net                               |

**Source: DMI Survey**

Except Andhra Pradesh, in all other important Mango growing states, crude method of harvesting i.e., hand plucking and use of pole are in use. In Andhra Pradesh, in addition to local methods of harvesting, Dapoli harvester is also used for harvesting of the fruits. Mangoes are plucked quite green to avoid bird damage and the dealers layer them with rice straw in ventilated storage rooms over a period of one week.

### 3.5 Post-harvest operations:

Improved post-harvest practices results in reduction in losses, improve overall quality, extend shelf life and higher profits for growers and marketers.

Normally, Mangoes do not need any post-harvest treatment for marketing in local markets, except simple washing with water to remove the latex and dust. On a commercial scale or for export purpose, they are sometimes dipped in hot water, containing fungicide for the control of diseases. However, hot water treatment (HWT) is an effective post-harvest treatment for Mangoes. Dipping newly harvested fruits in hot water minimizes fruit fly damage, anthracnose, and stem-end rot infections.

Curing, washing, grading, packaging, storage, transportation, processing and marketing etc are the important post-harvest operation.

#### 3.5.1 Ripening:

Fruits are plucked early in the season (premature stage) to capture early market, traders use carbide treatment for artificial ripening of the fruits.

#### 3.4.2 Ripening Aids

- The Langra Mangoes can be ripened at room temperature in open, in a wooden box lined with paper, in an earthen pitcher treated with carbide and in a box filled with wood wool.
- In Alphonso fruits, ripening is very much hastened when the mature fruits are kept in a chamber saturated with ethylene gas released from 10,000-ppm ethrel solution, containing sodium hydroxide pellets.
- The effect of ethrel and calcium carbide on Dashehari Mango fruits by placing 4 g of calcium carbide/kg fruits is superior in palatability and attractive colour development. Such fruits are higher in TSS, sugars and carotenoid content but little lower in ascorbic acid content.
- Langra Mangoes ripened with calcium carbide (6 g/kg of fruits) is better in taste when followed by ethrel treated (800 ppm).
- Ripening with ethylene is the best method.

- Acetylene gas, liberated from calcium carbide by the addition of water or by contact with moisture in air, can be used as commercial ripening aids.
- The commercial use of acetylene, liberated from calcium carbide, often results in fruits that are soft and have good peel colour development, but are poor in flavour.
- Acetylene concentrations of 0.4 ml per litre for 24 hours at 25<sup>0</sup> C may advance softening and peel colour development.
- Fruit ripened at 19-21<sup>0</sup> C give better quality characteristics than those ripened at 28-30<sup>0</sup> C.
- A simple method is to place the fruits in baskets lined with banana leaves with calcium carbide. This gave fruit of uniform colour within 2-3 days at but with inferior flavour than fruit ripened without calcium carbide.

Ethrel ripening though slow had better quality.

### **3.4.3 Curing , washing and cooling:**

Curing is necessary when fruits are to be stored for long periods to extend the shelf life. The fruits are usually spread on the floor in the orchard's yard, having the cushion of paddy straw or simple straw for nearly 24 hrs and then washed to remove the dirt. Post-harvest cooling rapidly removes field heat from freshly harvested fruits, which helps in stabilizing the metabolic process. Post-harvest cooling can:

- Suppress enzymatic degradation and respiratory activity (softening)
- Slow or inhibit water loss (wilting)
- Slow or inhibit the growth of decay-producing microorganisms (molds and bacteria)
- Reduce production of ethylene (a ripening agent)

In addition to protecting quality, post-harvest cooling provides marketing flexibility by making it possible to market at the optimum time. Few of the cooling methods are room cooling, forced air-cooling and hydro cooling.

#### **3.4.4 Ripening:**

In India, 99% of the Mangoes are ripened by using Calcium Carbide, which is a toxic chemical and extremely hazardous. It is the most economical way to ripen a mango, but a banned chemical, and should not be used for ripening of fruits. Such fruits do not ripen uniformly and quality of fruits remains inferior. It would be better to treat the fruits with ethylene gas (100 ppm) in airtight room by exposing them for 24 – 48 hrs under controlled conditions of temperature and humidity, for ripening purpose.

Alternatively, fruits may be ripened with dip treatment of ethrel / ethephon solution (250 –750 ppm) in hot water ( $52\pm 20^{\circ}\text{C}$ ) for 5 minutes. The same solution could be used four times. Premature fruits (fruits harvested up to 2 weeks prior to maturity) can be ripened to an acceptance quality by dipping the fruits in 750-ppm ethrel solution. Similarly, less mature and mature fruits can be ripened by dipping the fruits in 500 and 250-ppm ethrel solution, respectively.

These treatments ripen the fruits uniformly with attractive colour.

#### **3.5 Grading:**

Grading of agricultural produce as per accepted quality standards helps farmers, marketing functionaries, processors, traders and consumers in efficient marketing.

The fruits graded according to their size, weight, colour and maturity benefits both the producer and consumer. It has been observed that bigger size fruits take 2-4 days more time in ripening than smaller ones and hinder to achieve uniform ripening. Therefore, grading according to size play an important role in packaging of the fruits. During grading, the immature, overripe, damaged and diseased fruits should be discarded.

The state-wise grading parameters used for grading of Mangoes and per centage share graded by different agencies, are given in table No 9.

**Table No. 9**  
**Grading Parameters used**

| Sl.No. | State          | Agency                 | Whether Agmark standards are used | If not, parameters used for grading  |
|--------|----------------|------------------------|-----------------------------------|--|
| 1      | 2              | 3                      | 4                                 | 5  |
| 1      | Andhra Pradesh | Producers              | No                                | Size, Shape  |
|        |                | Wholesaler             | No                                | Size, Shape  |
|        |                | Pre-harvest contractor | No                                | Size, Shape  |
|        |                | Commission agent       | No                                | Size, Shape  |
|        |                | Processor              | No                                | Physical appearance  |
|        |                | Exporter               | No                                | Size, Shape, Weight, Maturity, Physical appearance   |
| 2      | Gujarat        | Pre-harvest contractor | No                                | Size, Shape  |
|        |                | Processor              | No                                | Size, Shape  |
| 3      | Jharkhand      | Producers              | No                                | Damaged and diseased fruits are sorted out. Size and shape is considered for grading of the fruits |
|        |                | Wholesaler             | No                                |  |
|        |                | Pre-harvest contractor | No                                |  |
|        |                | Commission agent       | No                                |  |
| 4      | Karnataka      | Producers              | No                                | Colour, Shining, Size, Firmness  |
|        |                | Wholesalers            | No                                | Colour, Shining, Size, Firmness  |
|        |                | Retailers              | No                                | Colour, Shining, Size, Firmness  |
| 5      | Kerala         | Producers              | No                                | Colour, Shining, Size, Shape   |
|        |                | Wholesaler             | No                                | Colour, Shining, Size, Shape   |
|        |                | Pre-harvest contractor | No                                | Colour, Shining, Size, Shape   |
|        |                | Commission agent       | No                                | Colour, Shining, Size, Shape   |
| 6      | Maharashtra    | Producers              | No                                | Size, Colour, Ripening stage and varieties characteristics   |
|        |                | Pre-harvest contractor |                                   |  |
|        |                | Wholesalers            |                                   |  |
|        |                | Commission agents      |                                   |  |
|        |                | Processor              |                                   |  |
| 7      | Orissa         | Producers              | No                                | Size, shape and maturity   |
|        |                | Pre-harvest            |                                   |  |



|   |               |                        |    |   |
|---|---------------|------------------------|----|---|
|   |               | contractor             |    |   |
|   |               | Wholesalers            |    |   |
|   |               | Commission agents      |    |   |
|   |               | Processor              |    |   |
| 8 | Uttar Pradesh | Producers              | No | Colour, Shining, Size, Shape and firmness         |
|   |               | Pre-harvest contractor |    |   |
|   |               | Wholesalers            |    |   |
|   |               | Commission agents      |    |   |
|   |               | Processor              |    |   |
| 9 | Tamil Nadu    | Producers              | No | Colour, Shining, Size, Firmness, Ash coat on skin |
|   |               | Pre-harvest contractor | No |   |
|   |               | Commission agents      | No |   |
|   |               | Processors             | No |   |
|   |               | Retailers              | No |   |

**Source: DMI Survey**

From the above table, it is evident that in India the practice of systematic grading of Mangoes, based on scientific grade standards, is not so far being followed by any of the agency, engaged in the distribution of this fruit. Since, there is a huge domestic market, producers do not bother about grading and seldom grade them in the orchards. At the best, the growers remove immature, rotten or diseased fruits from the bulk. Wholesalers or pre-harvest contractors who purchase the produce from grower grade mangoes according to size and variety before the consignments are dispatched to the consuming centers.

The practice of sorting the fruits in several grades is common in Gujarat and Maharashtra, particularly for 'Alphonso'. Similarly, in Chittoor district of Andhra Pradesh for 'Bangalora', and for 'Dashehari' in Uttar Pradesh, the fruits are graded in several grades, according to size, colour and maturity of the fruit. Some growers and contractors use sieves, having circular holes of 8, 7.5 and 7 cm diameter to distinguish fruits by simple marks on the package.

The grades vary with variety. For Alphonso and Kesar the commercially accepted grades are as under

- A+ grade >300 g
- A grade 250-299 g
- B grade 200-249 g
- C grade 150-199 g
- D grade <150 g

However, the 'topping' malpractice, where 25% of the better quality, bigger fruits is placed at the top of each package continues.

The need for standardization of packages and grading of Mangoes has become imperative in the context of an expanding export market for this fruit. Grade designations and definitions of quality have been prescribed under voluntary Agricultural Produce (Grading and Marketing Act, 1937), for 'Alphonso' intended for marketing within the country as well as for export markets, separately.

### **3.5.1 Advantages of Grading and standardization:**

- i) Grading is beneficial to the farmers, traders as well as to the consumers, as it provides common language to all.
- ii) Grading of produce before sale enables farmers to get better price for their produce.
- iii) Grading assists producers and other intermediaries in preparing fresh produce for market with appropriate labeling.
- iv) Grading helps consumers to get standard quality produce at fair price.
- v) It facilitates consumer to compare the prices of different qualities of a produce in the market.
- vi) It assures quality of the produce and also reduces cost of marketing and transportation.
- vii) Produce of similar grade can be stored in bulk.
- viii) Market values are better understood.
- ix) Commodities can be bought and sold without inspection, through e-trading.
- x) Grading provides an authentic and scientific basis in promoting and managing marketing system.
- xi) It serves as a realistic and common basis for market intelligence and reporting.
- xii) It facilitates settlement of grading disputes between buyers and sellers.

### 3.5.2 Grading at producers' level:

Though, there is no grading of Mangoes at producers level, but there is an increasing recognition to the fact that producers need to be assisted in grading their produce before sale so that farmers may get better price. For securing adequate returns to producer/seller, scheme of "Grading at Producers' Level" was introduced in 1962-63 by Directorate of Marketing and Inspection. Main objective of this scheme is to subject the produce to simple test and assign a grade before it is offered for sale. After grading, producers get prices commensurate with quality of produce. The programme is implemented by the States/Union Territories. At present, some fruits are graded at producer's level, mainly in the regulated markets of Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal etc. Total number of producers' level grading units, as on 31-03-07 are 2143.

### 3.5.3 Benefits of Grading at producers' level:

1. Grading of produce at producers' level enable farmers to get higher price for their produce as well as it helps the consumers to get standard quality produce at fair price.
2. Grading not only facilitates dissemination of prices and market information but also assist machinery of distribution at all stages.
3. Grading at producers level helps them to develop suitable marketing strategy.

### 3.5.4 GRADE DESIGNATION AND QUALITY OF MANGOES (AGMARK):

1. Mangoes shall be fruits obtained from Varieties (cultivars) of plant *Mangifera indica* L. of Anacardiaceae family.

#### 2. MINIMUM REQUIREMENTS

(i) Mangoes shall be: -

- (a) Whole, firm, sound and fresh in appearance. Produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- (b) Clean, practically free of any visible foreign matter;
- (c) Free of black necrotic stains or trails;
- (d) Free of marked bruising;
- (e) Free of abnormal external moisture, excluding condensation following removal from cold storage;
- (f) Free from damage caused by low/or high temperature;

- (g) Free of any foreign smell and/or taste;
- (h) Free of damage caused by pests;
- (i) Sufficiently developed and display satisfactory ripeness;
- (ii) When a peduncle is present, it shall not be no longer than 1.0 cm.
- (iii) Mangoes shall comply with the residue levels of heavy metals, pesticides and other food safety parameters as laid down by the Codex Alimentarius Commission for exports.

| Grade designation | Grade Requirements   | Grade tolerances  |
|-------------------|--|---|
| 1                 | 2  | 3   |
| Extra class       | Mangoes must be of superior quality. They must be characteristic of the variety. They must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearances of the produce, the quality, the keeping quality and presentation in the package.   | 5% by number or weight of mangoes not satisfying the requirements for the grade, but meeting those of Class I or exceptionally, coming within the tolerances of that grade.         |
| Class I           | Mangoes must be of good quality. They must be characteristic of the variety. Mangoes may have following slight defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.<br>- slight defects in shape;<br>- slight skin defects due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 2,3,4,5 sq. cm. for size groups A, B, C, D respectively | 10% by number or weight of mangoes not satisfying the requirements for the grade, but meeting those of Class II grade or, exceptionally coming within the tolerances of that grade. |

|          |   |  |
|----------|---|--|
| Class II | <p>This grade includes mangoes which do not qualify for inclusion in the higher grades, but satisfy the minimum requirements. Mangoes may have following defects, provided they retain their essential characteristics as regards the quality, keeping quality and presentation.</p> <ul style="list-style-type: none"> <li>- defects in shape,</li> <li>- slight skin defects due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 4,5,6,7 sq. cm. for size groups A, B, C, D respectively</li> </ul> | 10% by number or weight of mangoes not satisfying the requirements of the grade, but meeting the minimum requirements. |
|----------|---|--|

**Footnote:** In Class I and Class II, scattered suberized rusty lenticels, as well as yellowing of green varieties due to exposure to direct sunlight, not exceeding 40% of the surface and not showing any signs of necrosis are allowed.

### 3.5.5 OTHER REQUIREMENTS

The development and condition of the mangoes must be such as to enable them:

- to ensure a continuation of the maturation process until they reach the appropriate degree of maturity
- Corresponding to the varietal characteristics,
- to withstand transport and handling, and
- to arrive in satisfactory condition at the place of destination.

### 3.5.6 PROVISIONS CONCERNING SIZING

Size is determined by the weight of the fruit, in accordance with the following table:

| Size Code | Weight (in grams) | Maximum permissible difference between fruits within the Package (in grams) |
|-----------|-------------------|---|
| A         | 100-200           | 50  |
| B         | 201-350           | 75  |
| C         | 351-550           | 100   |
| D         | 551-800           | 125   |

**Size Tolerances:**

For all grades, 10% by number or weight of mangoes in each package are permitted to be outside (above or below) the group size range by 50% of the maximum permissible difference for the group. In the smallest size range, mangoes must not be less than 90 gms. and for those in the largest size range a maximum of 925 grams applies, as follows:

| <b>Size code</b> | <b>Normal size range</b> | <b>Permissible size range.</b> | <b>Max. permissible difference between fruit in each package (10% of fruit/ package exceeding the normal size range).</b> |
|------------------|--------------------------|--------------------------------|---|
| A                | 100-200                  | 90-220                         | 50.0  |
| B                | 201-350                  | 180-425                        | 112.5   |
| C                | 351-550                  | 251-650                        | 150   |
| D                | 551-800                  | 426-925                        | 187.5   |

**3.6 CODEX STANDARD FOR MANGOES****1. DEFINITION OF PRODUCE**

This Standard applies to commercial varieties of mangoes grown from *Mangifera indica* L., of the *Anacardiaceae* family, to be supplied fresh to the consumer, after preparation and packaging. Mangoes for industrial processing are excluded.

**2. PROVISIONS CONCERNING QUALITY****2.1 MINIMUM REQUIREMENTS**

In all classes, subject to the special provisions for each class and the tolerances allowed, the mangoes must be:

- whole;
- sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- clean, practically free of any visible foreign matter;
- practically free of damage caused by pests;
- free of abnormal external moisture, excluding condensation following removal from cold storage;
- free of any foreign smell and/or taste;
- firm;

- fresh in appearance;
- free of damage caused by low temperatures;
- free of black necrotic stains or trails;
- free of marked bruising; and
- sufficiently developed and display satisfactory ripeness.

When a peduncle is present, it shall be no longer than 1.0 cm.

**2.1.1** The development and condition of the mangoes must be such as to enable them:

- to ensure a continuation of the maturation process until they reach the appropriate degree of maturity corresponding to the varietal characteristics;
- to withstand transport and handling; and
- to arrive in satisfactory condition at the place of destination.

In relation to the evolution of maturing, the colour may vary according to variety.

## **2.2 CLASSIFICATION**

Mangoes are classified in three classes defined below:

### **2.2.1 “Extra” Class**

Mangoes in this class must be of superior quality. They must be characteristic of the variety. They must be free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

### **2.2.2 Class I**

Mangoes in this class must be of good quality. They must be characteristic of the variety. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- slight defects in shape;
- slight skin defects due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 3, 4, 5 cm<sup>2</sup> for size groups A, B, C respectively.

### **2.2.3 Class II**

This class includes mangoes which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified in Section 2.1 above. The following defects, however, may be allowed, provided the mangoes retain their essential characteristics as regards the quality, the keeping quality and presentation:

- defects in shape;



- skin defects due to rubbing or sunburn, suberized stains due to resin exudation (elongated trails included) and healed bruises not exceeding 5, 6, 7 cm<sup>2</sup> for size groups A, B, C respectively.

In Classes I and II, scattered suberized rusty lenticels, as well as yellowing of green varieties due to exposure to direct sunlight, not exceeding 40 per cent of the surface and not showing any signs of necrosis are allowed.

### 3. PROVISIONS CONCERNING SIZING

Size is determined by the weight of the fruit, in accordance with the following table:

**Size Code    Weight (in grams)**

|   |           |
|---|-----------|
| A | 200 - 350 |
| B | 351 - 550 |
| C | 551 - 800 |

The maximum permissible difference between fruit in the same package belonging to one of the above mentioned size groups shall be 75, 100 and 125 g respectively. The minimum weight of mangoes must not be less than 200 g.

### 4. PROVISIONS CONCERNING TOLERANCES

Tolerances in respect of quality and size shall be allowed in each package for produce not satisfying the requirements of the class indicated.

#### 4.1 QUALITY TOLERANCES

##### 4.1.1 “Extra” Class

Five per cent by number or weight of mangoes not satisfying the requirements of the class, but meeting those of Class I or, exceptionally, coming within the tolerances of that class.

##### 4.1.2 Class I

Ten per cent by number or weight of mangoes not satisfying the requirements of the class, but meeting those of Class II or, exceptionally, coming within the tolerances of that class.

##### 4.1.3 Class II

Ten per cent by number or weight of mangoes satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting, marked bruising or any other deterioration rendering it unfit for consumption.

## 4.2 SIZE TOLERANCES

For all classes, 10% by number or weight of mangoes in each package are permitted to be outside (above or below) the group size range by 50% of the maximum permissible difference for the group. In the smallest size range, mangoes must not be less than 180 g and for those in the largest size range a maximum of 925 g applies, as follows:

| Size Code | Normal Size Range | Permissible Size Range<br>( $\leq 10\%$ of fruit/package exceeding the normal size range) | Max. Permissible Difference between fruit in each package |
|-----------|-------------------|---|---|
| A         | 200 – 350         | 180 – 425   | 112.5   |
| B         | 351 – 550         | 251 – 650   | 150   |
| C         | 551 – 800         | 426 – 925   | 187.5   |

## 5. PROVISIONS CONCERNING PRESENTATION

### 5.1 UNIFORMITY

The contents of each package must be uniform and contain only mangoes of the same origin, variety, quality and size. The visible part of the contents of the package must be representative of the entire

### 5.2 PACKAGING

Mangoes must be packed in such a way as to protect the produce properly. The materials used inside the package must be new<sup>1</sup>, clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed, provided the printing or labeling has been done with non-toxic ink or glue. Mangoes shall be packed in each container in compliance with the Recommended International Code of Practice for Packaging and Transport of Fresh Fruits and Vegetables (CAC/RCP 44-1995, Amd. 1-2004).

#### 5.2.1 Description of Containers

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the mangoes. Packages (or lot for produce presented in bulk) must be free of all foreign matter and smell.

## **6. MARKING OR LABELLING**

### **6.1 CONSUMER PACKAGES**

In addition to the requirements of the Codex General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1-1985, Rev. 1-1991), the following specific provisions apply:

#### **6.1.1 Nature of Produce**

If the produce is not visible from the outside, each package shall be labelled as to the name of the produce and may be labelled as to name of the variety.

### **6.2 NON-RETAIL CONTAINERS**

Each package must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside, or in the documents accompanying the shipment. For produce transported in bulk these particulars must appear on a document accompanying the goods.

#### **6.2.1 Identification**

Name and address of exporter, packer and/or dispatcher. Identification code (optional).

#### **6.2.2 Nature of Produce**

Name of the produce if the contents are not visible from the outside. Name of the variety or commercial type (optional).

#### **6.2.3 Origin of Produce**

Country of origin and, optionally, district where grown or national, regional or local place name.

#### **6.2.4 Commercial Identification**

- Class;
- Size (size code or weight range in grams);
- Number of units (optional);
- Net weight (optional).

#### **6.2.5 Official Inspection Mark (optional)**

## 7. CONTAMINANTS

### 7.1 HEAVY METALS

Mangoes shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity.

### 7.2 PESTICIDE RESIDUES

Mangoes shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

## 8. HYGIENE

**8.1** It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of the Recommended International Code of Practice – General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 4-2003), Code of Hygienic Practice for Fresh Fruits and Vegetables (CAC/RCP 53-2003), and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

**8.2** The produce should comply with any microbiological criteria established in accordance with the Principles for the Establishment and Application of Microbiological Criteria for Foods (CAC/GL 21-1997).

## 3.7 CODEX STANDARD FOR CANNED MANGOES

### 1. DESCRIPTION

#### 1.1 Product Definition

Canned mango is the product:

- (a) prepared from stemmed, peeled, fresh, sound, clean and mature fruit of commercial varieties conforming to the characteristics of the fruits of *Mangifera indica* L.; (b) which may or may not be packed with a suitable liquid packing medium, nutritive sweeteners and other seasoning or flavouring ingredients appropriate to the product; and (c) processed by heat, in an appropriate manner, before or after being sealed in a container, in order to preserve its essential composition and quality factors.

#### 1.2 Types of varieties

Any cultivated variety or type suitable for Canned Mangoes may be used in the preparation.

#### 1.3 Styles

The product shall be prepared from peeled fruit for all the following styles:

**1.3.1 Halves** - cut into two approximately equal parts along the stone from stem to apex and the flesh separated from the skin.

**1.3.2 Slices** - Long, slender pieces cut lengthwise or crosswise.

**1.3.3 Pieces** - (or mixed pieces or irregular pieces) - pitted and comprising **irregular shapes and sizes.**

**1.3.4 Diced** - flesh cut into cube-like parts with a dimension of at least 12 mm on the longest side.

**1.3.5 Other Styles** - Any other presentation of the product shall be permitted provided that the product:

- (a) is sufficiently distinctive from other forms of presentation laid down in this standard;
- (b) meets all relevant requirements of this standard, including requirements relating to limitations on defects, drained weight, and any other requirements in this standard which are applicable to that style in the standard which most closely resembles the style or styles intended to be provided for under this provision.
- (c) is adequately described on the label to avoid confusing or misleading the consumer.

## **1.4 Types of Pack**

**1.4.1 Regular pack** - with liquid packing medium.

**1.4.2 Solid pack** - closely packed fruit prepared by packing without a liquid packing medium; a dry nutritive sweetener may be used.

## **2. ESSENTIAL COMPOSITION AND QUALITY FACTORS**

### **2.1 Packing Media**

**2.1.1** Where a packing medium is used, it may consist of:

**2.1.1.1 Water** - in which water is the sole packing medium;

**2.1.1.2 Fruit Juice**<sup>1</sup> - in which mango juice - or any other compatible fruit juice is the sole packing medium;

**2.1.1.3 Mixed Fruit Juices**<sup>1</sup> - in which two or more compatible fruit juices which may include mango juice, are combined to form the packing medium;

**2.1.1.4 Water and Fruit Juice(s)** - in which water and mango juice, or water and any other single fruit juice or water and two or more fruit juices are combined in any proportion to form the packing medium.

**2.1.2** Any of the foregoing packing media may have one or more of the following nutritive sweeteners as defined by the Codex Alimentarius Commission

added: sucrose, invert sugar syrup, dextrose, dried glucose syrup, glucose syrup, fructose, fructose syrup, honey.

- 2.1.3** Dry nutritive sweeteners namely sucrose, invert sugar, dextrose and dried glucose syrup, may be added to solid packs without added liquid but with such slight amounts of steam, water or natural juice as occur in the normal canning of the product.

**2.1.4 Classification of packing media when nutritive sweeteners are added**

- 2.1.4.1** When nutritive sweeteners are added to fruit juice(s) the packing media shall be not less than 11° Brix and shall be classified on the basis of the cut-out strength as follows:

Lightly sweetened fruit juice(s) - Not less than 11° Brix  
Heavily sweetened fruit juice(s) - Not less than 15° Brix

- 2.1.4.2** When nutritive sweeteners are added to water or water and fruit juice(s) or water and nectar the liquid media shall be classified on the basis of the cut-out strength as follows:

Slightly sweetened water) - Not less than 10° Brix but less than 14°  
Water slightly sweetened) Brix  
Extra light syrup )  
Light syrup - Not less than 14° Brix but less than 18° Brix  
Heavy syrup - Not less than 18° Brix but less than 24° Brix  
Extra heavy syrup - Not less than 24° Brix but not more than 35°  
Brix

- 2.1.4.3** When nutritive sweeteners are added to water and fruit juice(s) and the minimum fruit juice content of the packing medium is not less than 40% m/m, the packing medium may be classified as a nectar provided the cut-out strength is not less than 20° Brix.

- 2.1.4.4** The cut-out strength for any packing medium shall be determined on average, but no container may have a Brix value lower than that of the next category below.

**2.2 Other Ingredients**

Nutritive sweeteners as defined by the Codex Alimentarius Commission.

**2.3 Quality Criteria**

**2.3.1 Colour**

The colour of the product shall be characteristic of the type or variety of mango. Canned mangoes containing special ingredients shall be considered to be of characteristic colour when there is no abnormal discolouration of the respective ingredient used.

### 2.3.2 Flavour

Canned mangoes shall have a flavour and odour characteristic of the variety or type used for canning and shall be free from odours or flavours foreign to the product; and canned mangoes with special ingredients shall have the characteristic flavour of the mangoes and the other substances used.

### 2.3.3 Texture

The mangoes shall be reasonably fleshy and have little fiber. They may be variable in tenderness but shall neither be mushy nor excessively firm in liquid media packs, and shall not be excessively firm in solid packs.

### 2.3.4 Uniformity of Size

**2.3.4.1 Halves** - 90% by count of the units shall be reasonably uniform in size.

Where a unit has broken within the container, the combined broken pieces are considered as a single unit.

**2.3.4.2 Other styles** - (There are no requirements for size uniformity).

**2.3.5 Symmetry** - Not more than 20% by count of units shall be sliced in a direction other than parallel to the crease (as stated above) and of these not more than half may have been sliced horizontally.

### 2.3.6 Definition of defects

(a) **Blemishes** - surface discolouration and spots arising from physical, pathological, insect or other agents that definitely contrast with the overall colour, and which may penetrate into the flesh. Examples include bruises, scab and dark discolouration.

(b) **Crushed or mashed** - means a unit which has been crushed to the extent that it has lost its normal shape (not due to ripeness) or has been severed into definite parts. Partially disintegrated halves are not counted as broken. All portions that collectively equal the size of a full size unit are considered one unit in applying the allowance herein.

(c) **Rind** - considered as a defect. It refers to rind adhering to the pulp of the mango or found loose in the container.

(d) **Pit (or stone) material** - considered a defect in all styles.

(e) **Harmless extraneous material** - means any vegetable substance (such as, but not limited to a leaf or portion thereof or a stem or portion thereof) that is harmless but which tends to detract from the appearance of the product.

(f) **Trim** - considered a defect only in halved and sliced canned mangoes in liquid media packs. The trimming must be excessive and includes serious gouges (whether due to physical trimming or other means) on the surface of the units which definitely detract from the appearance.

### **2.3.7 Allowances for defects**

The product shall be reasonably free from defects such as extraneous material, pit (stone) material, rind and spotted slices or chunks. Certain common defects shall not be present in amounts greater than the following limitations:

#### **Defects Liquid media packs Solid packs**

Blemishes and trim 30% by count 3 units per 500 g

Rind not more than 6 cm<sup>2</sup>

aggregate area per 500 g

not more than 12 cm<sup>2</sup>

Crushed or mashed 5% by weight not applicable

aggregate area per 500 g

Pit or pit material (average) 1/8 stone or equivalent per 500 g

1/8 stone or equivalent per 500 g

Harmless extraneous material

2 pieces per 500 g 3 pieces per 500 g

The weight of the product referred to in the above table is the drained weight (Codex Alimentarius Volume 13).

### **2.4 Classification of "Defectives"**

A container that fails to meet one or more of the applicable quality requirements as set out in sub-sections 2.3.1 to 2.3.7 (except for rinds and pit or pit material, which are based on averages), shall be considered a "defective".

### **2.5 Lot Acceptance**

A lot shall be considered as meeting the applicable quality requirements referred to in subsection 2.4 when:

- (a) for those requirements which are not based on averages, the number of "defectives" as defined in sub-section 2.4 does not exceed the acceptance number
- (c) of the appropriate sampling plan (AQL-6.5) in the Joint FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods (1969) (CAC/RM 42-1969) (Codex Alimentarius Volume 13) as amended, and (b) the requirements which are based on sample average are complied with.

### **2.6 Organoleptic Characteristics**

The product shall have the colour, odour and flavour characteristics corresponding to the varieties or types of mango used in the preparation of the product.

## **3. FOOD ADDITIVES**

### **3.1 Colour Maximum level in the finished product**

*beta*-carotene 100 mg/kg

### **3.2 Acidifying agent**

Citric acid Limited by GMP



**3.3 Antioxidant**

Ascorbic acid 200 mg/kg

**3.4 Firming Agents**

**3.4.1** Calcium chloride 350 mg/kg, calculated as Ca in the finished product

**3.4.2** Pectins Limited by GMP

**4. CONTAMINANTS**

Lead (Pb) 1 mg/kg

Tin (Sn) 250 mg/kg calculated as Sn

**5. HYGIENE**

**5.1** It is recommended that the product covered by the provisions of this standard be prepared and handled in accordance with the appropriate sections of the Recommended International Code of Practice - General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 2 (1985) Codex Alimentarius Volume 1), and other Codes of Practice recommended by the Codex Alimentarius Commission which are relevant to this product.

**5.2** To the extent possible in Good Manufacturing Practice, the product shall be free from objectionable matter.

**5.3** When tested by appropriate methods of sampling and examination, the product:- shall be free from microorganisms in amounts which may represent a hazard to health;

- shall be free from parasites which may represent a hazard to health; and
- shall not contain any substance originating from microorganisms in amounts which may represent a hazard to health.

**6. WEIGHTS AND MEASURES****6.1 Fill of Container****6.1.1 Minimum Fill**

The container shall be well filled with mangoes and the product (including packing medium) shall occupy not less than 90% of the water capacity of the container. The water capacity of the container is the volume of distilled water at 20oC which the sealed container will hold when completely filled.

**6.1.2 Classification of "Defectives"**

A container that fails to meet the requirement for minimum fill (90% container capacity) of sub-section 6.1.1 shall be considered a "defective".

**6.1.3 Lot Acceptance**

A lot will be considered as meeting the requirements of sub-section 6.1.1 when the number of "defectives" as defined in sub-section 6.1.2 does not exceed the acceptance number (c) of the appropriate Sampling Plans (AQL-6.5) in the Joint FAO/WHO Codex Alimentarius Sampling Plans for Pre-packaged Foods (1969) (CAC/RM 42-1969), (see Codex Alimentarius Volume 13) as amended.

## **6.2 Minimum Drained Weight**

- 6.2.1** The drained weight of the product shall be not less than 55% of the distilled water at 20oC which the sealed container will hold when completely filled.
- 6.2.2** The requirements for minimum drained weight shall be deemed to be complied with when the average drained weight of all containers examined is not less than the minimum required, provided that there is no unreasonable shortage in individual containers.

## **7. LABELLING**

In addition to the requirements of the Codex General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1-1985 (Rev. 1-1991) Codex Alimentarius Volume 1)1 the following specific provisions apply:

### **7.1 The Name of the Food**

- 7.1.1** The name of the food to be declared on the label shall be "Mangoes".
- 7.1.2** The style, as appropriate, shall be declared as part of the name or in close proximity to the name: "Halves", "Slices", "Diced", "Pieces" or "Mixed Pieces" or "Irregular Pieces". If the product is produced in accordance with the other styles provision (sub-section 1.3.5), the label shall contain in close proximity to the name of the product such additional words or phrases 1 Hereafter referred to as the "General Standard". that will avoid misleading or confusing the consumer.
- 7.1.3** The packing medium shall be declared as part of the name, or in close proximity to the name, as appropriate.
- 7.1.3.1** When the packing medium is composed of water, the packing medium shall be declared as: "In water" or "Packed in water".
- 7.1.3.2** When the packing medium is composed of a single fruit juice, the packing medium shall be declared as: "In juice" or "In Mango juice" where mango juice has been used; or "In (name of fruit) juice" for all other fruit juices.
- 7.1.3.3** When the packing medium is composed of two or more fruit juices, which may include mango juice, it shall be declared as: "In (name of fruits) juice"; or "In fruit juices"; or "In mixed fruit juices".
- 7.1.3.4** When nutritive sweeteners are added to mango juice, the packing medium shall be declared as:  
 "Lightly sweetened juice"; or  
 "Lightly sweetened mango juice"; or  
 "Heavily sweetened juice"; or  
 "Heavily sweetened mango juice"  
 as may be appropriate.
- 7.1.3.5** When nutritive sweeteners are added to a single fruit juice (not including mango juice) or mixtures of two or more fruit juices (which may include mango juice), the packing medium shall be declared as:  
 "Lightly sweetened (name of fruit) juice"; or  
 "Lightly sweetened (name of fruits) juices"; or  
 "Lightly sweetened fruit juices"; or

"Lightly sweetened mixed fruit juices"  
as may be appropriate, or the same for  
"Heavily sweetened" juice(s).

**7.1.3.6** When nutritive sweeteners are added to water, or water and a single fruit juice (including mango juice) or water and two or more fruit juices, the packing medium shall be declared as:

"Slightly sweetened water"  
"Water slightly sweetened"  
"Extra light syrup"  
"Light syrup"  
"Heavy syrup"  
"Extra heavy syrup".

**7.1.3.7** When nutritive sweeteners, water and fruit juice(s) are combined to form a nectar, the packing medium shall be declared as:

"In nectar" or "In mango nectar"  
where the juice component is solely mango, or  
"In (name of fruit) nectar"  
"In (name of fruits) nectar"  
"In fruit nectars" or  
"In mixed fruit nectars"  
for all other cases as may be appropriate.

**7.1.3.8** When the packing medium contains water and mango juice or water and one or more fruit juice(s), the packing medium shall be designated to indicate the preponderance of water or such fruit juice as may be the case, for example:

"Mango juice and water"  
"Water and (mango) juice"  
"(name of fruit(s) juice(s)) and water"; or  
"Water and (name of fruit(s) juice(s))".

**7.1.3.9** The fruit juice component of any packing medium shall not be declared in the name of the food if it comprises less than 10% m/m of the total packing medium but it shall be declared in the list of ingredients.

**7.1.3.10** When the name of the fruits in a mixed fruit juice or mixed fruit nectar is listed individually in the packing medium, they shall be declared in descending order of proportion.

**7.1.3.11** When the packing medium contains no added sweetening agents, the term "no added sugar" or other words of similar import may be used in association with, or in close proximity to the name of the food.

## **7.2 Instructions for Use**

In accordance with the General Standard.

**7.3 Additional Mandatory Requirements****7.3.1 Quantative Labelling of Ingredients**

In accordance with the General Standard.

**7.3.2 Irradiated Foods**

In accordance with the General Standard.

**7.4 Exemptions from Mandatory Labelling Requirements**

In accordance with the General Standard.

**7.5 Labelling of Non-Retail Containers**

In addition to the requirements of the General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1-1985 (Rev. 1-1991) Codex Alimentarius Volume 1) the following specific provision applies:

**7.5.1** Information on labelling as specified above shall be given either on the container or in accompanying documents, except that the name of the product, lot identification, and the name and address of the manufacturer or packer shall appear on the container.

**7.5.2** Lot identification, and the name and address of the manufacturer or packer may be replaced by an identification mark, provided that such a mark is clearly identifiable with the accompanying documents.

**7.5.3** Outer containers holding prepackaged foods in small units (see the General Standard) shall be fully labeled.

### 3.8 Packaging:

Packaging fresh fruits and vegetables is one of the most important steps in the long and complicated journey from grower to consumer. Therefore, main purpose of packaging is to provide produce with attributes necessary to survive a number of different hazards that can be expected during storage, transportation and distribution. Bags, crates, hampers, baskets, cartons, bulk bins, and palletized containers are convenient containers for handling, transporting, and marketing fresh produce. Packaging of fruits in standard containers is one way to reduce cost, the trend in recent years has moved toward a wider range of package sizes to accommodate diverse needs of wholesalers, consumers, food service buyers, and processing operations.

Packaging of fruits is also required for efficient handling and marketing, better eye appeal and better shelf life by reducing mechanical damage and water loss. Proper packaging protects fruits from pilferage, dirt, physiological and pathological deterioration during further handling.

Packing and packaging materials contribute a significant cost in marketing of the fruits, therefore it is important to have a clear understanding of the wide range of packaging options available in market. Proper packaging helps in efficient marketing of fresh fruits, as it protects them from mechanical damage, moisture loss, pilferage and dirt.

#### 3.8.1 Types packaging:

Two types of packaging i.e. Conventional packaging and modern packaging are used in packaging of the fruits. Conventional packaging is comprises of wooden boxes, bamboo boxes and jute gunny bags, baskets made of woven strips of leaves, while in modern packaging, card board, plastic crates, poly bags, flexible sacks made of plastic jute such as bags (small sacks) and nets (made of open mesh), Plastic crates Pallet boxes and shipping containers, wire bags, are generally used. But, C.A.P. (Controlled Atmospheric Packaging) is the best modern packaging method for packaging of fruits. It allows certain gaseous component from atmosphere to replace, released by the fruits or check the gaseous exchange around fruit pack and thus enhance shelf life of fruits.

Most popular containers used for packing Mangoes are baskets of various makes and crates and boxes.

**Central Institute for Subtropical Horticulture, Lucknow** has designed and developed CFB Boxes of 5 kg and 10 kg capacity for packing and shipping of Mango fruits successfully as an alternative to traditional nailed wooden boxes.

Experiments conducted by the Directorate of Marketing and Inspection show that wooden crates are better package material than others because these can withstand a longer transportation with less damages.

Use of CFB boxes for packaging for the domestic market is need of the hour due to scarcity of the wood and environmental concerns of the country. For export purposes, CFB boxes are already in extensive use. Paper scraps, newspapers, etc., are commonly used as cushioning material for the packaging of fruits, which prevent them from being bruised and spoiled during storage and transportation. Polythene (LDPE) lining has also been found beneficial as it maintains humidity, which results in lesser shrinkage during storage.

Wrapping of fruits individually (Unipack) with newspaper or tissue paper and packing in honeycomb nets helps in getting optimum ripening with reduced spoilage.

### **3.8.2 Few facts about the packaging:**

- The use of steel trunks or tin containers is limited, and 4-5% of the total despatches of Mango from Ratnagiri and Vengurla are packed in such containers.
- Wooden crates are good containers, especially for expensive varieties, which are packed in mature condition.
- There is no standardization of weight for any pack and it may differ from place to place.
- Cost of containers for packing Mangoes also differs from place to place, depending upon availability of raw material and labour.
- Padding or cushioning material in packaging of Mangoes varies from grass, paddy or wheat straw, to paper shreddings and leaves of Mango.
- At times, no padding material is used.

- In some places, newspapers are used as lining material in different packages.
- Ventilated wooden boxes with paper shavings in alternate layers, as cushioning material is ideal for transportation of ‘Dashehari’ and ‘Banganpalli’ varieties for long distance by rail.
- No sudden change in the existing system of package of this fruit seems to be possible.

### **3.8.3 Preparation of fruits for packaging:**

Fruits should be checked prior to packing to ensure absence of blemishes, bruises, insect infestation and mechanical damage. Stem of fruit should be removed, while holding the fruit with stem end down. After removal of stem, fruits should be placed on a de-sapping bench and allow sap to drain for 20-30 minutes. Fruits should also be washed in order to reduce the chances of any sap burn. Care should also be taken while handling fruits so that stems are not accidentally broken. Fruits should be packed with stem end down and convex curve up. This position prevents any sap that oozes after fruit has been packed from spoiling appearance of fruit.

### **3.8.4 Qualities of packaging material:**

Packages act as a container, which offers accommodation to fruits for storage and transportation, therefore packages must have following basic qualities.

- a) Package must have sufficient mechanical strength to protect the contents during handling, transport, and stacking.
- b) Packaging material must be free of chemical substances that could be transferred to the produce and become toxic to man.
- c) Package must meet handling and marketing requirements in terms of weight, size, and shape.
- d) Package should allow rapid cooling of contents and prevent build up of heat

- e) Mechanical strength of package should be largely unaffected by moisture content (when wet) or high humidity conditions.
- f) Package should be reusable, and biodegradable.
- g) Cost of package should be as low as possible.
- h) It must prevent spoilage during transit and storage.
- i) Labeling of package must indicate about quality, variety, date of packing, weight and price etc.
- j) It must be convenient in handling operations and to stack.
- k) It must be clean and attractive.
- l) It should immobilize the fruits placed inside.
- q) Quality and hygienic cushioning material must be used to protect fruits from impact, injury and compression.
- r) It should offer good ambient conditions to fruits congenial for storage and transportation
- s) It should meet optimum requirements of ventilation vis-à-vis temperature and relative humidity management.

### **3.8.5 Precaution to be taken before packaging:**

- i) Mangoes should be plucked at appropriate maturity, keeping in view the time span of marketing.
- ii) Mangoes should be sorted and graded as per accepted quality standards, before packing. Only sound fruits should be packed.
- iii) Before packing, fungicides should be resorted to as a prophylactic measure against pathogenic invasion in transit.
- iv) For prevention of bruising/abrasion injuries, paper liners, pads, trays or tissue wraps may be used. As an alternative, cushioning with easily available paddy straw keeps packing cost minimum. It will maintain a level of R.H. because of moisture absorbing tendency of the paddy straw and keep temperature down.
- v) Wrap fruits individually to avoid bruising.



- vi) Careful placement of Mangoes in cartons is necessary to avoid bruising. Use of telescopic boxes can overcome this problem very well.
- vii) Pack only sound and uniform grade of fruits.
- viii) Use new, clean and good quality packaging material.
- ix) Package should be free from any foreign material like nails, pins, etc., and smell.
- x) For securing packages, use of adhesive tape (3 to 4 cm) may be used. The packages can also be secured with thin rope of coconut fiber, or polythene sutli, as an alternative.
- xi) Provide proper ventilation to package.
- xii) Avoid under or over filling of fruits.
- xiii) Filled packages/ boxes should be kept under the shade.
- xiv) Package should meet handling and shipping requirements of international standard.
- xv) Packages should be labeled with name of variety, grade and origin.

### **3.8.6 Precautions during packaging:**

During packing, fruits should never be packed loosely to avoid shaking of fruits inside packing, which may lead to friction among fruit surface, causing damage. In wooden boxes or cartons, filling should be done up to a height, above the rim and lid should be closed with little pressure so that during transit period when the volume of the fruits reduce due to dehydration and adjustment of space due to jerks in transit, pack structure does not get loose.

It is also observed that during the packaging, sharp edges of the packing material damage the fruits. Therefore, care should be taken so that they do not come out of the containers, resulting in bruising, puncturing and damaging fruits.

It has been observed that bigger size fruits take 2-4 days more time in ripening than smaller ones. Hence, packaging of smaller fruits with larger ones should be avoided to achieve uniform ripening. The packing of immature, overripe, damaged and diseased fruits should be discarded.

During packaging, care should be taken so that nails do not come out of the packing material, resulting in bruising, puncturing and decay of fruits.

Similarly, there should not be too much ventilation, which can affect quality of fruits due to shrinkage, loss in weight, colour, etc.

### 3.8.7 Efficient Packaging of Mangoes:

Mango fruits can be packed in three ways:

- **With stems removed:** - Care should be taken, when the Mangoes are packed with stem removed, since initial spurt of sap would burn fruit, leaving a blemish that will develop during storage and transport. Sap burns must be avoided. Therefore, stems should be clipped in short, holding fruit with the stem end down. Fruits can be placed on the de-sapping bench and allow them to drain for 20-30 minutes until sap flow has stopped.
- **With stem attached:** When the Mangoes are packed with stem then there are very chances of broken off the stem. Therefore, care should be taken while handling these fruits so that stems are not accidentally broken.
- **Telescopic tray** of 450x290x105 mm: these trays are robust and protect fruits well. A plastic cup insert, called a plix liner, is used, which acts as a packing guide and 'nests' the fruit. For better look, fruits can be placed with stem end down and convex curve up. This position also prevents any sap that oozes after the fruit has been packed from spoiling appearance of fruit.

During the survey, it was observed that there is no standardization of weight for any pack and may differ from place to place. Usually, fruits are placed in layers one above the other, with a straw padding in-between. Most popular containers used for packing Mangoes are baskets, bamboo boxes and wooden boxes of various makes, whereas crates, boxes, etc. are used occasionally at some places.

Packaging material and mode of packaging at different markets are given in table No10.

**Table No10**  
**Packaging Material Used and Mode of Packaging**

| Sl. No | State          | Agency                             | Mode of packaging  |                      | Remarks  |
|--------|----------------|------------------------------------|--|----------------------|--|
|        |                |                                    | Type   | Capacity (Kg.)       |  |
| 1      | 2              | 3                                  | 4  | 5                    | 6  |
| 1      | Andhra Pradesh | Producers                          | Bamboo basket/<br>Plastic crates/ Bulk break                                 | 20, 25, & 30.        | Mostly bulk sale   |
|        |                | Preharvest contractor              | Bamboo basket/<br>Plastic crates/ Bulk                                       | 20, 25, & 30.        |  |
|        |                | Wholesalers                        | Bulk break/<br>Cardboard cartons/<br>Wooden boxes                            | 5, 10, 20.           | 90% of the sale takes place in bulk. Only 10% in packed form |
|        |                | Processor                          | Bulk break   | -                    | -  |
|        |                | Exporters                          | Cardboard cartons, Thermo cool boxes, Fordable plastic boxes, CFC boxes etc. | 3, 4.5, 5, 10., 20   | Packaging as per exporter requirements                       |
|        |                | Retailers                          | Bamboo basket/<br>Bulk/ Push carts/<br>Cycles/ Kavadi                        | No specific capacity | No Packaging   |
| 2      | Gujarat        | Preharvest contractor              | Thick paper box  | 10                   | Mostly bulk sale   |
| 3      | Jharkhand      | Producers,                         | Gunny bags   | 25-60                | Mostly bulk sale   |
|        |                | Pre-harvest Contractor,            | Basket   | 5-20                 |  |
|        |                | Wholesalers,                       | Loose  |                      |  |
|        |                | Commission - agent                 |  |                      |  |
| 4      | Karnataka      | Retailers                          | Basket   | 10-25                | Mostly bulk sale   |
|        |                |                                    | Wooden boxes   | 5-9                  |  |
|        |                | Cooperatives                       | Plastic crates   | 10, 20               |  |
|        |                | Exporters                          | Cartons  | 6                    |  |
| 5      | Kerala         | Producers, Pre-harvest contractors | Gunny bags   | 10-100               | Packaging is not very common.                                |
|        |                | Wholesalers,                       | Wooden crates  | 100                  |  |

|   |               |                                     |   |                              |  |
|---|---------------|-------------------------------------|---|------------------------------|--|
|   |               | Commission agents                   |   |                              |  |
|   |               | Exporters                           | Paper boxes                               | 10-20                        |  |
|   |               | Retailers                           | Paper/Plastic cover                       | 1-5                          |  |
| 6 | Maharashtra   | Producers                           | Loose,<br><br>Gunny bags,<br>Wooden boxes | 5-50<br>5-15                 | No packaging   |
|   |               | Pre-harvest contractor              | Wooden boxes                              | Not specified                |  |
|   |               | Wholesalers                         | Wooden boxes, plastic crates              | 5-15<br>3-5                  |  |
|   |               | Processors                          | Tin/Food grade pack                       | 200 ml. onwards              |  |
|   |               | Exporters                           | Carton boxes                              | 2 dozens                     |  |
|   |               | Retailers                           | Loose                                     | Loose                        |  |
| 7 | Orissa        | Producers                           | Loose,<br>Gunny bags                      | -<br>60-90                   | Mostly bulk sale   |
|   |               | Pre-harvest contractor, Wholesalers | Bamboo boxes, Corrugated boxes            | 15<br>15                     | 80-90% of the sale takes place in bulk. Only 10-20% in packed form |
|   |               | Retailers                           | Loose                                     | -                            | -  |
| 8 | Uttar Pradesh | Producers                           | Wooden boxes                              | 2-10, 15                     |  |
|   |               |                                     | Plastic crates                            | 15-20, 18-25                 |  |
|   |               |                                     | Gunny bags                                | 50                           |  |
|   |               |                                     | Bamboo boxes                              | 10-15                        |  |
|   |               |                                     | Loose                                     | -                            |  |
|   |               | Pre-harvest contractor              | Wooden boxes                              | 7-10, 10-15, 18-25           |  |
|   |               |                                     | Plastic crates<br>Bamboo boxes<br>Loose   | 15-20, 18-25, 25-35<br>10-15 |  |
|   |               | Wholesalers and commission agents   | Wooden boxes                              | 15, 25-30, 8-15              |  |
|   |               |                                     | Plastic crates<br><br>Loose               | 15-20, 18-25, 25-35\         |  |

|    |             |   |   |  |     |
|----|-------------|---|---|--|-----|
|    |             | Retailers   | Loose   | -  |     |
| 9  | Uttaranchal |   |   |  |     |
| 10 | Tamil Nadu  | Producers,<br><br>Preharvest<br>contractor and<br>Retailers | i) Bamboo<br>baskets<br>ii) Gunnies<br><br>Plastic crates | 5, 10, 20,<br>25, 30, 35,<br>40, 45, 50,<br>& 60 30,<br>40, 50<br>& 80<br><br>10, 25, 25<br>& 40 | Nil |
|    |             | Processor   | Loose   | -  |     |

**Source: DMI Survey**

From table no. 8, it may be seen that there is no standardization of weight for any pack and the standards differ from place to place. Therefore, steps should be taken to eliminate too many sizes and shapes of containers and to evolve tentative specifications of standard containers and methods of packaging. These may be drawn up in consultation with trade, research organizations and Government departments, keeping the economy, availability of the raw material and existing systems of transportation in view.

Information regarding capacity of packages, approximate weight per package used, number of layers of Mango kept in the packages, their count, use of chemical during packaging, material used as packaging cushion etc, are given in table No 11.

Table No. 11

## Capacity of packages and Packaging material Used

| Sl. No | State          | Type of packaging            | Capacity of packaging |             |               | Use of chemical | Cushion material used                                       | Packaging meant for            |
|--------|----------------|------------------------------|-----------------------|-------------|---------------|-----------------|---|--------------------------------|
|        |                |                              | Weight (Kg.)          | Count (No.) | No. of layers |                 |   |                                |
| 1      | 2              | 3                            | 4                     | 5           | 6             | 7               | 8   | 9                              |
| 1      | Andhra Pradesh | Corrugated fiber board boxes | 3-5                   | 15-20       | One           | Nil             | Polyurethane sheet, bubble sheet, shredded papers, polynets | Sale within the state          |
|        |                |                              | 10.                   | 15-20       | Two           | Nil             |   |                                |
|        |                | Wooden boxes                 | 10                    | 15-20.      | Two           | Nil             | Waste paper, shredded papers, paddy straw, grass            | Sale within the country/ state |
|        |                |                              | 20                    | 15-20       | Three         | Nil             |   |                                |
|        |                | Plastic crates               | 20 & 30               | 15-20       | 4-5           | Nil             | Waste paper, Polyurethane sheet                             | Local transportation           |
|        |                | Thermo cool boxes            | 3 , 4.5 & 5           | 15-20       | 1-2           | Nil             | Polyurethane sheet, bubble sheet, polynets                  | Export                         |
| 2      | Gujarat        | Thick paper box              | 10                    | 35-40       | 4             | Nil             | Old news papers   | Local                          |
| 3      | Jharkhand      | Bamboo boxes                 | 5-20                  | 20-100      | 4-5           | Nil             | Old papers  | Local markets                  |
| 4      | Karnataka      | Corrugated fiber board boxes | 5                     | 24          | 2             | Nil             | Waste paper   |                                |
|        |                | Wooden boxes                 | 10-12                 | 50-60       | 5             | Nil             | Waste paper   | Inter state markets            |
|        |                | Bamboo boxes                 | 10                    | 48          | 5             | Nil             | Waste paper   | Local markets                  |
|        |                | Plastic crates               | 15                    | 60          | 5             | Nil             | Waste paper   | Export                         |
| 5      | Kerala         | Corrugated fiber             | 15-20                 | 55-80       | 3-4           | Nil             | Dry leaves, Paddy straw, waste                              | Local                          |

|    |               |                            |   |                     |               |     |                                       |                                       |
|----|---------------|----------------------------|---|---------------------|---------------|-----|---------------------------------------|---------------------------------------|
|    |               | board boxes                |   |                     |               |     | papers, dry banana leaves             | markets                               |
|    |               | Plastic crates             | 15-20                                   | 55-80               | 3-5           | Nil | Paddy straw, waste papers             | Local markets                         |
|    |               | Paper boxes                | 10-20                                   | 35-75               | 3-5           | Nil | Paddy straw, waste papers             | Export purpose                        |
| 6  | Maharashtra   | Corrugated fibre board     | 3                                       | 12                  | 1             | No  | Paddy straws, Husk, Grass straws      | Export                                |
|    |               | Wooden boxes               | 16                                      | 48-60               | 4-5           |     |                                       | Domestic                              |
|    |               | Plastic crates             | 16                                      | 60-72               | 5-6           |     |                                       | Domestic                              |
| 7  | Orissa        | Corrugated fiber board box | 15                                      | 35                  | 4             | No  | Old paper, husk                       | Inter state movement by reputed firms |
|    |               | Bamboo boxes               | 15                                      | 35-40               | 2             | No  | Old paper, husk                       | Inter state as well as local          |
|    |               | Gunny bags                 | 60-90                                   | 200-300             | -             | No  | -                                     |                                       |
| 8  | Uttar Pradesh | Wooden boxes               | 8-10, 15-20                             | 40-50,              | 5             | No  | Old news papers                       | Locals                                |
|    |               | Bamboo boxes               | 15                                      | 70-100              | 5             | No  |                                       |                                       |
|    |               | Plastic crates             | 15-20                                   | 90-120              | 5             | No  |                                       |                                       |
|    |               | Bamboo boxes               | 15                                      | 70-100              | 5             | No  |                                       |                                       |
|    |               | Corrugated boxes           | 5-10                                    | 15-28               | 1             | No  |                                       |                                       |
| 9  | Uttaranchal   | Nil                        | Nil                                     | Nil                 | Nil           | Nil | Nil                                   | nil                                   |
| 10 | Tamil Nadu    | Bamboo baskets             | 5, 10, 20, 25, 30, 35, 40, 45, 50, & 60 | 3-8 fruits per Kgs. | Not specified | Nil | News paper, Paddy straw, Mango leaves | Locals                                |
|    |               | Plastic crates             | 10, 25, 25 & 40                         | 3-8 fruits per Kgs  | Not specified | Nil | News paper                            | Local and Inter-state                 |
|    |               | Loose                      | -                                       |                     |               |     |                                       |                                       |

Source: DMI Survey

The State Trading Corporation has developed attractive standard boxes of this type for exporting mangoes to European markets.

### 3.9 Storage:

Storage is essential for extending the consumption period of fruits, regulating their supply to the market and for transportation to long distances. Storage of fruits is also important due to reason that their production is seasonal, but demand remains for a longer period.

Storage at 10 to 13 °C (50 to 55 °F) with 85 to 90% RH, give a shelf life of 14 to 28 days for mature green fruit, depending upon variety. Ripe fruits can be stored at 7 to 8 °C (44.6 to 46.4 °F). Mature green fruits can be stored at room temperature for about 4-10 days, depending upon variety. When fruits are treated chemically and precooled to 10-12°C before storing them at an appropriate temperature, their shelf life is enhanced. **Central Institute for Subtropical Horticulture, Lucknow** has suggested to store Dashehari and Mallika at 12 °C, Langra at 15 °C, Chousa at 10 °C to enhance the shelf life to 2 to 3 weeks. It is better if fruits are precooled before keeping them at low temperature.

Precaution should be taken that no other fruit is stored with Mangoes under low temperature conditions. Stored fruits should be gradually transferred to room temperature to minimize sweating. Similarly, rigid containers, that can withstand stacking without getting deformed, should only be used.

Storage of Mangoes, in different markets, is given in table No.12



**Table No. 12**  
**Storage of Mangoes**

| Sl. No | State          | Agency  | Type of storage<br>(Simple storage/cold storage)                                      | Period of storage | Cost Qtls./month    | Method of storage   |
|--------|----------------|---|---|-------------------|---------------------|---|
| 1      | 2              | 3   | 4   | 5                 | 6                   | 7   |
| 1      | Andhra Pradesh | Producers                                     | Simple storage  | 24 hrs.           | Nil<br>(Own stores) | Loose   |
|        |                | Wholesalers/<br>C.A. level                    | Simple storage.<br>Closed chamber   | Maximum one week  |                     |   |
|        |                | Retailer                                      | Simple storage.   | 3 days            |                     |   |
|        |                | Processor                                     | Simple storage.   | Maximum one week  |                     |   |
|        |                | Exporter                                      | Pre-cooling chambers for 48 hours. Later kept in cold storage at 12°c until shipment. | Maximum 5 days    |                     | As per buyers requirements. Size 3 - 10 kgs., of different packages |
| 2      | Gujarat        | Producers                                     | Simple storage  | 24 hrs.           | Nil<br>(Own stores) | Loose   |
|        |                | Wholesaler/Commission Agent                   | Simple storage  | 1-2 days          |                     |   |
| 3      | Jharkhand      | Producers<br>Wholesalers<br>Commission agents | Simple storage  | 1-2 days          | Nil<br>(Own stores) | 98 % Loose  |
| 4      | Karnataka      | Producers                                     | No storage  | -                 | -                   | -   |
|        |                | Wholesaler/Commission Agent                   | Simple storage  | 1-2 days          | Nil<br>(Own stores) | Loose   |
|        |                | Retailers                                     | Simple storage  | 2-3 days          |                     |   |
| 5      | Kerala         | Producers                                     | Simple storage  | 1-5 days          | Nil                 | 99 % Loose  |

|    |               |                                      |                |             |                                |   |
|----|---------------|--------------------------------------|----------------|-------------|--------------------------------|---|
|    |               | Wholesalers<br>Commission<br>agents  |                |             | (Own<br>stores)                |   |
| 6  | Maharashtra   | Producers                            | Simple         | 1-3 days    | Nil<br>(Own<br>stores)         | Loose and<br>packed                                 |
|    |               | Wholesalers/<br>Commission<br>agents | Market         | 1-2 days    | Nil<br>(Own<br>stores)         | Loose and<br>wooden<br>packs)                       |
|    |               | Retailers                            | -              | 1-2 days    | Nil<br>(Own<br>stores)         | Loose and<br>wooden<br>packs)                       |
|    |               | Marketing<br>Board                   | 125 Mts        | Feb to June | 30 paise<br>per Kg.<br>per day | Crates of 15<br>Kg. or<br>boxes of 3.5<br>Kg.       |
| 7  | Orissa        | Producers                            | Simple storage | 2-3 days    | Nil<br>(Own<br>stores)         | Loose   |
|    |               | Wholesalers                          | Simple storage | 2-3 days    | Nil<br>(Own<br>stores)         | Loose and<br>packed                                 |
|    |               | Commission<br>agents                 | Simple storage | 4-5 days    | Nil<br>(Own<br>stores)         | Loose and<br>packed                                 |
| 8  | Uttar Pradesh | Producers                            | Simple storage | 1-2 days    | Nil<br>(Own<br>stores)         | Loose   |
|    |               | Wholesalers                          | Simple storage | 2-12 days   |                                | Loose/<br>packed                                    |
|    |               | Exporters                            | N.A.           | 4-5 days    |                                | Wooden<br>box                                       |
| 9  | Uttranchal    |                                      |                |             |                                |   |
| 10 | Tamil Nadu    | Producers                            | Simple storage | 1-5 Hrs.    | Nil<br>(Own<br>stores)         | Loose   |
|    |               | Wholesalers/<br>C.A.                 | Simple storage | 5-10 Hrs.   | N.A.                           | Loose   |
|    |               | Retailers                            | Simple storage | 1-5 days    | N.A.                           | Bamboo<br>baskets,<br>Gunnies,<br>Plastic<br>crates |
|    |               | Processors                           | Simple storage | 1-2 days    | N.A.                           | Loose   |

**Source: DMI Survey**

### **3.9.1 Requirements for safe storage:**

Following are the requirements for safe storage of Mangoes.

#### **i) Selection of site (location):**

- i) Storage structure should be located on a raised well-drained place.
- ii) It should be easily accessible.
- iii) Structure should be protected from excessive humidity, excessive heat, direct sunrays, and pests.
- iv) It should be constructed on a well-built platform at a height of not less than 1 foot from ground level to prevent dampness.

#### **ii) Cleaning of storage structures:**

- i) Storage structures should be properly cleaned before storing fruits.
- ii) There should be no left over, cracks, holes and crevices in structure, which may harbour insects.
- iii) Before storage, the storage structure should be cleaned and fumigated.

#### **iii) Cleaning and drying of fruits:**

- iv) Before storage, the Mangoes should be properly cleaned and dried.
- v) Damaged fruits should be discarded to avoid quality deterioration and pest attack.

#### **iv) Cleaning of bags:**

As far as possible, new packages should be used. The old packages bags should be properly cleaned, dried and fumigated before use.

**v) Separate storage of new and old stock:**

New and old stock should be stored separately to check infestation and to maintain hygienic condition of godown.

**vi) Proper aeration:**

There should be proper aeration.

**Vii) Regular inspection:**

Regular inspection of stored fruits should be carried out to check infestation. It is necessary to maintain proper health and hygiene of the stock.

### **3.10 Transportation:**

Transportation is considered as backbone and lifeline of agricultural marketing. Surface, rail, air and water are means of transporting of fruits.

#### **3.10.1 Surface transportation:**

Surface transport is more preferred to other modes of transportation due to its easy approach from the orchards to market. In surface transportation, head load, animal pack, bullock carts, auto rickshaw, lorry, minitrucks and trucks are the means of transportation, and their use depends upon the geographical location of the orchards, distance from the markets, etc.

For shorter distances, the Mangoes are transported as head load while for a radius of 10-20 Km., bullock cart/tractor trolley, auto rickshaw, mini lorry is quite common. For carrying the fruits to the distance more than 100 Km., use of trucks are found to be the most convenient mode of transport due to its easy approach from the orchards to markets.

Consigner prefers surface transport because of ready availability of trucks unlike wagons, their arrival to destination in time, absence of pilferage and facilities of road at doors of consigners and direct delivery to the market. In spite of concessional freight rates offered by railways for fresh Mangoes, the shift has continued towards surface road transport.

Trucks sometimes exert lot of pressure on the fruits and do not possess temperature reducing devices. Therefore, it is essential to design and develop suitable transport system. For long distance transportation and export purposes, the refrigerated vans should be used, to reduce the post harvest losses.

It is observed that the temperature, humidity and ethylene production during the transportation affect the quality of the fruits, which leads the fruit to rot and dehydration. Therefore, insulated and/or refrigerated trucks with elaborated intake capacity should be used for long distances road transportation.

It is also observed that losses during transit by trucks are considerably reduced because the trucks run during night, thus avoiding the excessive heat of the day.

### **3.10.2 Rail:**

Rail transport has certain advantages over surface transport. In rail transport, the damage to the produce is less as compared with that of transporting of rough roads. The transport cost is also much less in this mode of transport.

Transport by rail is preferred when the commodities are to be transported in bulk or when the distances involved are long. When fruits are transported by rail, particularly over longer distances, losses are more mainly because of frequent delays in the movement of the wagons.

However, the air-conditioned container on the Indian Railways have done a commendable job in reducing the spoilage and extending the keeping quality. Coaches maintain a temperature of 12.8-15.6<sup>0</sup> C, with a relative humidity of 60%.

### **3.10.3 Air transport:**

Air transportation is the fastest but most expensive mode of transport. However, this is essential for high-value short-life commodities. Generally, refrigeration facilities are not available and on contrary, low pressure environment with low RH are encountered at high altitude. This increases the rate of water loss of the produce. For air transportation, providing PE Film liner with perforation within box or over-wrapping of unit load is necessary. Packed produce coming in for air transportation has to be pre-cooled sufficiently to counterpoise the lack of refrigeration facility. As there are no cold storage facilities at airports in India, it is necessary to transport the pre-cooled produce in insulated or refrigerated trucks or vans to airport to obviate

possible delays in loading due to late arrivals or non-availability of required space on a particular flight.

#### **3.10.4 Water transport:**

In-land, waterways can be used as an effective means of transport for fresh fruits and vegetables.

Although marine transport is relatively slow which consume a fairly more time in comparison to other means of transportation to cover long destinations, inter-continental transportation, ship is the cheapest and most energy efficient. To survive long distance transportation in waterways, most of produce requires low temperature environment with enough ventilation to minimize CO<sub>2</sub> and ethylene accumulation. Refrigerated modular containers should be used for purpose, which can be loaded at the packing house/centre and transported on trucks to the port, for onward transportation.

Transport of Mangoes by boats is a common practice in West Bengal and Assam. This method of transport is the cheapest.

#### **3.10.5 Few facts about the use of mode of transportation:**

- For a radius of about 8-10 km of market, transportation of fruits by head loads or by bullock cart is quite common.
- For distant producing centres, transportation is done mainly by road, rail, waterways in small quantities and air in very little quantities.
- Due to distinct advantages in transporting goods by trucks compared with railways, there has been a definite shift in favour of road transport of Mangoes.
- Trucks are now plying over long distances of 800 to 1,000 km, connecting producing centres of one state with the consuming centres in other.

- In Delhi, up to 90% of total arrivals are transported by road. In Chennai, 83% Mangoes are transported by trucks.
- Loss during transit by trucks is very small (about 1%) because trucks run during night, thus avoiding the excessive heat of the day.
- When fruit is transported by rail, particularly over longer distances, there is loss of 10-20% in the consignment, mainly because of frequent delays in the movement of the wagons.
- Hence, in spite of concessional freight rates offered by the railways for fresh Mangoes, shift has continued towards road transport.
- Consigner prefers road transport because of ready availability of trucks unlike wagons, their arrival at destination in time, absence of pilferage *enroute* and facilities of road at the doors of the consigners and direct delivery to the market.
- Despite these advantages, transport by rail still prevails when commodities have to be transported in bulk or when the distances involved are long.
- Air-conditioned containers on the Indian Railways have done a commendable job in reducing the spoilage and extending the keeping quality.
- Containers maintain a temperature of 12.8-15.6<sup>0</sup> C with a relative humidity of 60%. Pre-cooling of fruits is always better. Railway wagons or covered trucks can also be utilized for refrigerated

transport by cooling them with ice. Air must be circulated in vans by fitting a fan inside.

### 3.10.6 Mode of transportation used and average distance covered:

Details of transporting Mangoes from “Farm to Assembling Markets/Farm to Consuming Markets and Assembling Markets to Consuming Markets, Mode of Transportation, Average Distance Covered and Method of Packing for Purpose of Transportation” are given at table No 13.

**Table No.13**

#### Transportation of Mango

| Sl. No. | State          | Farm to assembling market/ assembling market to consuming market | Mode of transport                                 | Average distance traveled (Km.) | Transported (Loose /Packaged) % |          |
|---------|----------------|--|---|---------------------------------|---------------------------------|----------|
|         |                |  |   |                                 | Loose                           | Packaged |
| 1       | 2              | 3  | 4   | 6                               | 6                               | 7        |
| 1       | Andhra Pradesh | Farm to assembling market  | Bullock carts, Tractors, Mini trucks, Auto trucks | Less than 100                   | 100                             | Nil      |
|         |                | Assembling market to consuming market                            | trucks, Mini trucks, Railway                      | 100-2500                        | 90                              | 10       |
| 2       | Gujarat        | Farm to assembling market  | Bullock carts, Tractors, Mini trucks, Auto trucks | 20-30                           | 5                               | 95       |
|         |                | Assembling market to consuming market                            | trucks, Mini trucks, Railway                      | 200                             | 5                               | 95       |
| 3       | Jharkhand      | Farm to assembling market  | Truck, auto, bus, cycle,                          | 15                              | 80                              | 20       |



|   |             |  |   |        |       |       |
|---|-------------|--|---|--------|-------|-------|
|   |             |  | head load   |        |       |       |
|   |             | Assembling market to consuming market/terminal market  | Truck, auto, bus, cycle                               | 20     | 50    | 50    |
| 4 | Karnataka   | Farm to assembling market                              | Tri-wheelers, Tractors, Mini Lorry, Trucks            | 30-40  | 100   | -     |
|   |             | Assembling market to consuming market                  | Tempo, Mini Lorry, Trucks                             | 50-100 | 90    | 10    |
| 5 | Kerala      | Farm to assembling market                              | Bullock carts, Tractors, Mini trucks, Auto, Head load | 20-80  | 90    | 10    |
|   |             | Assembling market to consuming market/ terminal market | Hand pulled cart, Mini van, Auto rikshaw              | 2-15   | 90    | 10    |
| 6 | Maharashtra | Farm to assembling market                              | Bullock carts, Tractors, Mini trucks, Auto trucks     | 10-80  | NA    | NA    |
|   |             | Assembling market to consuming market                  | Truck, tempo and loose                                | 60-400 | 10-20 | 80-90 |
| 7 | Orissa      | Farm to assembling market                              | Bullock carts, Tractors, Cycle                        | 15-20  | 100   | -     |

|    |               |  |   |          |       |       |
|----|---------------|--|---|----------|-------|-------|
|    |               | Assembling market to consuming market      | Tractor, Van, Mini truck                              | 10-50    | 90-95 | 5-10  |
| 8  | Uttar Pradesh | Farm to assembling market                  | Bullock carts, Tractors, Mini trucks, Auto trucks     | 5-10     | 90-95 | 5-10  |
|    |               | Assembling market to consuming market      | Tractors, Mini trucks, Auto trucks                    | 10-500   | 20-25 | 75-80 |
| 9  | Uttaranchal   | Farm to assembling market/Commission Mandi |   |          |       |       |
|    |               | Assembling market to consuming market      |   |          |       |       |
| 10 | Tamil Nadu    | Farm to assembling market/Commission Mandi | Cycles, Bullock carts, Lorry, Tempo, Matador, Tractor | 40-60    | 30-95 | 70-05 |
|    |               | Assembling market to consuming market      | Lorry, Tempo  | 120-2000 | 20-85 | 80-15 |
|    |               |  |   |          |       |       |

**Source: DMI Survey**

From table no. 11, it may be seen that for carrying the produce from farm to assembling markets, for 10 to 100 Km., Bullock carts, Tractors, Mini trucks, Auto trucks are generally used. Mangoes are dispatched to consuming markets and terminal markets up to a distance of 2500 Km., use of rail and trucks is more prominent. It is also seen that produced is loosely transported to assembling markets, while for transporting the consignment to wholesale, consuming and terminal markets, they are transported in well packed manner.

Wooden boxes are commonly used for packaging and transportation of Mango fruits. Under dynamic transport conditions, nails come out due to vibration and puncture fruits, which result in bruising, decay and low price of fruits. Further, too much ventilation affects quality of fruits due to shrinkage, loss in weight, colour, etc. To overcome these problems, CFB (carton fibreboard) Boxes of 5 kg and 10 kg capacity for packing and transporting of Mango fruits may be used successfully as an alternative to traditional nailed wooden boxes. Use of CFB boxes for packaging for domestic market is also need of the hour due to scarcity of wood and environmental concerns. For export purposes, CFB boxes are already in extensive use. Paper scraps, newspapers, etc., are commonly used as cushioning material for the packaging of fruits, which prevent them from getting bruised and spoiled during storage and transportation. Low-density polyethylene (LDPE) lining has also been found beneficial as it maintains humidity, which results in lesser shrinkage during storage. Wrapping of fruits individually (Unipack) with newspaper or tissue paper and packing in honeycomb structure helps in getting optimum ripening with reduced spoilage.

For long distance transportation and export purposes, it is better to use refrigerated vans to reduce the post harvest losses.

### **3.10.7 Selection of Mode of Transportation:**

Since, the body of the vehicle is also a container; the fruits to be transported should meet certain basic requirements as a carrier of packages.

Following points should be considered for the selection of mode of transportation:

- a. The mode of transportation should be cheaper among available alternatives.
- b. It should immobilize the packages placed inside.
- c. It should not cause damage to packages, because of uneven surface or protrusions in the body due to nuts and bolts.
- d. It should work as a safe carrier of the packages placed inside.
- e. It should be convenient during loading and unloading.
- f. It must protect the Mangoes during transportation from adverse weather conditions.
- g. It should be safe from pilferage, etc.

- h. It should deliver the fruits to consignee in stipulated period.
- i. It should be easily available, particularly during post harvest period.
- j. Distance of the market should be considered for selecting the mode of transportation.

### **3.10.8 Precautions to be taken while loading:**

It is observed that workers, engaged in loading trucks place packages without taking proper care. Packages are roughly handled. It is also seen that wooden boxes are forcibly placed in trucks to fix them in stack. Such practice is likely to damage box, so also adjoining boxes. Therefore, such practices should be avoided. Following precautions should be taken while loading in trucks.

1. Workers, engaged in loading of Mangoes, should be awakened through informal training to handle the packages carefully so that mechanical injury at the time of loading/ unloading is minimum.
2. Packages should not be thrown during loading and unloading.
3. Stacking should be done in such a manner that packages are locked with each other in a stack. This will help to immobilize packages within truck.
4. Packages should be arranged in such a manner that there is proper air circulation.
5. Provide cushioning with clean paddy straw on all sides to the extent possible, so that there is no damage to packages because of protrusions of nuts/bolts, angles, etc., in body of trucks at various places.
6. Instead of dark coloured tarpaulin used for securing packages, white tarpaulin should be used. This will help to keep the packages cool to some extent because of heat reflection. Covering should also provide proper aeration.
7. Transport the fruits during the cooler part of the day, preferably at night.
8. Too large containers should not be used for transportation.
9. Cold storage fruits should be transported in a refer van.

### **3.10.9 Cool Chain:**

Cool chain is essential during the transport of quality Mangoes all the way from the farm to customer. This helps in maintaining the temperature inside box at the same low level as in the cold storage.

Various stages of the cool chain are:

1. Cold store at the farm.
2. Reefer Van/ truck from farm to the airport
3. Cold store at the airport.
4. Building up of the pallet in a cold store at the airport.
5. Loading aircrafts directly from cold store in a short time.
6. Cargo aircraft maintains cold store temperature in transit.
7. Off loading direct into a cold store in the receiving country.
8. Refrigerated truck to air-cooled departmental stores.

### **3.11 Preparation for the Market:**

During the survey, it was found that producers for carrying the Mangoes to the markets do no special preparation. At the most, Mangoes are washed and cleaned before carrying them to markets. For washing purpose, water used for cleaning should be sanitized with 150-ppm free chlorine and maintained at a pH of 6.5. This is equal to 2 oz of household bleach per 5 gallons of water, or 0.3 liters of bleach per 100 liters of water.

Before despatching the fruits, they should be sorted according to size, shape, firmness, external colour, insect damage, and decay. They should be clean, free of dirt and latex stains, mature, firm, well-shaped, free of injury and wounds, free of sunburn, free of insect damage and decay (particularly anthracnose), and have a well trimmed stem with a length of less than 1 cm. Visibly damaged fruit should be rejected. Care should be taken that fruits are firm, mature and green in order to withstand the rigors of transportation. For export marketing, fruit should be carefully sorted for uniformity of size and shape.

During the survey, it was found that in most of states, fruits are treated with ethylene, thiabendazole Ethrel and calcium carbide for their ripening.

State-wise information regarding treatment given to the fruits for preparation of market, method used for ripening of fruits and chemical used for their ripening is given in table No 14.

**Table No.14**

**Preparation for Market**

| Sl. No | State          | Agency                            | Treatment for the market |         |          | Method used for ripening                 | Chemical used for ripening |
|--------|----------------|-----------------------------------|--------------------------|---------|----------|--|----------------------------|
|        |                |                                   | Washing/<br>Cleaning     | Cooling | Chemical |  |                            |
| 1      | 2              | 3                                 | 4                        | 5       | 6        | 7  | 8                          |
| 1      | Andhra Pradesh | Producers                         | No                       | No.     | No.      | Normal ripening                          | Nil                        |
|        |                | Preharvest contractors            | No                       | No.     | No.      | Normal ripening                          | Calcium Carbide            |
|        |                | Wholesalers/<br>Commission agents | No                       | No.     | No.      | Normal ripening/<br>artificial ripening  | Calcium Carbide            |
|        |                | Cooperatives/<br>Govt.institution | No                       | No.     | No.      | Normal ripening &<br>artificial ripening | Calcium Carbide            |
|        |                | Processor                         | Yes                      | No.     | No.      | Normal ripening &<br>artificial ripening | Ethylene                   |
|        |                | Exporters                         | Yes                      | Yes     | Yes      | Artificial ripening                      | Ethylene                   |
|        |                | Retailers                         | Yes                      | Yes     | Yes      | Artificial ripening                      | Calcium Carbide            |
| 2      | Gujarat        | Producers                         | No                       | No      | No       | No                                       | No                         |
|        |                | Preharvest Contractor             | Yes                      | No      | No       | Sun ripening                             | No                         |
|        |                | Wholesalers                       | Yes                      | No      | No       | No                                       | No                         |
| 3      | Jharkhand      | All functionaries                 | No                       | No      | No       | No                                       | No                         |
| 4      | Karnataka      | Producers                         | No                       | No      | No       | By covering with paddy in a room         | N.A.                       |
|        |                | Wholesalers                       | No                       | No      | No       | Chemical ripening                        | Calcium Carbide            |
|        |                | Retailers                         | No                       | No      | No       | No                                       | No                         |
| 5      | Kerala         | Producers,                        | No                       | No      | No       | Conventional                             | No                         |

|    |              |                              |     |     |     |                                |                                      |
|----|--------------|------------------------------|-----|-----|-----|--------------------------------|--------------------------------------|
|    |              | Pre-harvest Contractor       |     |     |     | meathod                        |                                      |
|    |              | Commission agents            | No  | No  | No  | Conventional meathod/ Chemical | Ethanol, Ethereal Calcium Carbide    |
|    |              | Commission agents            | No  | No  | No  | Conventional meathod/ Chemical | Ethanol, Ethereal Calcium Carbide    |
|    |              | Others                       | No  | No  | No  | No                             | No                                   |
| 6  | Maharashtra  | Producers                    | No  | No  | No  | No                             | No                                   |
|    |              | Preharvest Contractor        | -   | No  | No  | Natural                        | No                                   |
|    |              | Wholesalers                  | Yes | No  | No  | NA                             | -                                    |
|    |              | Commission agents            | Yes | No  | No  | NA                             | -                                    |
|    |              | Cooperatives                 | Yes | No  | No  | Natural and chemical           | Thiabendazole Ethrel/Calcium carbide |
|    |              | Producers                    | No  | No  | No  |                                |                                      |
|    |              | Exporters                    | Yes | Yes | Yes |                                |                                      |
|    |              | Retailers                    | No  | No  | No  | -                              | -                                    |
| 7  | Orissa       | Producers                    | No  | No  | No  | Paddy, straw, fumigation       | No                                   |
|    |              | Wholesalers                  | No  | No  | No  | Chemical                       | Ethanal, Calcium Carbide             |
|    |              | Others                       | No  | No  | No  | No                             | No                                   |
| 8  | UttarPradesh | Producers                    | Yes | NA  | Yes | Yes                            | Carbide Carbide                      |
|    |              | Wholesalers                  | Yes | NA  | Yes | Yes                            | Calcium Carbide                      |
|    |              | Commission agents            | Yes | NA  | Yes | Yes                            | Calcium Carbide                      |
|    |              | Retailers                    | Yes | NA  | Yes | Yes                            | Calcium Carbide                      |
| 9  | Uttranchal   |                              |     |     |     |                                |                                      |
| 10 | Tamil nadu   | Wholesalers, C.A., Retailers | No  | No  | Yes | Paddy straw                    | Calcium Carbide                      |

Source: DMI Survey

### 3.12 Post-harvest Losses:

Fresh fruits are inherently perishable. During process of distribution and marketing, substantial losses are recorded which range from a slight loss of quality to total spoilage. Post-harvest losses may occur at any point in marketing process, from initial harvesting, grading, packaging, transportation from field to storage and storage to assembly point, during storage and distribution to final consumer. Causes of losses are many such as physical damage during handling and transport, physiological decay, water loss etc.

A large number of intermediaries in system results in further wastage due to repeated handling of fruits. Between the farmer and retailer are local retailer, transporter, wholesale market and distributor, etc., and at every step recordable wastage is noticed.

### **3.12.1 Nature and causes of post-harvest losses:**

There are various reasons for post-harvest losses of horticultural produce. Some of them are as under.

- (i) Mechanical injury:
- (ii) Injuries due to thermal shock;
- (iii) Disease and pest attack;
- (iv) Microbial attack; and
- (v) Physio-biochemical reasons.

### **3.12.2 Losses at different stages:**

Harvesting, grading, packaging, transportation, assembling, loading/unloading, storage, and ripening are main stages where the losses occur.

#### **3.16.2.1 Losses during harvesting:**

Main causes of losses during harvesting are physical damage, falling of fruits, improper plucking, insect infestation, etc. Reasons for losses during harvesting are summarised as under.

- i) Harvesting of fruits at improper maturity.
- ii) Harvesting not done properly.
- iii) Harvesting equipments are not clean.
- iv) Harvesting during warmest part of the day.
- v) Exposures to unnecessary high temperature.

The nature, causes and per centage of losses during harvesting are given at table No.15



**Table No.15****Nature, causes and per centage of losses during harvesting**

| Sl. No. | State          | Losses during harvesting  |  |             |
|---------|----------------|---|--|-------------|
|         |                | Nature/ Type  | Causes   | Per centage |
| 1       | 2              | 3   | 4  | 5           |
| 1       | Andhra Pradesh | Cuts, Bruises, Skin rashes, Broken, Bird eaten, Over ripened  | Due to free fall, careless handling and natural calamity                     | 1 - 2       |
| 2       | Gujarat        | Bruises, Skin damage, Broken  | Mishandling, Fall from the tree, Weather                                     | 0.25        |
| 3       | Jharkhand      | Bruises, cuts and damage  | Falling from the tree, Mishandling   | 3-5         |
| 4       | Karnataka      | Breakage, Over matured, Pests and diseases spots, Wind, rain or hailstorm, Physical injury, Scratches | Default harvesting, Delay in harvesting, Insect infestation, Natural factors | 5-15        |
| 5       | Kerla          | Skin injuries   | Improper method of harvesting  | 3-15        |
| 6       | Maharashtra    | Bruises , Cuts, Broken, Scratches   | Rains and winds, Hailstroms, Birds, Improper handling                        | 10          |
| 7       | Orissa         | Mechanical injuries, Cuts   | Improper handling, Falling of fruits   | 10          |
| 8       | Uttar Pradesh  | Skin damage, Bruises, broken  | Improper harvesting, Falling from tree, Birds                                | 5-10        |
| 9       | Uttranchal     |   |  |             |
| 10      | Tamil Nadu     | Physical damage, Immature, Shriveled  | Improper harvesting, Falling from tree, Birds                                | 1-5         |

**Source: DMI Survey**

### **3.12.3 Losses during grading:**

Market functionaries do grading of Mangoes at different level. But, during the survey, it was observed that no scientific grading of Mangoes was

done by any of the functionaries. At the most, Mangoes are cleaned and then sorted out according to size, shape and colour.

Some losses in process of grading takes place due to improper handling of the fruits or due to over ripened fruits. Some times, fruits also get infected due to injuries and resulting in huge losses during grading. State-wise losses of Mangoes during grading are given in table No 16.

**Table No. 16**

**Percentage of losses during grading at different levels**

| Sl. No. | State          | Losses during grading   |                  |
|---------|----------------|---|------------------|
|         |                | Losses at different levels  | Total percentage |
| 1       | 2              | 3   | 4                |
| 1       | Andhra Pradesh | Wholesaler (5%), Processor (5%),  | 10               |
| 2       | Gujarat        | Preharvest contractor (0.05%), Processor (0.20%)  | 0.25             |
| 3       | Jharkhand      | Preharvest contractor (2-3%), Wholesaler (1-2%), Commission agent (1-2%), Retailers (1-2%)                              | 5-9              |
| 4       | Karnataka      | Producers (1-2%), Preharvest contractors (1-2%), Wholesalers (2-5%), Processor (1%)                                     | 5-10             |
| 5       | Kerala         | Producers (2-3%), Preharvest contractors (2-3%), Wholesalers (4-5%), Processor (1%)                                     | 8-11             |
| 6       | Maharashtra    | Producers (2-5%), Preharvest contractors (2-5%), Wholesalers (2-5%), Processor (2%), Exporters (0.5%)                   | 8-15             |
| 7       | Orissa         | Pre-harvest contractors (5-10%)   | 5-10             |
| 8       | Uttar Pradesh  | Producers (2-3%), Preharvest contractors (2-3%), Wholesalers (2-5%), Processor (2%)                                     | 8-11             |
| 9       | Tamil Nadu     | Producers (1%), Preharvest contractors (1%), Commission agents, (Wholesaler (0.5%), Processor (0.5%), Retailers (1-2%)) | 3-5              |

**Source: DMI Survey**

### 3.12.4 Losses during packaging:

Main causes of losses during packaging are improper handling, overloading and falling of fruits during packaging. Losses and their causes during the packaging are given in table No. 17.

**Table No. 17**

#### Percentage of losses during Packaging at different stages

| Sl. No. | State          | Losses during packaging   |                  |
|---------|----------------|---|------------------|
|         |                | Losses at different stages  | Total percentage |
| 1       | 2              | 3   | 2                |
| 1       | Andhra Pradesh | Producers (1-2%), Preharvet contractor (1-2%), Wholesalers (4-5%), Processor (1-2%), Exporters (1-2%), Retailers (1-2%) | 9 to 15          |
| 2       | Gujarat        | Preharvet contractors (2%)  | 2                |
| 3       | Jharkhand      | Producers (1-2%), Preharvet contractor (1-2%), Wholesalers (1-5%), Commission agents (1-2%), Retailers (2-3%)           | 6-14             |
| 4       | Karnataka      | No losses at any level  | Nil              |
| 5       | Kerla          | Producers (1-5%), Preharvet contractor (1-7%), Wholesalers (2-3%), Commission agents (2-3%), Exporters (0.5-1%)         | 6-18             |
| 6       | Maharashtra    | Producers (2-4%), Processor (1-3%), Exporters (10-2%), Retailers (5-10%)  | 9-19             |
| 7       | Uttar Pradesh  | Producers (1-2%), Preharvet contractor (1-2%), Wholesalers (3-5%), Processor (1-2%), Exporters (1-2%), Retailers (3-5%) | 10-19            |
| 8       | Uttranchal     |   |                  |
| 9       | Tamil Nadu     | No losses at any level  | Nil              |

**Source: DMI Survey**

### 3.12.5 Losses during transportation:

Main cause of losses during transportation is when transportation is not well planned or managed. This damage can lead to non-acceptability of the produce by the consumers, resulting in overall economic losses.

Other cause of losses during transportation is the road condition, which is generally bouncy and uneven. Due to these unfriendly roads, stacks are considerably compressed and affect other packages. Therefore, to overcome this problem, interspace of the packages should be kept minimum by designing the suitable size of the containers to utilize space of vehicle properly.

Losses in transporting of Mangoes from field to assembling markets and assembling markets to consuming markets/terminal markets are given in table No 18.

**Table No. 18**

#### Causes and percentage of losses during transportation at different stages

| Sl. No | State          | Losses during transportation    |                      |   |                      | Total losses |
|--------|----------------|---------------------------------|----------------------|---|----------------------|--------------|
|        |                | Field to assembling market      |                      | Assembling market to consumer/terminal market   |                      |              |
|        |                | Causes of losses                | Percentage of losses | Causes of losses                                | Percentage of losses |              |
| 1      | 2              | 3                               | 4                    | 5   | 6                    | 7            |
| 1      | Andhra Pradesh | Carelessness handling, Overload | 2-5                  | Carelessness handling, Overburden               | 5-10                 | 7-10         |
| 2      | Gujarat        | Weight loss                     | 2                    | Weight loss                                     | 2                    | 4            |
| 3      | Jharkhand      | Physical injuries               | 1                    | Carelessness handling                           | 2-5                  | 2-6          |
| 4      | Karnataka      | Carelessness, Injuries          | 1                    | Physical injuries during loading and unloading  | 2-5                  | 3-5          |
| 5      | Kerala         | Injuries, Heat, Rain            | 10                   | Heat, Fungal infection                          | 10                   | 20           |
| 6      | Maharashtra    | Injuries, Handling              | 2                    | Overloading, Overheat                           | 10                   | 12           |
| 7      | Orissa         | Carelessness, Injuries          | 10                   | Injuries during loading and unloading, Overheat | 2                    | 12           |

|   |               |   |     |   |      |      |
|---|---------------|---|-----|---|------|------|
| 8 | Uttar Pradesh | Mishandling, Weight losses, Physical injuries | 3-5 | Mishandling, Weight losses, Physical injuries | 3-5  | 6-10 |
| 9 | Tamil Nadu    | Injuries during handling                      | 1   | Rottening                                     | 3-10 | 4-10 |

**Source: DMI Survey**

### 3.12.6 Losses during storage:

Rough handling of produce, improper and too high stacking, high temperature and inadequate ventilation are major factors for the losses during storage.

Losses during storage of mangoes are given in table No. 19.

**Table No. 19**

### Losses of Mangoes during Storage

| Sl. No. | State          | Losses during storage   |
|---------|----------------|---|
|         |                | Losses at different levels  |
| 1       | 2              | 3   |
| 1       | Andhra Pradesh | Producers' level (1%), Wholesaler level/C.A. level (4%), Retailer level (5%), Processor (1%-2%), Cold storage (1%)  |
| 2       | Gujarat        | Wholesaler level/C.A. level (0.05%)   |
| 3       | Jharkhand      | Producers' level (1%), Wholesaler level/C.A. level (1-2%), Retailer level (2-3%)                                    |
| 4       | Karnataka      | Producers' level (1-2%), Wholesaler level/C.A. level (1-2%), Retailer level (3-5%), Cold storage (1%)               |
| 5       | Kerala         | Wholesaler level/C.A. level (0.5-1%), Retailer level (0.5-1%)   |
| 6       | Maharashtra    | Producers' level (10%), Wholesaler level/C.A. level (5-10%), Retailer level (5%)                                    |
| 7       | Orissa         | Producers' level (1-2%), Wholesaler level/C.A. level (0.5-1%), Retailer level (3-5%)                                |
| 8       | Uttar Pradesh  | Producers' level (1-2%), Wholesaler level/C.A. level (6%), Retailer level (7%), Processor (1-2%), Cold storage (1%) |
| 9       | Tamil Nadu     | Retailers (20%), Processor (1-2%)   |

**Source: DMI Survey**

### 3.12.7 Losses during preparation of market:

During survey, it was observed that producers generally do not undertake any type of special treatment. They simply wash and cool fruits before bringing them to market. Therefore, losses at this stage are found negligible, in case of producers. Most of the losses during preparation of markets are found at wholesaler and commission agent levels. Improper handling, over ripening, falling of the fruits, rotting and shrinkage of the fruits are the main reasons for losses in preparation of the market.

Losses during preparation of market are given in table No. 20.

**Table No. 20**

#### Nature, causes and percentage of losses during preparation for the market

| Sl. No | State          | Losses during preparation for the market                                      |   |  |
|--------|----------------|---|---|--|
|        |                | Nature/ Type  | Causes of losses  | Losses at different stages   |
| 1      | 2              | 3   | 4   | 5  |
| 1      | Andhra Pradesh | Over ripening, immature, fungus, crushed, damaged, diseased, Over/under sized | Bad harvesting, careless handling, poor storage                                     | Producers (1%), Preharvest contractor (1%), Wholesalers/C.A. (1%-2%), Processor (1%-2%), Exporters (1%-2%), Retailers (5%) |
| 2      | Gujarat        | Crushed, Immature, Over mature, Diseased                                      | Carelessness, Improper storage  | Producers (1-2%), Preharvest contractor (2%), Wholesalers/C.A. (2%-3.5%)   |
| 3      | Jharkhand      | Fruit damage  | Over ripened fruits, Sun scratch, Acidic fruits.                                    | Producers (1%), Wholesalers (2-5%), Retailers (5-10%)  |
| 4      | Karnataka      | Injuries, Falling of fruits   | Overripened   | Producers (1%), Wholesalers/C.A. (2-5%), Retailers (5-10%)   |
| 5      | Kerla          | Fruit damage  | Improper handling and Movements   | Producers (1%), Preharvest contractor (1%), Wholesalers/C.A. (0.5-1%)  |
| 6      | Maharasgtra    | Skin disorder. Surface burn, Spoilage, Blemishes, reptures                    | Sap exude from stemend, Contact from soil, Unhygienic conditions, Mechanical damage | Producers (1%), Wholesalers/C.A. (1-2%),Preharvest contractor (1%)   |
| 7      | Orissa         | Damage of fruits,   | Unhygenic   | Producers (1%),  |

|    |               |   |   |  |
|----|---------------|---|---|--|
|    |               | Diseases                                  | storage,<br>Improper<br>handling              | Wholesalers/C.A. (2%-3%),<br>Retailers (3-5%)  |
| 8  | Uttar Pradesh | Spoilage, Broken of skin, Diseased fruits | Fruit sap, Overripened, Lalling on the ground | Producers (1%), Wholesalers/C.A. (1-3%), Retailers (5-7%)  |
| 9  | Uttranchal    |   |   | Producers (1%), Preharvest contractor (1%), Wholesalers/C.A. (1%-2%), Processor (1%-2%), Exporters (1%-2%), Retailers (5%) |
| 10 | Tamil Nadu    | Rotten                                    | Overripened, Falling of fruits                | Wholesalers/C.A. (2.-5%), Retailers (Upto 20%)   |

Source: DMI Survey

### 3.12.7 Main Causes of Post Harvest Losses:

Following are the main causes of post harvest losses.

#### A) During Harvesting:

- i) Harvesting of fruits at improper maturity.
- ii) Harvesting not done properly
- iii) Harvesting equipments are not clean
- iv) Harvesting during warmest part of the day
- v) Exposures to unnecessary high temperature

#### B) Transportation:

- i) Careless Driving.
- ii) Too high loading/stacking.
- iii) Poor roads.
- iv) Unsuitable transport containers.
- v) Overloading with other fruits and vegetables (in some cases people even sit on top of the load)
- vi) Lack of link roads, leading to highways or collection centers.
- Viii) Heat accumulation or very poor ventilation within the transport vehicles.
- ix) Virtual absence of refrigerated and insulated trucks.

**C) Grading / Packing:**

- i) Lack of quality standards or minimum requirement.
- ii) Rough handling.
- iii) Unsuitable packaging material.
- iv) Overfilling of containers.

**D) Assembling:**

Assembly points are not properly/ adequately prepared.

**E) Loading / Unloading:**

- i) Rough handling.
- ii) Loading too high.
- iii) Bad stacking.
- iv) Improper cushioning of carrier.

**F) Storage:**

- i) Inadequate ventilation in packages and carrier used.
- ii) Storage temperature is too high.
- iii) Rough handling.
- iv) Too high heaps or stacks.

**G) Ripening:**

- i) Lack of uniformity and homogeneity of the produce.
- ii) Inadequate equipment and ripening method.
- iii) Rough handling.

**3.13 Post-harvest treatment:**

Post-harvest losses can be minimized by adopting certain pre-harvest strategy and post-harvest management/technology. Principal pre-harvest strategy and post-harvest technology for reducing post-harvest losses are as under.

- (i) Pre-harvest treatment;
- (ii) Proper curing
- (iii) Washing, cleaning and grading;
- (iv) Scientific packing
- (v) Pre-cooling



- (vi) Use of cold storage
- (vii) Suitable use of transport and
- (viii) Efficient marketing.

Brief description of the principles and methodologies of pre-harvest strategy and post-harvest management of horticultural produce are as follows.

### **3.13.1 Pre-Harvest Treatment:**

Mango fruit fly is a major pest of mango but can be well managed by a combination of pre harvest and post harvest treatments. Pre-harvest treatments alone ensure 100% control and it can be further subjected to post harvest treatments to satisfy international disinfestations requirement. These strategies are environment friendly and residue-free.

The Use of fertilizers, pest control, growth regulators, climatic conditions like wet and windy weather and tree conditions influence the shelf life of Mangoes by regulating physiology and chemical composition of fruits.

### **3.13.2 Post-harvest Treatment:**

#### **3.13.3 Personal Hygiene:**

All persons engaged in packaging should maintain hygienic conditions by

- Entering packhouse after taking wash
- Wearing disposable gowns, caps & hand gloves
- Not using perfumes, dangling jewellery or glass \ items
- Not eating, drink & smokey in the packaging area

#### **3.13.4 Washing and cleaning:**

Washing and air-drying improve appearance of fruits and avoid wilting. During washing, rotten, diseased, insect damaged, discoloured and deformed fruits should be sorted out. Washing should be done with a very mild detergent and using a soft cloth to remove any dirt or latex. Water used for cleaning should be sanitized with 150-ppm free chlorine and maintained at a pH of 6.5.

### 3.13.5 Gentle handling

In order to reduce the post harvest losses, fruits should be handled gently to minimize bruising and breaking of skin. Breaking of the skin stimulates dehydration of the fruits and make the site open for microbial attack. By reduction of number of handling of commodity, mechanical damage can be significantly reduced.

### 3.13.6 Temperature control:

Temperature control (Pre-cooling) is very much necessary to remove field heat and to retard the ripening of fruit after harvesting, particularly when harvesting is undertaken in hot weather. It considerably reduces storage losses considerably. Low-pressure vacuum cooling technique is another option for temperature control. Cooling of fruit, not only extends storage life by reducing the rate of physiological change, but also retards microbial growth. Even low-cost cooling or refreshing the produce is better than no cooling at all. If temperature between 2°C to 3°C (36°F to 38°F) is maintained, the market period can be extended up to 4 months, if harvesting is carried out at right maturity. For short-term storage and during transit period, 10°C (50°F) is adequate to minimize decay of fruits.

Storing at high temperature causes rapid moisture loss, flavour deterioration, resulting in decay of fruits. It is preferable to store fruits at their optimum relative humidity (RH) of 90% to 95%. At a low RH, peel becomes thin, dry, and shriveled.

There are several ways of reducing storage temperature of fruits.

- a) Protect the fruits from direct sunrays.
- b) Cool promptly after harvest.
- c) Use of natural cooling, e.g., harvesting during cool early morning hours, open stores for ventilation during the night,
- d) Evaporative cooling, obtained by drawing dry air over a moist surface.
- e) Mechanical refrigeration

### 3.13.7 Precaution during storing in cold storage:

There are four basic principles that must be correctly applied for successful refrigeration of perishable crops like Mangoes:

- i. **Select only healthy Mangoes:** Refrigeration does not destroy pathogens responsible for deterioration, but only slows down their activity. It also does not improve produce quality, only maintains it. A damaged fruit will deteriorate more quickly than a healthy one even in refrigerated storage. Hence, store only sound produce in refrigeration.
- ii. **Timely cooling:** Since, refrigeration slows the development of microorganisms and physiological changes, responsible for deterioration of fruits. Allow the produce to cool, soon after harvesting.
- iii. **Optimum temperature:** Adhere closely to optimal conditions for temperature and relative humidity
- iv. **Uninterrupted cooling:** Refrigeration should be applied from the point of harvest to point of consumption.

### 3.13.8 High humidity

High humidity retards wilting and maintains the crop in better condition. Horticultural produce can be stored best in an atmosphere that has a relative humidity of 90 per cent.

### 3.13.9 Waxing of the surface

Waxing is one such technology suitable for preservation of fruits. By this method, shelf life of fruit can be enhanced by more than two weeks. This gives breathing time for marketing.

Shine on the outer surface of fruit is due to natural wax. Most of the natural wax on peel surface is removed during washing. When this wax is removed, the fruit becomes dry. Wax prevents evaporation of water from produce and adds shine to the surface. Food grade wax can be applied manually by rubbing it onto the fruit surface or by spraying/dripping it on a bed of slowly rotating horsehair-grade brushes.

### 3.13.10 Controlled atmosphere storage

In Controlled atmosphere storage, fruit is placed in the gas-tight refrigerated chamber allowing natural respiration of fruit. This decreases oxygen content and increases percentage of carbon dioxide in chamber. This controlled atmospheric storage extends storage life of fruit.

### 3.13.11 Hypobaric Storage:

Hypobaric is a type of 'Controlled Atmospheric' storage with emphasis on reducing pressure exerted on storage material. This not only reduces O<sub>2</sub> concentration, but also increased diffusion of ethylene by evacuating it from tissues of fruit, consequently extending storage life.

It is found that fruits stored at 100 and 75 mm mercury (Hg) started to ripen after 25-35 days as against control after 16 days.

### **3.13.12 Shorten the time between harvest and consumption**

Losses of fruits can also be reduced to a large extent by reducing marketing channel. Shorter is marketing channel, lesser will be losses during the process of marketing.

### **3.13.13 Sanitation and Quarantine:**

#### **1 Sanitation of packing equipment:**

Proper sanitary conditions must be maintained during operation like handling, storage, cleaning and washing equipment, used for the fruits to minimize risk of spreading microbial growth. Diseased or damaged fruits should be sorted out and properly disposed off to prevent likely growth of fungi and bacteria on sound fruits. Insects infesting culled fruits may fly to good fruits, introduce pathogenic organisms, and increase losses.

Sanitisers should be used after equipments have been cleaned. Steam cleaners or high-pressure hot water applicators are very effective. Otherwise, household detergent can also be used. It would be better, if chlorinated water is used for the purpose.

Sanitation of equipments can be done by spraying a sanitising agent such Sodium hypochlorite (liquid), containing 5% to 12.5% available chlorine, Calcium hypochlorite (powder), containing approximately 30% active chlorine and Use 20 to 50 ml of formalin/L water. Chlorine may corrode steel and some rubber compounds, if used continuously, but 2 or 3 sprays a week does not cause problems.

#### **2 Quarternary ammonium compounds**

*Quarantine of equipment can be done by use of ammonium compounds and formalin.*

Water used for sanitation and quarantine purpose should also be changed at regular intervals before it becomes heavily contaminated with fungi and bacteria, which spreads infection. Chlorinated water or water with

some other chemical reduces the count of viable organisms. Precautions should be taken to avoid inhalation of gases.

### **3 Peel De-Greening:**

De-greening is the process where the green chlorophyll in the peel of the fruit is broken down and yellow/orange xanthophyll and carotenoid pigments are formed. De-greening is generally considered uneconomic unless large quantities of fruit are treated at one time.

Ethylene, which is a naturally produced plant growth hormone, is also effective as a de-greening agent. It breaks down green chlorophyll pigment. This treatment also improves external skin color and export market acceptance. This treatment is solely cosmetic in effect and does not alter the flavor of the fruit.

The de-greening process involves exposing green-skinned Mango fruits of uniform grade to low levels of ethylene (usually between 1 p.p.m to 10 p.p.m) at 20°C to 25°C (68°F to 78°F) and 90% Relative Humidity. Good internal air movement is needed, so that, the air circulates every 2 to 3 minutes. Precautions should be taken that the carbon dioxide level inside the treatment chamber should not rise above 2000 p.p.m. Care should be taken that the fruits are not be washed before de-greening. Ethephon (500 ppm for 1 minutes), ethylene-releasing liquid compound, can also be applied by dipping the fruit in a tank of sanitized water at room temperature. Since, higher concentration of ethylene is injurious to fruits, therefore its concentration should be maintained within the limit

It is always better, if ethylene treatment is given immediately after harvest and prior to waxing. Care should also be taken that the fruits do not dry before treatment.

### **4 Gentle handling**

Skin of fruit is an effective barrier to most of opportunistic bacteria and fungi that cause rotting of tissues. Therefore, fruits should be handled gently to minimize bruising and breaking of the skin and reducing post-harvest losses. Breaking of skin stimulates physiological deterioration and dehydration.

Similarly, reducing the number of handling of commodity, mechanical damage can be reduced significantly.

## **5 Vapour heat treatment:**

Vapor-heat treatment (VHT) is accepted quarantine treatment for export of Mangoes. VHT enhanced ripening of fruits during storage, resulting in better marketability of fruits due to uniform peel colour development.

Vapor-heat treatment also reduced rate of fruit softening and mesocarp color development. Mango fruit apparently have capacity to recover from vapor-heat quarantine treatments.

In Vapor-heat treatment, heated air, saturated with water vapor is used to raise temperature of commodity to a required point and holds temperature for a specified period. Latent heat released by condensation of vapor on commodity raises pulp temperature quickly and evenly and thus prevents damage.

Temperature-time relationship varies with the commodity and the pest involved. In case of treatment against fruit flies, pulp temperature of the commodity is raised by the saturated water vapor to 46-48° C for 4 hours and then the fruits are held at required temperature for a period of 30 min. Exposure periods and treatment temperatures also vary with kind of fruit fly species and commodity involved.

Fruits before subjecting to VHT should be conditioned, usually at a relative humidity less than 100 per cent.

Fruits should be cooled immediately after VHT treatment by allowing the fruits to simply stand for at least 30 minutes after removal from the VHT chamber in an insect proofed and well-ventilated chambers. After cooling, Mangoes is stored at 55 °F to 57 °F (12.8°C) at 85 to 90% relative humidity.

Adequate safeguards must be maintained to prevent re- infestation or contamination of treated commodities or their containers. Packing rooms must be fly-proof and only treated host material permitted therein.

## **5 Hypoboric Storage:**

Hypoboric is a type of 'Controlled Atmospheric' storage with emphasis on reducing the pressure exerted on storage material. This not only reduces O<sub>2</sub> concentration but also increased the diffusion of ethylene by evacuating it from tissues of the fruit, consequently extending the storage life.

It is found that fruits stored at 100 and 75 mm mercury (Hg) started to ripen after 25-35 days as against control after 16 days.

## **6 Irradiation:**

Irradiation involves exposing food to ionizing energy for a specific length of time in order to destroy or sterilize bacteria, microorganisms, or other pests of concern. Energy waves produced during the irradiation process physically breaks molecular structure of pests' DNA, killing or sterilizing them. However, at specified doses, structure of atom is not affected. Fruit is irradiated in a special processing facility and never comes in direct contact with energy source. Irradiation sometimes does not necessarily kill the pest but sterilize it, rendering it incapable of reproducing or emerging from a host to an adult. Irradiation controls fruit flies, kills the bacteria and increase shelf life. It also controls Mango Seed weevil. For irradiation, Cobalt-60 and kGy are generally used. Irradiation followed immediately by hot water treatment controlled anthracnose and stem-end rot during storage at 20<sup>0</sup> C.

### **3.14. Post-harvest Diseases:**

Post-harvest diseases that cause spoilage are widespread. Some of the post-harvest diseases and disorders occur due to infestations before harvest and the affected fruits can be culled during grading and packing, while others diseases shows symptoms when fruits are ripening and ready for display before buyers.

Post-harvest diseases in fresh fruits can be both quantitative and qualitative. These diseases are mainly caused by fungi and bacteria. Initially, only a few pathogens may invade and break down tissue systems, followed by subsequent attack of weak pathogens. High temperature and humidity accelerate process of post harvest decaying by microorganisms.

Severity of infection and degree of damage, however differ, depending upon the region of cultivation, season and even the root-stock used for grafting. The fruits dropping on the ground due to physiological disorders are also infected by pathogenic organisms and have poor storability.

Harvest injury, defective handling, inappropriate temperature and humidity affect the storage life of the fruits. Presence of blemished fruits with sound ones also contributes to decay and damage. If there is a surface bruise or injury to the fruit, microorganisms such as yeast, bacteria, and molds invade through this and cause internal decay. Insect damage is caused by insect holes through Fruit fly.

Control of post-harvest diseases in Mango can be achieved by a combination of pre-harvest and post-harvest pesticide application, orchard hygiene and post-harvest temperature management. Control of diseases occurring on leaves, stems and flowers (pre-harvest) are important in reducing

post-harvest losses. Similarly, post-harvest temperature management and proper handling during storage and transportation are equally important, since high temperature and injuries or wounds would lead to post-harvest diseases.

Under conditions favoring pathogens, loss caused by post-harvest diseases may be greater than the economic gains achieved by improvements in primary production.

#### **3.14.1 Pre-harvest control:**

Postharvest treatments do not provide complete disease control, until proper measures to control pre-harvest diseases are not taken. Some of measures are as under.

- i) During flowering stage, weekly spray with mancozeb (800 g/kg at 2 g/L) and then monthly until harvest can control the fungal diseases. Spray of mancozeb should be stopped before 14 days of harvest. During dry weather, flower sprays may be reduced to fortnightly intervals.
- ii) At the flowering stage, if there is rain, it would be better to apply prochloraz (462 g/kg) (Octave, registered trade mark), using 1 g product/L in a tank mix with mancozeb, every 3-4 weeks.

#### **3.14.2 Post-harvest diseases and control:**

Mango fruits are susceptible to many postharvest diseases such as, anthracnose (*C. gloeosporioides*) and stem end rot (*L. theobromae*) during storage under ambient conditions or even at low temperature. Aspergillus rot is another postharvest disease of Mangoes.

#### **3.14.3 Control:**

Postharvest dip treatment of fruits with fungicides can control the diseases during storage with the help of the following treatments.

- (i) Three sprays of carbendazim (0.1%), orthiophante-methyl (0.1%) at 15 days interval should be done in such a way that the last spray falls 15 days prior to harvest.
- (ii) Postharvest dip treatment of fruits in carbendazim (0.1%) in hot water at  $52 \pm 1^{\circ}\text{C}$  for 15 minutes.

Some of the important diseases are given in table No. 21



**Table No. 21****Miscellaneous diseases**

| <b>Sl. No</b> | <b>Casual organism / Source</b>    | <b>Disease / Disorder</b> | <b>Symptoms</b>   | <b>Control / Treatment</b>   |
|---------------|------------------------------------|---------------------------|---|--|
| 1             | Colletotrichum gloesporioides      | Anthracnose               | Latent infection before harvest, black spot on skin, become sunken and coalesces  | Hot water treatment (50 to 55 ° C) and dipping fruit in Benomyl (500 ppm) and thiobendazole (900 ppm) solution   |
| 2             | Diplodia natalensis                | Stem and rot              | In ripe mango, below the stalk skin is black circular patch and then complete black in 2-3 days, pulp is brown and turns into soft rot. | Dip fruits in 6 % Borax soln. at 43 ° C for three minutes. Harvest the fruit on clear dry day and shift the fruit in covered chamber. Prevent snapping of pedicle. Coat the exposed surface with chambattia paint. |
| 3             | Rizopus arrhizus                   | Soft rot                  | Dark brown to blackish spots under lying tissues. Soft and juicy.   | Dip the fruit in Benomyl 0.5-1.0 grms per litre solution.  |
| 4             | Boron deficiency and secondary rot | Black tip                 | Tip side of the fruit develops black sunken spot and later becomes soft pulpy.  | Smoke from brick kilns is to be prevented and soil treatment to correct the Boron level of soil.   |

## **4.0 MARKETING PRACTICES AND CONSTRAINTS:**

Marketing is a key to horticultural development of the region. The absence of a proper marketing plan and organisational arrangements, agro processing facilities, which otherwise have high potential for indigenous production to the extent of self-sustainability, causing great concern and is a disincentive to the local growers.

### **4.1 Assembling:**

Assembling is an important phase in the marketing of Mangoes. Fruits after harvesting have to be passed through several agencies before reaching to markets and then finally to the consumers.

Generally, producers do not take part in assembling activity of the produce. Producers prefer to lease out the orchards to the pre-harvest contractors, who take care of watch and ward of crop until the maturity, and then disposed of the produce themselves. Producers lease out these orchards to pre-harvest contractors at “Flowering to maturity stage or after maturity”, while only a little number of producers directly takes part in assembling of Mangoes.

Main reasons for sale of produce to pre-harvest contractor are as under.

- a) High risk of spoilage of fruits from natural calamity.
- b) No assurance of higher prices in markets.
- c) Delay in getting payment of produce.
- d) Pressing need of money for immediate payments.
- e) Higher transportation cost.
- f) Lack of market information.

Pre-harvest contractors sell produce to commission agents who take care of proper storage, packaging and transport. These commission agents are an important link in marketing chain and controls nearly 60 to 80 per cent of produce in assembling of fruits. Sometimes, these commission agents also act as a wholesaler. These commission agents supply most of the fruit for processing industries.

#### **4.1.1 Major assembling markets:**

The state-wise major assembling markets are given in table No. 22

**Table No. 22**  
**State-wise major assembling markets.**

| Sl. No | State          | Important markets   |
|--------|----------------|---|
| 1      | 2              | 3   |
| 1      | Andhra Pradesh | Vijayawada, Nuziveedu, Chittoor, Pakala, Tirupat Banarupalem, Palamaneru, Pottur and Koduru   |
| 2      | Gujarat        | Ahmedabad, Surat, Baroda and Talala   |
| 3      | Jharkhand      | Ranchi, Gumla, Lohardga, Dumka, Deogarh, Godda  |
| 4      | Karnataka      | Bangalore, Srinivasapur, Kankapura, Chinthamani, Madhugiri, Malur, Arsikere, Athani, Karawar, Hubli   |
| 5      | Kerala         | Thiruvananthapuram, Kollam, Pathnamthitta, Kottayam, Alappuzha, Ernakulam, Idukki, Thrissur, Palakkad, Malappuram, Wayanad, Kozhikkode, Kannur, Kassargod,  |
| 6      | Maharashtra    | Ratnagiri, Kalyan, Nasik, Kolhapur, Pune, Sangli, Solapur, Aurangabad, Gondia, Nagpur   |
| 7      | Orissa         | Bhubaneshwar, Dhenkanal, Angul, Ganjam, Keonjhar, Kalahandi, Koraput, Rayagada, Mayurbhanj, Sundergarh  |
| 8      | Uttar Pradesh  | Lucknow, Saharanpur, Unnao, Sitapur, Sultanpur, Jyoti-ba-phule Nagar, Bulandshehar, Lakhimpur Kheri, Barabanki, Hardoi  |
| 9      | Tamil Nadu     | Ciombatore, Pollachi, Udumalpet, Dharampuri, Palacode, Gopalpatti, Natham, Odanchatram, Old Ayakudi, Krishnagiri, Kaveripattinam, Madurri, Salem, Bodinayaknur, Periyakulam, Tiruchirapalli, Tiruneveli, Praoor, Tirupattur, Rajapalayam, |

**Source: DMI Survey**

#### **4.2 Arrivals:**

Due to high degree of perishability and thereby economic losses caused to growers, marketable surplus of produce should be rushed to immediate nearby market avenues. Markets, where fruits are to be disposed off should have a better market accessibility, supported by efficient transport and communication facilities.

Arrival of Mangoes, in markets, commence generally from April/May and last till August. Maximum arrival of fruit is seen during months May, June and July. Firstly, Baganphally Mangoes from Andhra Pradesh starts reaching in the markets, followed by other varieties like Alphanso, Dussehry, Langra, Totaphally etc.

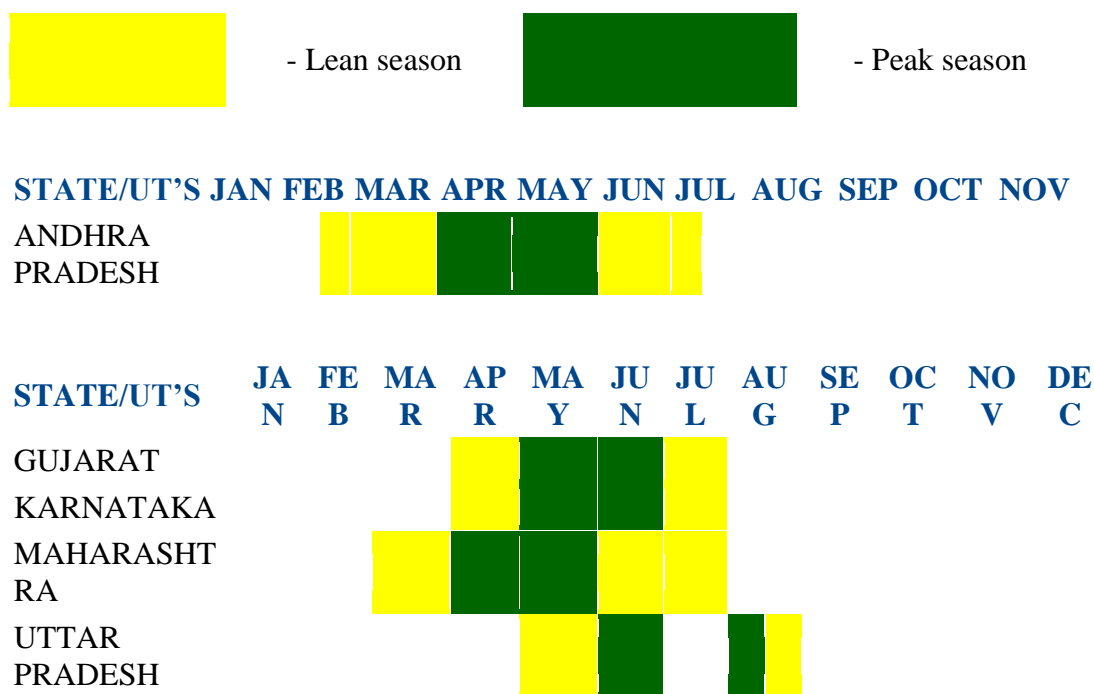
The quality criteria of Mangoes, arriving in markets should be:

- Physiologically mature;
- Commencing ripening with 30 to 50% coloration;
- Significant area of red colour on the fruit shoulders;
- Relatively firm;
- Minimum sugar content of 10%;
- Uniform shape;
- Free from disease, decay, sunscald, cracks, bruises, latex stains, insect and mechanical damage;

State-wise arrivals of Mangoes, in important markets are given in table No 23.

**Table No. 23**

**Arrivals of Mangoes in important markets of major producing states**



**\*The above graph shows harvest pattern in leading mango growing states**

Source: Source: DMI Survey

### 4.3 Dispatches:

After meeting the local requirements, Mangoes are dispatched to various markets of the different states. From Andhra Pradesh, the main producing state of the Mangoes, the fruits are dispatched nearly to all over India. While from Gujarat, the Mangoes are dispatched mainly to Andhra Pradesh, Kerala, Uttar Pradesh and Bihar. Similarly, from Karnataka, the fruits are dispatched to Tamil Nadu, Andhra Pradesh, Kerala and North Indian states.

The states to which the mangoes are dispatched from the producing centers are given at table No. 24

**Table No. 24**  
**States-wise dispatches of mangoes**

| Sl. No. | States         | States to which dispatches   |
|---------|----------------|--|
| 1       | 2              | 3  |
| 1       | Andhra Pradesh | All over India   |
| 2       | Gujarat        | Andhra Pradesh, Kerala, Uttar Pradesh, Bihar, Maharashtra  |
| 3       | Jharkhand      | Nearby districts   |
| 4       | Karnataka      | Tamil Nadu, Andhra Pradesh, Kerala, North Indian states  |
| 5       | Kerala         | Andhra Pradesh, Karnataka, Tamil Nadu  |
| 6       | Maharashtra    | Nearby districts, Alphanso is distpached all over the India  |
| 7       | Orissa         | Nearby districts   |
| 8       | Uttar Pradesh  | Bihar, West Bengal, Haryana, Delhi, Maharashtra, Rajasthan, Madhya Pradesh, Uttranchal, Jharkhand, Jammu & Kashmir |
| 9       | Uttranchal     |  |
| 10      | Tamil Nadu     |  |

**Source: DMI Survey**

#### 4.3.1 Dispatches from farm to markets:

The fruit, after harvesting/plucking, are sent to either to nearby assembly market, consuming markets/ terminal markets or to air port/ sea port for export. The percentage-wise share to the total production of the produce, sent to these markets are given at table No. 25

**Table No. 25**  
**Percentage-wise share of Mangoes sent to assembling markets,  
 consuming/ terminal markets and air port/sea port**

| Sl. No. | State          | Percentage share to total production |                                   |                            |
|---------|----------------|--------------------------------------|-----------------------------------|----------------------------|
|         |                | Farm to assembly market              | Farm to consuming/terminal market | Farm to air port/ sea port |
| 1       | Andhra Pradesh | 90                                   | Negligible                        | Negligible                 |
| 2       | Gujarat        | 33                                   | 67                                | Nil                        |
| 3       | Karnataka      | 95                                   | 5                                 | Nil                        |
| 4       | Kerala         | 40-75                                | 20-58                             | 2-5                        |
| 5       | Maharashtra    | 35-40                                | 40-45                             | 20-25                      |
| 6       | Orissa         | 55-75                                | 25-45                             | Nil                        |

**Source: DMI Survey**

#### **4.4 Constraints and problems in marketing of Mangoes:**

In marketing of Mangoes, not only the producers face the problems, the pre-harvest contractors, wholesalers, pack house owners and retailers also face the problems , as under

##### **4.4.1 By producers:**

##### **1 Sale to pre-harvest contractors:**

The inconveniences faced by producers in selling the fruits to pre-harvest contractors are as under.

- i) Delayed harvesting of fruits.
- ii) Delayed payment to the producers by the pre-harvest contractors.
- iii) No guarantee of sticking to the contract by the pre-harvest contractors.
- iv) Deduction in payment by the pre-harvest contractors, in the event of loss of fruits, due to dropping
- v) Financial losses to the producers due to wrong estimates by the pre-harvest contractors.

## **2 Sale in market premises:**

The problems, faced by the producers to sell the fruits in the market premises are as under.

- i) High commission, transportation, loading / unloading and other charges.
- ii) No assurance of remunerative prices.
- iii) Sometimes delayed payment by commission agents.
- iv) Sometimes unauthorised deduction by the commission agents.
- v) Delay in auctioning of produce.

## **3 By pre-harvest contractors:**

- i) Mismanagement of gardens, resulting in deterioration of quality and yield of fruits.
- ii) Risk of losses due to natural calamity like storms, rains, pest, etc.
- iii) Improper storage and transportation, lack of skilled labourer, absence of mechanical grading facilities, etc.

## **4 By wholesalers:**

- i) Costly, improper and inadequate road transportation facilities.
- ii) Labor problems
- iii) Costly packing material
- vi) Lack of infrastructural facilities

## **5 By packing center owners:**

- i) Costly packing materials
- ii) Lack of skilled workers
- iii) Non availability of cold storage

## **6 By retailers:**

- a) Losses due to spoilage of fruits
- b) Costly transportation

c) Lack of proper air cooled shops in the local markets

## 4.5 Marketing Channels:

Mangoes are produced in remote villages while consumed in semi-urban and urban areas in addition to the local area where it is produced. Different agencies and functionaries are engaged between producers and the consumers. Thus, a channel of distribution of a product is the route taken by the ownership of goods as they move from the producer to the consumer or industrial user.

These channels have great influence on marketing costs such as transport, commission charges, etc. and market margins received by the intermediaries such as trader, commission agent, wholesaler and retailer. Finally this decides the price to be paid by the consumer and share of it received by the farmer producer. That channel is considered as good or efficient which makes the produce available to the consumer at the cheapest price and also ensures the highest share to the producer. This is also reflected in low cost of marketing.

### 4.5.1 Factors affecting channels:

There are several channels of distribution depending upon type of produce or commodity. Each commodity group has slightly different channel. The factors are :

1. Perishable nature of produce .e.g. fruits, vegetables, flowers, milk, meat, etc.
2. Bulk and weight—cotton, fodders are bulky but light in weight.
3. Storage facilities.
4. Weak or strong marketing agency.
5. Distance between producer and consumer.
6. Nature of market i.e. local market or distant market

The main channels followed for marketing of Mangoes are as under:

- ★ *Growers – Pre-harvest contractors – Commission Agents – Retailers – Consumers.*
- ★ *Growers – Wholesalers – Commission Agents – Retailers – Consumers.*
- ★ *Growers – Commission Agents— Processing Industries - Retailers – Consumers.*
- ★ *Growers – Retailers – Consumers.*



★ *Growers–Exporters.*

**4.5.2 Criteria for selection of channels:**

1. The channel, which ensures the higher share to producer and also provides cheaper price to consumer, is considered as the most efficient channel.
2. Selection should be for shorter channel, to reduce marketing cost.
3. Avoid the longer channel, having more intermediaries, causing higher marketing cost and reduced producer's share.
4. Select the channel which distributes the produce appropriately at low expense and secure the desired volume of disposal.

**4.6 Efficient marketing:**

Efficient marketing system plays a crucial role in getting the remunerative prices to the producers, provided due attention is paid to it. In present scenario, it is observed that the producers do not pay proper attention for various components of marketing. The producers usually spend whole of the year on production and part with the produce to the pre-harvest contractors, that results in low share in consumer's price.

The strategy for efficient marketing is as under.

- a) Producers organisation and cooperative societies should be formed for marketing of Mangoes fruits.
- b) Fruits should be harvested at the proper maturity only.
- c) Precautions should be taken for avoiding injuries at the time of harvesting and transportation of fruits to the markets.
- d) There is a need to develop alternative marketing channel, involving cooperative societies to help the producers.
- e) Steps should be taken to link production, marketing and processing of Mango to avoid seasonal gluts in the markets.
- f) Considering the fragileness of the fruit, careful harvesting and handling of harvested fruits are of critical importance to maintain their 'Sales appeal' and delicate flavour.
- g) Ways and means should be explored for providing cheap packing material and transport facilities.
- h) Advance marketing credit/loan facilities should be provided by the banks to the Mango producers.
- i) In the absence of organised system of marketing and crop insurance policy, the Mango growers get poor returns. Therefore, the minimum support price of Mango fruits, during the productive years should be declared.
- j) There is need to ensure remunerative price to the Mango producer, reduction in marketing cost and low price to the consumer throughout the year.

## 5 MARKETING COSTS AND MARGINS:

### 5.1 Marketing Costs:

Marketing Costs are the actual expenses required in bringing goods from the producer to the consumers. The marketing cost normally includes

1. Handling charges at farm level,
2. Assembling charges,
3. Transport and storage costs,
4. Handling charges by wholesalers and retailers,
5. Expenses on secondary services like financing, risk taking and market intelligence, and
6. Profit margins of different agencies.

The marketing cost incurred by farmers and traders at Regulated market includes i) Market fee, ii) Commission, iii) Taxes, and iv) Other miscellaneous charges.

- i) Market fee:** Market fee is collected by the market committee of the markets. It is charged either on the basis of weight or on the basis of the value of the produce. It is usually collected from the buyers. The market fee differs from state to state. It varies from 0.5 per cent to 2.0 per cent ad valorem.
- ii) Commission:** It is paid to the commission agent for assisting in carrying out the transactions, and may be payable either by seller or by the buyer or sometimes by both. The charge is usually made in cash and varies considerably.
- iii) Taxes:** Different taxes are charged in different markets such as toll tax, terminal tax, sales tax, octroi etc. These taxes differ from market to market in the same state and from state to state. These taxes are usually payable by the seller.

- iv) Miscellaneous charges:** In addition to the above-mentioned charges, some other charges are levied in marketing of produce. These includes handling and weightment charges (weighing, loading, unloading, cleaning etc.), and charity etc. These charges may be payable either by the sellers or by the buyers or by both.

### **5.1.1 Marketing cost borne by producers and other functionaries:**

#### **1 Producers:**

The producer sells the fruits to pre-harvest contractors or sell themselves in the market premises. When farmers sell their produce to the pre-harvest contractors, they have to bear no cost on the marketing of fruits. The pre-harvest contractors make the payment for each post-harvest operation.

On contrary, if producers sell the produce themselves in the market premises or to a distant place, then they have to bear the expenses on labour for plucking of fruits, transportation, octroi, commission charges, heap making, and other miscellaneous activities.

#### **2 Pre-harvest contractors:**

Pre-harvest contractor makes the payment well in advance to the producers, therefore, they have to bear the expenditure on vigil and pre-harvest activities, in addition to post-harvest marketing activities.

The main post-harvest marketing cost borne by the pre-harvest contractors are like sorting and grading, packaging, transportation, octroi, loading and unloading, commission charges, heap making, market cess and other miscellaneous charges.

#### **3 Wholesalers:**

The wholesalers are the main purchasing agency in the markets. Generally, they have their own packing centres, located within the premises of the markets. They purchase the produce at their own or on behalf of other big traders. Sometimes, they also act as commission agents.

The wholesalers sell the produce outside of the market. The local sale of the fruits in the market premises is negligible. They have to incur expenditure on packing material, sorting & grading, transportation, octroi, loading / unloading, market cess, establishment and other miscellaneous items. The maximum expenditure of the wholesalers is on establishment and on other miscellaneous items.

#### 4 Retailers:

Retailer is the last functionary of the marketing channel of sale and purchase of the Mandarins. Retailers purchase the fruits from the wholesalers for the final sale to the consumers.

The expenditure of the retailers is found generally on transportation, commission charges, market cess, shop rents, baskets, shades, lighting, and maintenance of hand driven carts.

#### 5.2 Marketing Margins:

The margins of market intermediaries include profits and returns, which accrue to them for storage, the interest on capital and establishment after adjusting the marketing losses due to handling. The general expression for estimating the margin of the intermediaries is given below:

Intermediaries margin = Gross price (sale price) – Purchase price (cost price) – Cost of marketing – Loss in value during wholesaling

Marketing margin refers to the difference between the price paid and received by a specific marketing agency such as retailer or assemblers or by any combination of marketing agencies in the marketing system as a whole.

**Marketing Margin = Price Received by Agency- Price Paid by the Agency**

The marketing margin varies from market to market, channel to channel, time to time and place to place.

## **6 EXPORT AND IMPORT:**

### **6.1 National Trade:**

#### **6.1.1 Export:**

India is the largest producer of Mangoes in the world, including leading varieties like Alphonso. Therefore, India has a large opportunity to tap global trade in the export of Mangoes. Beside this, relatively long period of availability (March to August), diversity of the varieties, economic liberalisation and priority to export of fresh products have opened up the possibility of boosting Mango exports from India.

At present, Indian fresh Mangoes reach markets of over 80 countries. Some of regular importers of Indian fresh Mangoes and Mango products are UK, Kuwait, Malaysia, Netherlands, Bangladesh and some countries in gulf region.

India is the leading producer of more than one thousand varieties Mangoes that are unique in taste and aroma, accounting for more than 50 per cent of Mango production worldwide, but only 2 per cent of its production is exported. Other major Mango producing countries, like Mexico, Brazil, and Pakistan, export much higher quantity of their production contributing to their international trade. The reason may be that small farmers own the majority of India's Mango gardens, and some 72 per cent of the farms are less than three hectares. The other reason may also be that nearly 15 per cent of India's Mango production is wasted due to lack of adequate infrastructure facilities. In addition, India's Mangoes exports also suffer from other factors such as heterogeneous quality and phytosanitary issues due to lack of adequate post-harvest operations. Indian farmers are not properly informed about internationally practiced post harvest operations for Mangoes, which result in not only heavy post-harvest wastage but also low level of price realization in international markets.

The scenario of export of Mangoes may be altered by efficient orchard management, improvements in infrastructure, use of advanced technologies, and meeting the food quality standards such as ISO9001, HACCP, India has the potential to become the leading exporter.

No doubt, there is a huge market to capitalise its potential, exporters will have to comply with the quarantine requirements by adapting quality standards throughout value chain i.e., pre-harvest and post harvest requirements like plant quarantine, pre-shipment and treatment, phytosanitary certification, pre-surveillance and monitoring, irradiation treatment,

verification, and certification of vapor heat treatment, hot water dip treatment, and registration of packing house facilities. For the convenience of exporters, Govt. of India has instituted an elaborative mechanism, which includes all these operations. The early harvested crop of Mangoes (April-May) in India is well suited to international demand, as there is less competition from other countries during that period.

Constraints like suitability of a few varieties for exports, pests and disease problems, high freight charges, limited cargo space and high packing cost have restricted expansion of exports from India. Removal of some of these constraints will increase the potential for exports to USA and Japan.

Before the shipment the consignment are inspected by officers of the Directorate of Plant Protection, Quarantine and Storage to ensure compliance with phytosanitary requirements of importing country. National Plant Quarantine Centre is at New Delhi, while there are four regional quarantine stations located at Amritsar, Chennai, Kolkata and Mumbai. The Ministry of Agriculture undertakes regular pest survey and monitoring of Mangoes, meant for export under National Fruit Fly Surveillance Programme.

The country-wise export of Mango from India is given at table No 26.

**Table 26**

**Country-wise export Mango during 2009-10, 2010-11 and 2011-12**

Quantity in kg.

| <b>COUNTRY</b> | <b>2009-10</b> | <b>2010-11</b> | <b>2011-12</b> |
|----------------|----------------|----------------|----------------|
| UAE            | 2,56,08,155.00 | 2,54,74,530.00 | 2,20,13,880.00 |
| BANGLADESH     | 3,35,49,895.00 | 2,30,49,685.00 | 2,75,99,483.00 |
| UNITED KINGDOM | 29,58,655.00   | 27,21,906.00   | 25,32,422.00   |
| SAUDI ARABIA   | 31,47,133.00   | 15,82,378.00   | 23,88,634.00   |
| NEPAL          | 40,58,151.00   | 19,91,257.00   | 39,25,742.00   |
| KUWAIT         | 8,04,151.00    | 5,77,044.00    | 7,31,243.00    |
| SINGAPORE      | 3,67,577.00    | 3,91,297.00    | 5,99,273.00    |
| QATAR          | 6,59,023.00    | 3,77,099.00    | 8,16,102.00    |
| BAHRAIN        | 12,38,495.00   | 9,82,332.00    | 6,23,689.00    |
| UNITED STATES  | 1,75,401.00    | 99,699.00      | 3,53,177.00    |
| CANADA         | 2,55,193.00    | 4,26,682.00    | 4,05,759.00    |
| NETHERLAND     | 94,353.00      | 22,426.00      | 2,56,851.00    |
| MALAYSIA       | 4,15,309.00    | 3,97,821.00    | 3,53,413.00    |
| OMAN           | 2,69,500.00    | 1,36,756.00    | 1,54,774.00    |
| JAPAN          | 54,477.00      | 14,515.00      | 66,685.00      |
| SWITZERLAND    | 1,32,659.00    | 92,701.00      | 97,855.00      |

|                        |             |             |             |
|------------------------|-------------|-------------|-------------|
| HONG KONG              | 97,791.00   | 1,08,870.00 | 1,52,841.00 |
| FRANCE                 | 2,07,365.00 | 1,14,884.00 | 1,16,864.00 |
| GERMANY                | 1,08,809.00 | 78,679.00   | 99,993.00   |
| BELGIUM                | 39,697.00   | 40,095.00   | 32,194.00   |
| MALDIVES               | 25,779.00   | 8,781.00    | 17,026.00   |
| BRUNEI                 | 19,622.00   | 11,086.00   | 13,011.00   |
| IRAN                   | 39,141.00   | 31,400.00   | 37,730.00   |
| CHINA P RP             | 950.00      | 588.00      | 19,008.00   |
| SPAIN                  | 1,410.00    | 428.00      | 3,804.00    |
| AUSTRIA                | 7,567.00    | 7,331.00    | 10,783.00   |
| SWEDEN                 | 19,835.00   | 101.00      | 3,757.00    |
| ITALY                  | 18,180.00   | 5,960.00    | 1,075.00    |
| IRELAND                | 480.00      | 0.00        | 2,350.00    |
| RUSSIA                 | 2,684.00    | 0.00        | 1,383.00    |
| ARGENTINA              | 0.00        | 0.00        | 2,396.00    |
| SWAZILAND              | 0.00        | 0.00        | 3,578.00    |
| AUSTRALIA              | 22,800.00   | 0.00        | 3,610.00    |
| PORTUGAL               | 14,117.00   | 3,293.00    | 225.00      |
| EGYPT ARAB<br>REPUBLIC | 0.00        | 0.00        | 300.00      |
| ROMANIA                | 122.00      | 160.00      | 195.00      |
| NORWAY                 | 16,078.00   | 38,593.00   | 93.00       |
| THAILAND               | 705.00      | 380.00      | 42.00       |
| SRI LANKA              | 0.00        | 0.00        | 19.00       |
| ISRAEL                 | 0.00        | 18.00       | 9.00        |
| SLOVENIA               | 866.00      | 0.00        | 20.00       |
| GREECE                 | 1,776.00    | 0.00        | 0.00        |
| JORDAN                 | 122.00      | 0.00        | 0.00        |
| MALI                   | 16,078.00   | 0.00        | 0.00        |
| CONGO P<br>REPUBLIC    | 705.00      | 0.00        | 0.00        |
| CYPRUS                 | 0.00        | 0.00        | 0.00        |
| TUNISIA                | 0.00        | 0.00        | 0.00        |
| YEMEN<br>REPUBLIC      | 866.00      | 0.00        | 0.00        |
| KOREA<br>REPUBLIC      | 1,776.00    | 6.00        | 0.00        |
| DENMARK                | 122.00      | 0.00        | 0.00        |
| NIGERIA                | 16,078.00   | 3.00        | 0.00        |
| UNSPECIFIED            | 705.00      | 11,800.00   | 0.00        |
| LEBANON                | 0.00        | 0.00        | 0.00        |
| SOUTH AFRICA           | 0.00        | 4,351.00    | 0.00        |
| INDONESIA              | 866.00      | 0.00        | 0.00        |
| BHUTAN                 | 1,776.00    | 25,000.00   | 0.00        |
| BOSNIA-                | 122.00      | 0.00        | 0.00        |

|              |                       |                       |                       |
|--------------|-----------------------|-----------------------|-----------------------|
| HRZGOVINA    |                       |                       |                       |
| FINLAND      | 16,078.00             | 0.00                  | 0.00                  |
| UKRAINE      | 705.00                | 8,000.00              | 0.00                  |
| MAURITIUS    | 0.00                  | 2,166.00              | 0.00                  |
| KAZAKHSTAN   | 0.00                  | 0.00                  | 0.00                  |
| LITHUANIA    | 0.00                  | 8.00                  | 0.00                  |
| POLAND       | 29.00                 | 0.00                  | 0.00                  |
| TURKEY       | 0.00                  | 23,144.00             | 0.00                  |
| UGANDA       | 3,320.00              | 0.00                  | 0.00                  |
| LUXEMBOURG   | 0.00                  | 58.00                 | 0.00                  |
| PAKISTAN     | 0.00                  | 94.00                 | 0.00                  |
| <b>Total</b> | <b>7,44,60,609.00</b> | <b>5,88,63,405.00</b> | <b>6,34,41,288.00</b> |

Source: DGCIS Annual Export

During 2011-12, export of Mangoes was 63441 tonnes. Bangladesh, UAE, Saudi Arabia, Nepal and Behrain were the important countries where Mangoes were exported. During 2011-12, export of Mangoes to Bangladesh was heighest i.e., 2,75,99.5 tonnes.

## 6.2 Requirements for exporting Mangoes from India to the United States:

An APHIS preclearance officer, in India, first inspects Mangoes for presence of pests so that plant pests do not enter the United States. The fruit are treated with specified doses of irradiation prior to export. After passing preclearing requires, if however, live pests are found during the reclearance inspection, the shipment is rejected and is not eligible for export to the United States. Mangoes must be packed in insect-proof boxes and safeguarded after treatment to prevent re-infestation. It must also be accompanied by a phytosanitary certificate issued by the national plant protection organization (NPPO) of India with additional declarations certifying that the treatment and inspection of the mangoes are made in accordance with the regulations.

The present Model Project for export of Mangoes is yet another venture in this direction.

## 6.3 Export Potential:

Large domestic production base, relatively long period of availability (March to August), diversity of the varieties, economic liberalisation and priority to export of fresh products have opened up the possibility of boosting



Mango exports from India. The Expert Group of the Planning Commission has estimated the export potential of mangoes at 44000 tonnes per annum.

### **1 Strategy for Export:**

The strategies for boosting up of Mango export suggested by the Expert Group of the Planning Commission and APEDA are as under:-

- i. Transshipment of Mangoes by sea to make them competitive in price sensitive markets of Europe and Middle East.
- ii. Promotion of non-traditional varieties like Chausa, Safeda and Badami.
- iii. Augmentation of supply during seasonal gaps. (February/March in Middle East and March/April and July/August in Europe).
- iv. Development of post-harvest management facilities/ practices.

### **2 Objectives of the Project:**

Primary objective of project could be extension of financial assistance for export-oriented projects on Mangoes.

### **3 Project Components:**

Major components of present project include the following:-

- A. Packhouse
- B. Precooling and cold store
- C. Reefer Van
- D. Genset
- E. Office
- F. Office Equipments

### **4 Packhouse:**

100 sq.m. area, raised pucca cemented floor with roof of corrugated G.I. sheet. It may be open on all sides. This will serve as space for grading as well as packing. This can also be used for storing of packing materials and equipments.

### **5 Precooling and cold store**

Separate pre-cooling facility is proposed for rapid removal of field heat. Ideally, Mangoes are graded, packed, pre-cooled and transhipped. In

practice, grading and packing may be delayed. Likewise, immediate transshipment of Mangoes may not be possible due to volume insufficiency and/ or vehicle may be in transit. Therefore, cold store facility at farm gate is desirable for export purposes, particularly for export to U.K. The proposed size 120 Cu.m. is adequate for storing about 50 tonnes mango at a time.

## **6 Reefer Van:**

Since, it is essential that there is no break in the cold chain from harvest to final sale, a refrigerated van may be required.

## **7 Genset:**

A standby Genset of 27.5 KVA may be required to keep the cold store operational in case of power failure.

## **8 Office and Office Equipments:**

An export-oriented unit should have an office to manage various operations. Therefore, an office building of 50 sq.m. size has been proposed. Office should be fully equipped with facilities such as telephone, typewriter, and fax machine.

## **6.5 Financial Assistance:**

Scheme for export of Mangoes is eligible for refinance support by NABARD, provided the scheme is technically feasible and financially viable. If the beneficiaries require, banks may also provide pre-shipment/post-shipment credit from out of their own resources.

### **6.5.1 Leading Terms and Requirements:**

#### **1 Margin Money:**

Beneficiaries should normally meet 25% of the project cost out of their own resources. However, NABARD may consider to provide margin money assistance in suitable cases,

#### **2 Interest Rate**

In terms of existing guidelines of the Reserve Bank of India, for limits in excess of Rs. 2 lakhs, commercial banks are free to determine interest rate to be charged by them to ultimate borrowers. In terms of the existing instructions, NABARD charge the concerned banks, a rate of interest, which would be 3% below the rate charged by the Bank.

### **3 Refinance**

NABARD provides refinance to the extent of 50% of the bank loan to commercial banks for financing such projects.

#### **6.6 Agri-Export zones:**

Agri Export Zones helps in developing and sourcing raw materials, their processing/packaging, leading to final exports in respect of a particular produce/product located in a contiguous area. It is also a cluster approach of identifying potential products, the geographical region in which these products are grown and adopting an end-to-end approach of integrating entire process right from stage of production till it reaches market.

At these zones, any difficulty, faced right from the developing and sourcing raw materials, their processing/packaging, leading to final exports are identified and solution their of are suggested.

AEZ are identified by the State Government, and evolve a comprehensive package of services provided by all State Government agencies, State agriculture universities and all institutions, and agencies of the Union Government for intensive delivery in these zones. Corporate sector with proven credentials are encouraged to sponsor new agri-export zone or take over already notified agri-export zone or part of such zones for boosting agri-exports from the zones.

Services, which are managed and coordinated by State Government/corporate sector and include provision of pre/post harvest treatment and operations, plant protection, processing, packaging, storage and related research & development etc., APEDA supplement within its schemes and provisions. State Governments also make efforts for facilitating such exports.

Units in AEZ are entitled for all the facilities available for exports of goods in terms of provisions of the respective schemes.

#### **6.7 Benefits of agri export zones:**

- i) Strengthening of backward linkages with a market oriented approach.
- ii) Product acceptability and its competitiveness abroad as well as in the domestic market.
- iii) Value addition to basic agricultural produce.

- iv) Bring down cost of production through economy of scale.
- iv) Better price for agricultural produce.
- v) Improvement in product quality and packaging.
- vii) Promote trade related research and development.
- viii) Increase employment opportunities.

### **6.7.1 Agri Export Zones of Mangoes in India:**

| <b><u>State</u></b> | <b><u>District/Area</u></b>   |
|---------------------|---|
| 1) Andhra Pradesh   | Chittor, Ranga Reddy, Medak & Parts of Mahaboobnagar, Krishna   |
| 2) Gujarat          | Ahmedabad, Khaida, Anand, Vadodra, Surat, Navsari, Valsad, Bharuch and Narmada  |
| 3) Kerala           | Thrissur, Ernakulam, Kottayaam, Alappuzha, Pathanumthitta, Kollam, Thiruvanthapuram, Idukki and Palakkod                      |
| 4) Maharashtra      | Ratnagiri, Sindhudurg, Raigarh and Thane, Aurangabad, Jalna, Beed, Latur, Ahmednagar and Nasik                                |
| 5) Orissa           | Kandhamal   |
| 6) Tamil Nadu       | Madurai, Theni, Dindigul, Virudhunagar and Tirunelveli  |
| 7) West Bengal      | Malda and Murshidabad   |
| 8) Uttar Pradesh    | Lucknow, Unnao, Hardoi, Sitapur & Barabanki Sahranpur, Muzaffarnagar, Bijnaur, Meerut, Baghpat, Bulandshar and Jyotifulenagar |

### 6.8 Export Specificaion for Mangoes:

| Variety             | Countries         |                      |                   |                   |                   |
|---------------------|-------------------|----------------------|-------------------|-------------------|-------------------|
|                     | Middle East       | Netherland / Germany | U.K.              | Japan             | USA               |
| Alphonso            | Wt                | Wt                   | Wt                | Wt                | Wt                |
|                     | 200-250 gm.       | 250-300 gm.          | 250-300 gm.       | 250-300 gm.       | 250-300 gm.       |
| Kesar               | Wt                | Wt                   | Wt                | Wt                | Wt                |
|                     | 200-250 gm.       | 225-250 gm.          | 225-250 gm.       | 250-300 gm.       | 250-300 gm.       |
| Packing             | 1 Doz / 2.5 Kg    | 1 Doz / 2.5 Kg       | 1 Doz / 2.5 Kg    | 1 Doz / 3.5 Kg    | 1 Doz / 3.5 Kg    |
| Storage Temperature | 13 <sup>0</sup> C | 13 <sup>0</sup> C    | 13 <sup>0</sup> C | 13 <sup>0</sup> C | 13 <sup>0</sup> C |
| Export              | By Sea            | By Air               | By Air            | By Air            | By Air            |

Source: National Horticulture Board

**LIST OF PACK HOUSES APPROVED FOR THE EXPORT OF MANGO TO USA**

| Sl. No | PACKHOUSE DETAILS  | PACKHOUSE NO. & CODE | FRUITS TREATED AT |       | APPROVED |       | NO. OF GROWERS | VARIETY OF MANGOES   |
|--------|--|----------------------|-------------------|-------|----------|-------|----------------|--|
|        |  |                      | LASAL-GAON        | VASHI | NPPO     | APHIS |                |  |
| 1      | M/s. Nikko Namdhari Foods Pvt. Ltd.<br>Gat No. 1398<br>At Post Sayyed Pimpri<br>Tal. & Dist. Nashik – 422 003<br>Maharashtra<br><br><a href="mailto:ravigupta@namdhariseeds.com">ravigupta@namdhariseeds.com</a><br><a href="mailto:ravigupta2626@yahoo.co.in">ravigupta2626@yahoo.co.in</a> | APEDA/FFV/PH/01/2008 | yes               | yes   | yes      | yes   | 28             | ALPHONSO<br>KESAR  |
| 2      | M/s. sachi Exports (India)<br>Dharampur Vapi Road<br>Behind Swami Narayan Gurukul<br>Khorl Fldya, Baroliya<br>Dharampur, Valsand<br>Gujarat<br><br><a href="mailto:varsha@sachikaushal.com">varsha@sachikaushal.com</a>  | APEDA/FFV/PH/02/2008 | yes               | yes   | yes      | yes   | 11             | ALPHANSO<br>DASHERI<br>KESAR<br>TOTAPURI<br>AMRAPALI<br>RAJAPURI<br>BAIGANPALI |

|   |   |                      |     |     |     |     |    |                                    |
|---|---|----------------------|-----|-----|-----|-----|----|------------------------------------|
| 3 | M/s. Desai Fruit & Vegetable Pvt. Ltd.<br>Plot No. 49, At & Post Amadpore<br>N.H.8, Tal. & Dist. Navsari<br>Gujarat<br><a href="mailto:ajit.desai@desaifv.com">ajit.desai@desaifv.com</a>                             | APEDA/FFV/PH/03/2008 | yes | yes | yes | yes | 33 | ALPHONSO<br>KESAR                  |
| 4 | M/s. Maagrita Exports Ltd.<br>No. 45, Sipcot Industrial Complex,<br>Pallapatti P.O.,<br>Nilakottai Taluk,<br>Dist. Dindigul – 624 201<br><a href="mailto:arunkumarsadanand@gmail.com">arunkumarsadanand@gmail.com</a> | APEDA/FFV/PH/04/2008 | yes | yes | yes | yes | 6  | ALPHONSO<br>IMAMPASAND<br>SENTURAM |
| 5 | M/s. Galla Foods Pvt. Ltd.<br>Rangampet Village<br>Puthalapattu Mandal<br>Dist. Chittoor – 517 124<br>Andhra Pradesh<br><a href="mailto:suninaidu@rediffmail.com">suninaidu@rediffmail.com</a>                        | APEDA/FFV/PH/05/2008 | yes | yes | yes | yes | 21 | ALPHONSO<br>BANGANPALI             |
| 6 | M/s. Vistas Investment Pvt. Ltd.<br>Market yard<br>Gollapudi<br>Vijayawada<br>Andhra pradesh<br><a href="mailto:vistasbg@vsnl.net">vistasbg@vsnl.net</a>  | APEDA/FFV/PH/06/2008 | yes | yes | yes | yes | 20 | ALPHONSO<br>BANGANPALI             |

|   |   |                      |     |     |     |     |    |                        |
|---|---|----------------------|-----|-----|-----|-----|----|------------------------|
| 7 | M/s.Vijay Lakshmi Agro Service Centre<br>59-7-8, Ramachandra Nagar<br>Vijayawada – 520 008<br>Andhra Pradesh<br><a href="mailto:kpr_45@yahoo.co.in">kpr_45@yahoo.co.in</a>  | APEDA/FFV/PH/07/2008 | yes | yes | yes | yes | 39 | ALPHONSO<br>BANGANPALI |
| 8 | M/s. MSAMB<br>Alphonso Mango Export Facility Centre<br>At Post Nachane<br>Tal. & Dist. Ratnagiri<br>Maharashtra<br><a href="mailto:export@msamb.com">export@msamb.com</a><br><a href="mailto:project@msmab.com">project@msmab.com</a>       | APEDA/FFV/PH/08/2008 | yes | yes | yes | yes | 53 | ALPHONSO               |
| 9 | M/s. MSAMB<br>Alphonso Mango Export Facility Centre<br>At. Jamsande, Tal. Devgad<br>Dist. Sindhudurg<br>Maharashtra<br><a href="mailto:export@msamb.com">export@msamb.com</a> ,<br><a href="mailto:project@msmab.com">project@msmab.com</a> | APEDA/FFV/PH/09/2008 | yes | yes | yes | yes | 18 | ALPHONSO               |



|    |   |                      |     |     |     |     |    |            |
|----|---|----------------------|-----|-----|-----|-----|----|------------|
| 10 | M/s. MSAMB<br>Kesar Mango Export Facility<br>Centre<br>Agriculture Produce Market<br>Committee<br>Premises, Jalana<br>Dist. Jalana<br>Maharashtra<br><a href="mailto:export@msamb.com">export@msamb.com</a><br><a href="mailto:project@msmab.com">project@msmab.com</a> | APEDA/FFV/PH/10/2008 | yes | yes | yes | yes | 51 | ALPHONSO   |
| 11 | M/s. Sam Agritech Ltd.<br>Sy. No. 608/6<br>Puduru Village<br>Medchal Mandal<br>RR District<br>Andhra Pradesh<br><a href="mailto:samagri@yahoo.co.in">samagri@yahoo.co.in</a>  | APEDA/FFV/PH/11/2008 | yes | yes | yes | yes | 15 | BANGANPALI |
| 12 | M/s. Hota Agro Tech Pvt. Ltd.<br>No. 3-100/1<br>Hukumpeta (V)<br>Gopalapuram Mandal<br>West Godavari Dist.<br>Andhra Pradesh<br><a href="mailto:hotaagro@yahoo.co.in">hotaagro@yahoo.co.in</a>  | APEDA/FFV/PH/12/2008 | yes | yes | yes | yes | 7  | BENISHAN   |

|    |  |                      |     |     |     |     |    |             |
|----|--|----------------------|-----|-----|-----|-----|----|-------------|
| 13 | Gujarat Agro Packhouse Pvt. Ltd.<br>Krishna 1 Teachers colony<br>Near Bileshwar Mandir,<br>Veraval, Gujarat 362266<br><a href="mailto:m_h_maru_13@yahoo.co.in">m_h_maru_13@yahoo.co.in</a> | APEDA/FFV/PH/14/2008 | yes | yes | yes | yes | 16 | KESAR       |
| 14 | Andhra Pradesh State Agro Industries Corporation Ltd<br>Agriculture Market Yard,<br>Tiruchanur Road, Tirupathi<br>Andhra Pradesh   | APEDA/FFV/PH/15/2008 | yes | yes | yes | yes | 6  | Banganpalli |

**Source: APEDA**

## **7.0 PROCESSING AND USES:**

India has an abundant supply of food, but the food processing industry is still in nascent stage. An average Indian spends about 50 per cent of household expenditure on food items, even though only two per cent of fruit and vegetables are processed.

Food processing is the set of methods and techniques used to transform raw ingredient into food or other forms for consumption by human or animals either in the home or by the food processing industry. Processed foods are often less susceptible to early spoilage than fresh foods, and are better suited for long distance transportation from the source to the consumers.

However, Mankind has always processed his food. Traditional food processing had two functions like

- i) To make food more digestible and
- ii) To preserve food during times of scarcity.

Mango fruits have been utilised for long time as fresh as well as its products like chutney, pickle, amchoor, pectins, jam, murabbas, toffees, am papad, Mango powder and many other preparations having Mango flavour green Mango beverage when it raw while ripe ones are used in making pulp, juice, nectar, squash, leather, slices, etc.

### **7.1 Raw Mango Products:**

Raw Mango fruits is generally used for sweet or sour chutney and some other useful products like amchoor, pickle, slices, green mangoes beverages (Panna) etc.

#### **1 Mango flakes:**

Mango flakes are considered a healthy snack. It is drum dried with or without starch. It can be used as ingredient or flavoring material to cereal, pie filling, yogurt, fruit bars, cakes, sauces, juices and pastries.

#### **2 Mango square:**

Mango square is a bakery product made from a flour margarine based dough and mango paste as filling. The mango paste is formulated from table ripe mango and sugar. It is a nutritious snack and desert item.

### 3 Green powered:

Green powder is produced from juice of green mangoes and dried through the process of spray drying. It has an aroma and flavor of fresh green mango, which is great for instant mango juice/shake and as soup base or broth.

### 7.2 Ripe Mango Products:

Ripe fruit has comparatively shorter storage life. Therefore, it is better to make their products immediately like pulp, beverages (Juice and nectar), squash, slices and aampaper (Mango leather) etc.

### 7.3 Waste Utilisation:

During the processing of Mangoes, peel and stone are generated as waste (40-50% of total fruit weight). They are rich in various nutrients and many value added products can be obtained from them. Good quality jelly grade pectin (6.1%) and edible fibre (5.4%) vinegar (5.2% acetic acid) and citric acid (20 g / kg) can be extracted from ripe mango peel.

Mango kernel contains high amount of fat and starch. The oil extracted from kernel is of good quality and could be used in cosmetic and soap industries. The kernel flour (starch) after mixing with wheat or maize flour is used for making chapaties. About ten per cent alcohol can be obtained from Mango kernel. Enzymes such as cellulase and pectinase from Mango peel and amylase from Mango kernel can also be obtained. Mango peel can be used as animal feed.

### 7.4 Fragrance

Fragrant Mango flowers are used to make a fragrant essential oil known as an “Otto”. It is also called as am attar and is produced by steam distilling the young flowers.

### 7.5 Gum and charcoal

Gum, a substitute to gum Arabic can be tapped from the stems of Mango trees. Charcoal can also be made from mango wood.

### 7.6 Mango -Traditional medicine

All parts of the Mango plant from the seeds and flowers to the leaves and gum are used in traditional South Asian medicine, but the fruits are most important. Unani physicians hold Mangos in very high esteem because of their many medicinal virtues. They are used for strengthening the nervous and blood systems, ridding the body of toxins and treating anaemia. In Ayurveda,

dried Mango flowers are used to cure dysentery, diarrhoea and inflammation of the urinary tract.

In South Asian folk medicine, rheumatism and diphtheria is treated using the astrigent bark of the Mango tree. Cracked skin on the soles of feet and scabies is cured by applying the gum, which oozes from trunk of the tree. Powdered seeds are used to stem bleeding. Fruits are eaten as a kidney tonic and to cure headaches.

Leaf, bark, stem and green unripe and half ripe fruits inhibit growth of bacteria, particularly *Escherichia coli*. Ripe mangos contain anti-fungal properties, juice from the seeds give relief from diarrhoea and young leaves prevent sickness.

## 7.7 Mango - Western medicine

Fruits, bark and seeds of Mango plants have been scientifically shown to possess a range of health-giving properties. Mango fruits can help to prevent colon cancer, especially in cases where there is a lack of fibre in the diet. Fruits also contain a compound called mangiferin, which has several medicinal attributes. It is particularly useful in promoting the action of the heart and excretion of urine, calming inflammation, treating diabetes and as an antioxidant. Fruits also contain the chemicals gallic acid and quercetine, which give protection against viruses.

Chemical compounds in extracts from the bark of Mango trees have been shown to protect against diarrhoea. The powdered seeds also have antimicrobial activity.

## 7.8 Other medicinal uses:

Mango is one of the most recommended fruits to fight beriberi and to heal bronchial diseases. Mixture of Mango pulp and honey can be made at home to fight bronchitis. Mango is an excellent depurative for the organ and it is recommended for nervous people, to fight insomnia, to heal brain fatigue, mental depression and as a laxative, besides it is very helpful to fight heartburn. It has excellent results when used to eliminate kidney sand and to assist digestion. An infusion can be made with Mango leaves to heal molar ache, to affix weak teeth and to eliminate pyorrhoea (pus from the gums). This infusion is very helpful to reduce the inflammation of the throat when used for gargling. For those who practice fasting, Mango fasting is recommended since it provides a high amount of minerals to the blood. Mango fasting can be extended up to two or three weeks but always under supervision. An extract can be made with Mango skin and pulp, which is very astrigent. The pulp can be used to rub skin affected by scabies, although it is not suggested for people who have delicate skin as this treatment might cause rash. Mango is a good diuretic that helps to evacuate a high amount of toxins through the urine.

Mangoes beyond being delicious and rich in vitamins, minerals and anti-oxidants, contain an enzyme with stomach soothing properties similar to papain found in papayas. These comforting enzymes act as a digestive aid and can be held partially responsible for that feeling of contentment we experience during and after our daily mango ritual.

Mangoes are an excellent source of Vitamins A and C, as well as a good source of Potassium and contain beta-carotene. Mangoes are high in fibre, but low in calories (approx. 110 per average sized mango) fat (only 1 g) and sodium, therefore are good for prevention against constipation, piles and spastic colon. The dietary fibres also have a protective effect against degenerative diseases, especially heart disease and may help to prevent certain types of cancer, as well as lowering blood cholesterol levels. Mangoes are also a great way to replenish that lost potassium. Mangoes also serve as nutritional supplement, providing remarkable quantities of microelements like selenium, copper and zinc.

## **7.9 Toxicity:**

The only toxic parts of the mango plant are various substances that are found in the skin of the fruit and the sap of the trunk. Mango is in the same family as poison ivy (Anacardiaceae) and, like many other species in this family, can cause allergic reactions in sensitive people. Contact with the skin of the fruit sap can irritate the skin, and it may be toxic if eaten.

## **7.10 Problems in Indian Mango Industry:**

- 1) Complex supply chain is one of the main barriers to development of the Indian Mango industry. In markets a number of small producers, commission agents are operating. Therefore, for a bulk purchase of lot, these numbers of functionaries are to be dealt, causing inconvenience and more post-harvest losses.
- 2) Weather fluctuations, causing interrupted supply of fruits to the industry. Sometimes, the weather also delayed arrivals, keeping prices on the boil till mid-May.
- 3) Lack of supply of Mangoes.
- 4) Lack of forward and backward linkage between growers/suppliers and buyers/exporters, which has affected the mango's market potential.
- 5) Inconsistent supply of quality and quantity of Mangoes.
- 6) Disaggregate and multi-layered marketing channels, resulting in inefficiencies in procuring of raw material.
- 7) Highly perishable (short storage life and susceptible to diseases) resulting in high post-harvest losses
- 8) High freight cost and inadequate transport facilities.

- 9) The rise in fuel prices, resulting in costlier fruits.
- 10) The disparity in wholesale and retail prices.
- 11) Due to alternate or irregular bearing (biennial bearers), which is the tendency of Mango trees to bear a heavy crop in one year (On year) and very little or no crop in the succeeding year (Off year), fruits are not available in required quantity, each year.

### **7.11 Drawbacks of processing:**

Some of drawbacks of processing of food are as under.

- 1) Fresh food contains a higher proportion of naturally occurring fibre and minerals. Similarly, Vitamin C is destroyed by heat and therefore canned fruits have a lower content of than fresh ones. Therefore, the nutritional value of foods is reduced.
- 2) Processed foods include food additives, such as flavourings and texture enhancing agents, which may have little or no nutritive value, or be unhealthy. Some preservatives added or created during processing such as nitrites or sulphites may cause adverse health effects.
- 3) Processed foods often have a higher ratio of calories to other essential nutrients than unprocessed foods.

Therefore, high quality and hygiene standards must be maintained to ensure consumer safety and failures to maintain adequate standards can have serious health consequences.

## Annexure I

### GUIDELINES FOR EXPORT OF INDIAN MANGOES TO USA

#### 1. Introduction:

##### 1.1. Scope & Purpose:

This document provides the guidance and requirements for the export of commercial shipments of fresh fruits of mango from India to USA in compliance with the phytosanitary requirements of USA.

The purpose of this document is to facilitate commercial export of fresh fruits of mango from India to USA after meeting the obligations covered under international agreements such as WTO-SPS agreement/ IPPC.

#### 1.2. Definition of Terms:

**APEDA:** Agricultural & Processed Food Products Export Development Authority, Ministry of Commerce & Industry

**Dte of PPQS:** Directorate of Plant Protection, Quarantine & Storage, Ministry of Agriculture, NH IV, Faridabad.

**IPPC:** The International Plant Protection Convention, FAO, Rome

**Lot:** A quantity of fruits sent from a single grower or producer (with a single production unit code) to a packinghouse for processing in a day.

**NPPO:** National Plant Protection Organization

**USDA-APHIS:** Animal & Plant Health Inspection Service, US Department of Agriculture

**WTO-SPS:** WTO Agreement on Application of Sanitary & Phytosanitary Measures

#### 1.3. References:

*Framework Equivalence Work Plan between India and USA*

*Irradiation Operational Work Plan between India and USA*

*Guidelines for Certification of Irradiation treatment facilities for meeting the phytosanitary requirements, Dte of PPQS, MOA (NPPO)*



*Guidelines for the use of irradiation as a phytosanitary measure, 2003, ISPM No. 18, FAO, Rome.*

*Standard Operating Procedures- Irradiation Treatment of Indian Mangoes for export to USA approved by the Dte of PPQS, MOA (NPPO)*

*Standard Operating Procedures- Packinghouse Facilities for Export of Indian Mangoes to USA approved by the Dte of PPQS, MOA (NPPO)*

#### **1.4. APHIS Requirements for Entry of Indian Mangoes into USA:**

The importation of mangoes from India is regulated under the 'Fruits and Vegetables Quarantine, 7 CFR 305 and 319 [Docket No.APHIS-2006-0121] RIN 0579-AC19, USDA-APHIS.

As a condition of entry into USA, the mangoes must be treated in India with irradiation by receiving a minimum absorbed dosage of 400 Grays.

Importers must secure the USDA-Import Permit at least 30 days in advance of arrival irradiated commodities at the scheduled port of entry to facilitate transmission of the permits to the inspector at the U.S. Port of entry in advance of arrival of shipments.

The mangoes must be given post-harvest hot water fungicidal dipping (Prochloraz at 500 ppm) at 52 C for 3-4 minutes.

Each consignment of mangoes must be inspected jointly by USDA-APHIS and NPPO of India (Dte of PPQS of MOA), as part of the required pre-clearance inspection activities as determined by mutual agreement between USDA-APHIS and NPPO of India.

Each consignment of mangoes must be accompanied by a phytosanitary certificate issued by NPPO of India (Dte of PPQS of MOA) certifying that the fruits received required irradiation treatment. The phytosanitary certificate must also bear the following two additional declarations confirming that:

- (1) the mangoes were subjected to post-harvest mitigation options described as above and
- (2) the mangoes were inspected during pre-clearance activities and found free of *Cytosphaera mangiferae*, *Macrophoma mangiferae*, and *Xanthomonas campestris* pv. *Mangiferaeindicae*

The mangoes will be permitted import in commercial consignments only.

## **2. Guidelines for Export of Mango Fruits to USA:**

### **2.1. Orchard Level**

#### **2.1.1. Registration of orchards**

The orchards involved in the export programme will be registered with a registered packinghouse facility.

The registered orchards will maintain documented record of all operations carried out at the orchard and adopt good agricultural practices for management of mango orchards established by APEDA.

#### **2.1.2. Pre-harvest orchard survey**

A pre-harvest orchard survey will be carried out by the registered packinghouse facility to assess the incidence of pests and the fruit production. The survey will involve fruit sampling to determine right stage of harvest of fruits for post-harvest processing.

If any pests are noticed during the survey, the same will be referred to the Dte of PPQS (NPPO) for correct identification of pest and advise appropriate measures to mitigate the pest.

#### **2.1.3. Harvesting/Marking of Fruit Crates.**

Mangoes for export by sea will be harvested, when the fruits are at half-maturity stage and for air shipments the fruits will be harvested, when they are fully matured.

Only healthy, good-looking fruits will be harvested with sufficient length of stalk with the help of specially designed harvesters, which have a long stick horizontally fitted with a curved blade at 45° angle and smooth net pouch for holding the harvested fruits.

The harvested fruits will be lowered and kept in a clean and disinfected ventilated plastic crates provided with a clean polyurethane foam cushion and stocked under the shade until transport to a packinghouse facility.

Each crate of fruits will be labeled/marked indicating the name of orchard/locality, production unit code, variety and date/time of harvesting.

Care should be taken to avoid contamination of fruits/crates with soil by keeping them over a clean plastic sheet/kraft paper spread on the ground.

If any immature/scarred fruits are noticed, they will be segregated into a separate crate distinctly marked 'not for export' to prevent their

transportation to packinghouse facility and all damaged/diseased/over-ripened or rotten fruits will be immediately disposed by burying 6” deep under soil in a pit at the orchard.

The workers will adopt hygienic practices, while handling the fruits during harvesting/segregating/packaging fruits in plastic crates at the orchards.

#### **2.1.4. Transport of mangoes to packinghouse facility**

The harvested fruits will be transported from registered orchard to a packinghouse facility in a clean and hygienic transport vehicle. No non-programmed fruits will be loaded and transported other than programmed fruits to the packinghouse facility.

### **2.2. Packing House Level**

#### **2.2.1 Registration of packinghouses**

The packinghouses involved with the export of mangoes to USA will be registered with the APEDA (Cooperator).

The registered packinghouses will abide by the Irradiation Operational Work plan and its addenda established between India and USA.

The registered packinghouses will have documented Standard Operating Procedures (SOPs) that are approved by the Dte of PPQS (NPPO), which describes in detail all the process related to desapping, cleaning and washing, hot-water fungicidal dipping, grading, hygienic handling, packing and labeling/marketing of mango fruits.

#### **2.2.2. Pre-processing Inspection**

Prior to processing, the packinghouses will carry out inspection of fruits received at the facility, to verify that crates of mangoes received at the facility are labeled/marked to ensure that they are from a registered orchard only.

If any mango fruits received from an un-registered orchard, the same may be refused for processing at the facility and will be distinctly marked ‘not for export to USA’ and stocked physically separated away from the registered orchard lots to prevent commingling and to prevent their export. The packinghouses will ensure that no other fruits or vegetables are processed, while processing mangoes at the facility.

If any damaged/diseased/over-ripen or rotten fruits are noticed, they will be physically segregated into separate crates. The segregated crates will be

immediately marked 'rejected' and removed to rejected articles storage area for disposal by burying under 6" deep soil in a pit.

### **2.2.3. Post-harvest processing**

The water used for cleaning/washing of fruits will be of potable quality and mixed with a neutral detergent such as Teepol, Sandovit or Indtron at 0.1% (1 ml of detergent per litre of water).

The processing lines will be physically inspected at the end of each process load to remove all debris collected at the conveyor belt and at fruit scrubbing brushes, rinsed and washed with clean water containing mild soap or detergent such as Teepol to remove any left over organic matter followed by mild scrubbing and second rinsing with clean water.

The processing lines will be cleaned before program fruit is packed and/or after nonprogram fruit is packed, as stated above.

Disinfestation of mango fruits will be carried out at the packinghouse facility by hot water fungicidal dipping (Sodium hypo chloride at 200 ppm) at 52° C for 3-4 minutes.

### **2.2.4. Packaging/Labeling/Marking**

Each individual fruit of mango will be enclosed in a clean, white, soft, expandable and netted type polystyrene sleeve to prevent bruising before packing in a box.

The mangoes must be packed in insect-proof boxes. If ventilated boxes are used, all the ventilator openings of the box should be covered with insect-proof screen of a minimum of 30 meshes per linear inch and all the sides of box should be sealed with adhesive tape to prevent any entry of pests.

Only packing material of food grade should be used for packing mangoes at the pack house facility and the package boxes having dimensions of 370 X 275 X 90 mm should be used for packing export mangoes, as approved by USDA-APHIS.

Each package must be either preprinted or affixed with a label as specified (refer to Addendum-5 of SOPs for packing house facility), which is duly approved by the USDAAPHIS. The label should be appropriately marked/stamped on left-half side indicating Production Unit Code Number (PUC), Packinghouse Code Number (PHC), Date of Packing, and Lot Number.

### **2.2.5. Quality inspection of mango fruits**

An appropriate sampling of packages of processed lots of mangoes will be carried out to ensure the required quality parameters as specified in the export contract are met with.

#### **2.2.6. Transport of packages of fruits to irradiation treatment facility**

Before loading the packages of processed mangoes, the conveyance must be carefully inspected to ensure it is thoroughly clean and free from hitch-hiking pests.

At the completion of loading, the doors of the vehicle will be closed and locked and suitable seal must be affixed to ensure the integrity of processed consignment.

### **2.3. Treatment Facility Level**

#### **2.3.1 Approval & Certification of Treatment Facility**

The treatment facility must be approved and certified by USDA-APHIS, PPQ, CPHST to be authorized to apply approved phytosanitary irradiation treatments.

The treatment facility will abide by the Irradiation Operational Work Plan between India and USA and its addenda.

The treatment facility offered for certification must develop and document Standard Operating procedures (SOPs) by each facility that address irradiation of commodities for mitigation of plant pests. These SOPs will be reviewed and approved by the NPPO of India (Dte of PPQS, MOA).

The treatment facility will be initially approved and certified by the Dte of PPQS, MOA (NPPO of India) before offering for certification by USDA-APHIS.

The treatment facility will enter into a compliance agreement with NPPO and APHIS in addition to Cooperative Agreement and the Irradiation Operational Work Plan.

The treatment facility will only accept mango fruits from registered packinghouse facility in insect-proof boxes and that the processed mangoes are only from registered orchards to ensure trace back.

#### **2.3.1 Preclearance Inspection & Sampling**

The Dte of PPQS, MOA (NPPO of India) and the inspector of APHIS, will jointly carry out preclearance inspection of mangoes received at the treatment facility just prior to treatment to confirm that the lot is free from non-target quarantine pests and meet the requirements for the target pests listed in addendum-2 to Irradiation Operational Work Plan.

For this purpose, a systemic sampling of lots, as specified in Addendum-2 of Irradiation Operational Work Plan, will be carried out using a random number table. The sample size shall include:

- Lot size of 1 to 4 cartons-inspect all cartons; minimum fruit to cut -10 fruits;
- Lot size of 5 to 99 cartons-inspect 5 cartons; minimum fruit to cut -20 fruits;
- Lot size of 100 to 240 cartons-inspect 7 cartons; minimum fruit to cut – 30fruits;
- Lot size of 241 or more cartons-inspect 14 cartons; minimum fruit to cut-30 fruits;

The exterior of selected cartons and fruits will be thoroughly inspected for target and non-target quarantine pests. Thereafter a minimum number of fruits as specified will be cut and examined for internal feeders.

In the event of interception of live pests during inspection the following actions will be undertaken:

- If any targeted pests such as fruit flies (Tephritidae), one or more detected, the entire lot will be rejected for export;
- If any target pests such as internal feeders (weevils), one or more detected, the lots will be cleared for treatment and certified under notification to APHIS IS Area Director.
- If any target external pests are detected in one or more, the lots will be cleared for treatment and certified. However APHIS IS Area Director will be notified.
- If any non-target quarantine pests (e.g., Adults and Pupae of Lepidoptera; fungal/bacterial pathogens, snails or mites), one or more are detected the entire lot will be rejected

### **2.3.2. Irradiation Treatment of Mango Fruits**

The mangoes for export will be irradiated with a minimum absorbed dosage of 400 Grays at the approved and certified irradiation treatment facility using Cobalt-60. The source and equipment used for pest mitigation treatments must be capable of safely and effectively irradiating the commodities to the specifications that are required for that are required for target pests.

### 2.3.3. Treatment Verification/Marking

Routine dosimetry as well as dose mapping will be carried out by Ceri-Cerous Sulphate (3 mM) dosimeters with a potentiometer read out system ISO/ASTM 51205: 2002 (E), which is calibrated by using Fricke Reference standard E 1026-04 with a spectrometer read out system.

If the absorbed doses fall outside the acceptable limits, the treatment facility will enter the results in the treatment register as “Failed”; mark the rejected articles “Rejected” on the cartons. The particulars of rejected articles will be entered in the product log book. The rejected articles will be immediately removed to rejected article storage area to prevent their shipment to USA. The treatment facility will notify the treatment failure to Dte of PPQS (NPPO of India) and APHIS and further investigate the cause of treatment failure and take preventive measures for such failures.

If the results of dosimetry reveal successful treatment, the particulars of treatment Viz., Treatment Facility Code (TFC), Treatment Identification Number (TIN) and Date of treatment must be marked on the right-half side of the preprinted or affixed RADURA label on each and every box as approved by USDA-APHIS and a treatment certificate will be issued for each treated lot.

The treated lots will be safeguarded in a secured holding room/area, which is distinctly separated from untreated lots storage area by an insect-proof screened partition to prevent any reinfestation of treated commodities by hitchhiking pests

### 2.3.4. Phytosanitary Certification

After verification of treatment, Dte of PPQS of MOA (NPPO of India) will issue a phytosanitary certificate with the following two additional declarations confirming that:

- (1) the mangoes were subjected to post-harvest mitigation options described as above and
- (2) the mangoes were inspected during pre-clearance activities and found free of *Cytosphaera mangiferae*, *Macrophoma mangiferae*, and *Xanthomonas campestris* pv. *mangiferaeindicae*

The particulars of treatment will be endorsed on the phytosanitary certificate. The USDA-APHIS import permit number will be marked in

each of the phytosanitary certificate issued and also the treatment certificate number.

The treated shipments of mangoes will be certified for export by the inspector of APHIS after verifying that all treatment requirements and post treatment security requirements have been met and maintained. The PPQ Form 203 (Foreign Site Certificate of Inspection and/or Treatment) will be completed, signed and issued by the inspector of APHIS and the original copy of the same will accompany the shipment to USA.

### **2.3.5. Transport of Treated Packages Direct to Airport**

The empty trucks or vans will be carefully inspected jointly by the Dte of PPQS of MOA (NPPO of India) and the APHIS to ensure free from pests and plant debris prior to loading with treated packages of mango.

If any pests are found, the empty van or truck should be thoroughly disinfected with a suitable insecticide followed by a second inspection to ensure that the pests are effectively controlled.

While loading, the space between the doors of van and loading area of the facility will be covered by insect-proof screen to prevent entry of hitchhiking pests

At the end of the loading, the doors of the van or truck is closed and secured by a lock and a seal will be affixed.

## **2.4. Airport level**

### **2.4.1. Loading/Sealing of Air Containers**

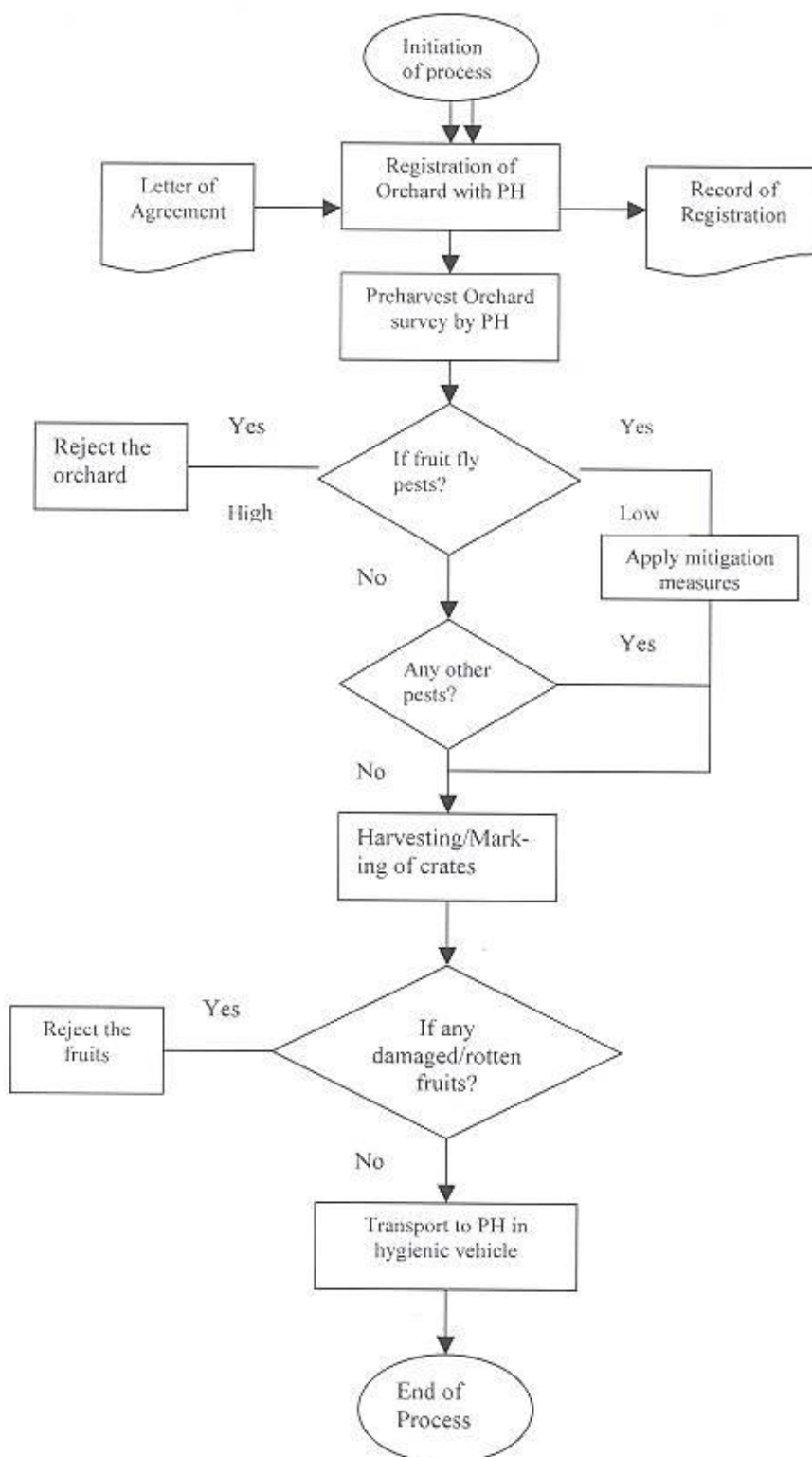
In case of air shipments, the treated packages immediately upon arrival at the perishable air cargo complex at Mumbai Airport, will be X-rayed for security, strapped into small shipping units, loaded into LD-3 or air containers and secured (doors closed/covered completely). The air containers will be immediately sealed by Customs and held at secured area until loaded on the aircraft

### **2.4.2. Safeguarding treated packages during storage at Airport**

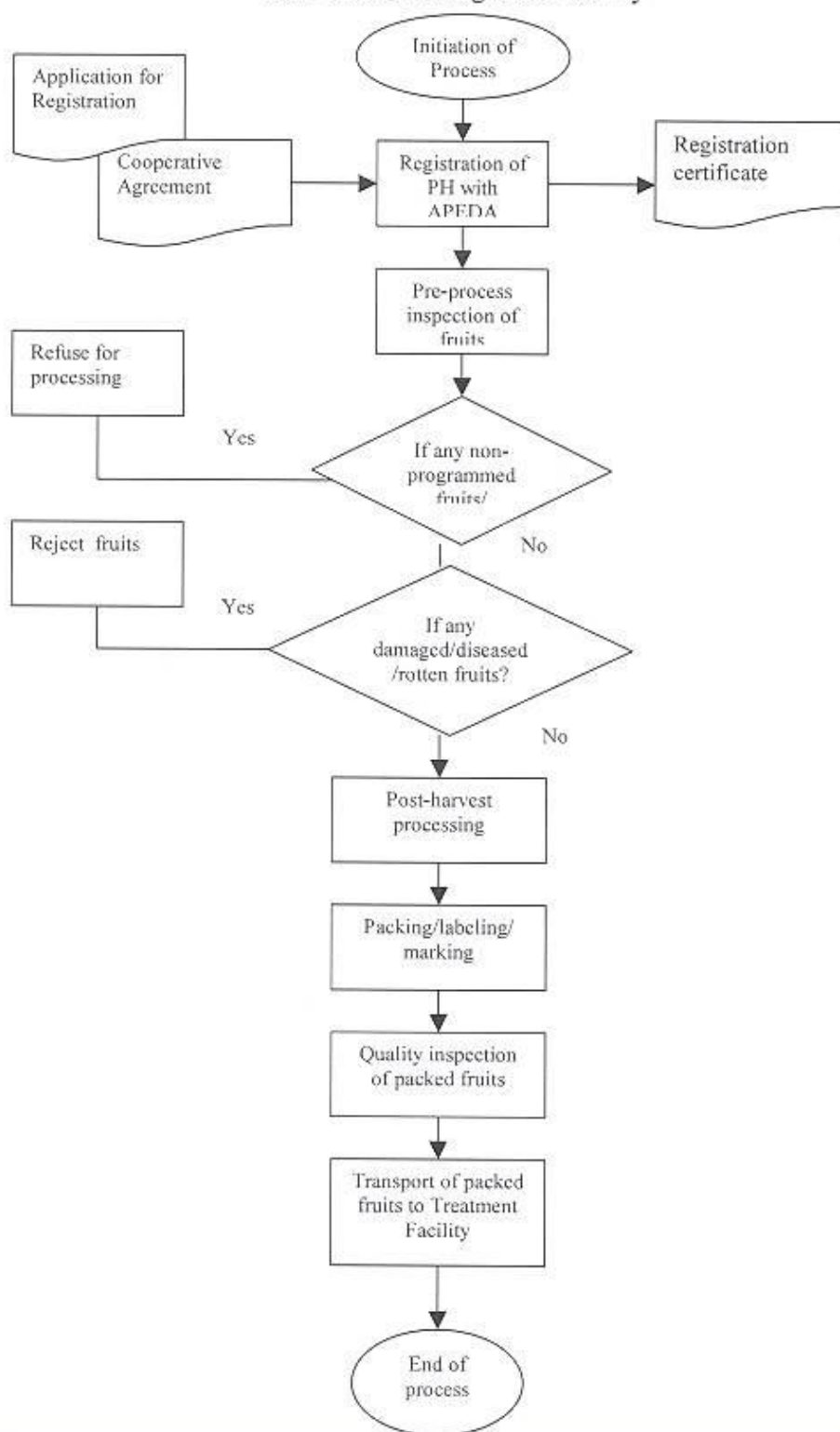
If an air shipment is delayed or the flight is cancelled, the treated packages will be safeguarded in secured cold storage room at the perishable air cargo complex at Mumbai Airport. Care should be undertaken to avoid commingling of treated packages from untreated articles and distinctly segregated from non programme articles to prevent crossinfestation.



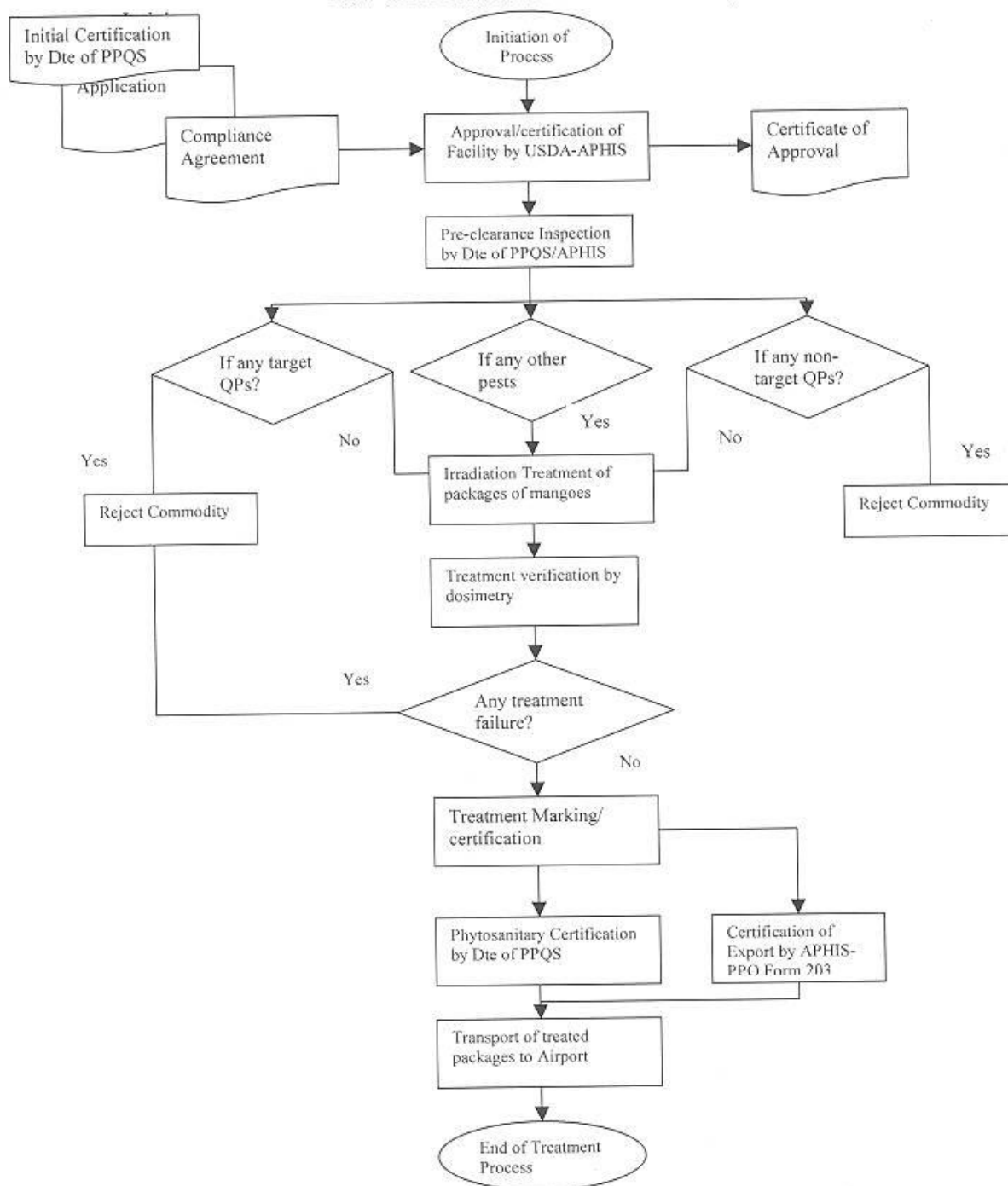
Flowchart-Orchards



Flow chart-Packinghouse Facility



Flow chart-Irradiation Treatment Facility



**Annexure II**  
**GUIDELINES FOR EXPORT OF MANGOES TO JAPAN**

**Varieties:** - Alphonso, Kesar, Chausa, Banganpalli, Mallika and Langra.

**I. Plants and Areas:** Plants for which these standards are established are fresh mango fruits of the Alphonso variety, the Kesar variety, the Chausa variety, the Banganpalli variety, the Mallika variety and the Langra variety produced in the designated area in India.

**II. Transport Methods:** The fresh fruit shall be imported as ship cargo and airfreight.

**III. Inspection and Certification in India:**

(1) The fresh fruit shall be inspected by the Indian Plant Quarantine Authority and shall also be accompanied by a phytosanitary certificate issued to the effect that, as a result of inspection, it is recognized or believed that they are not infested with any pests or diseases.

(2) Phytosanitary certificate shall bear the additional remarks:

(A) That the subject fruit is not infested with *Bactrocera dorsalis* species complex and Melon fly (hereinafter referred to as “fruit Flies”).

(B) That the fruits have been disinfested.

**IV. Disinfestation in India:** The fresh fruit of Mango shall be disinfested with saturated vapor in the vapor heat treatment facilities. The temperature of the treatment chamber shall be raised step by step to 50 degrees centigrade so that the temperature of the innermost fruit pulp reaches 47.5 degrees centigrade and is kept at 47.5 degrees centigrade or higher for 20 minutes.

**DETAILED RULES FOR PLANT QUARANTINE ENFORCEMENT REGULATION:**

The enforcement of plant quarantine on the fresh fruit of mango of Alphonso, Kesar, Chausa, Banganpalli, Mallika and Langra varieties produced in India shall be carried out in accordance with these Detailed Rules in addition to the standards established by the Ministry of Agriculture, Forestry and Fisheries Notification, Govt. of Japan.

**I. Areas:** The designated areas listed below fall under the pest control programme agreed to between Ministry of Agriculture Forestry & Fisheries, and the Indian Plant Quarantine Authority.

- (1) Andhra Pradesh
- (2) West Bengal
- (3) Uttar Pradesh
- (4) Gujarat
- (5) Maharashtra

## **II. Disinfestation Facilities:**

- (1) The mangoes to be exported are to be processed in the Vapour Heat Treatment facility set up at Vashi, Mumbai. The capacity of the said commercial facility is approximately 1.5 MT. per batch.

## **III. Packing and place of packing**

### **(1) Packaging:**

- A. The fruit shall be packed in a plastic bag (air holes of the bag must be less than 1.6 mm in diameter) and then packed in a box with ventilation.
- B. Ventilation holes of the package shall be screened (diagonal of the screen must be less than 1.6 mm).
- C. Package or bundled packages shall be fully covered with screen (Diagonal of the net must be less than 1.6 mm).

### **(2) Place of packing:**

- A. It shall be located near the disinfestations facilities. Windows and any other openings shall be screened (diagonal of the screen must be less than 1.6 mm) in order to prevent infestation by fruit flies.
- B. It shall be used exclusively for packing disinfested fresh fruit of mango, during the mango export season.
- C. It shall be disinfested with insecticides prior to its use each year and shall be disinfested as often as necessary.

## **IV. Inspection and confirmation of the Enforcement of Disinfestation**

- (1) The confirmation of inspection as per the Notification shall be conducted so that the fresh fruits of Mango shall be disinfested with saturated vapor in the vapor heat treatment facilities in the following manner:
  - A. Confirm that after the temperature of the treatment chamber has been stepped up to 50 degrees centigrade, and has been kept at that temperature, the temperature of the innermost fruit pulp shall be raised to 47.5 degrees centigrade and kept at that

temperature or higher for 20 minutes, and the accuracy of the calibration of the thermometers shall be confirmed.

- B. Confirm that the monitoring points of the innermost fruit pulp temperature are set appropriately and so on.
- C. Confirm the accuracy of reading of thermometers just before the vapor heat treatment.

(2) Confirmation of export inspection

- A. The confirmation of inspection shall be carried out by the Indian Plant Quarantine Authority on 5 per cent or more of the total number of fresh mango packages, and shall be confirmed by the Japanese inspector to determine the absence of any quarantine pests or diseases, especially fruit flies.
- A. If any fruit flies are found as a result of the inspection mentioned at point A, the cause of such infestation shall be studied jointly by the Indian Plant Quarantine Authority and the Japanese Inspector, and until the reason for the infestation has been clarified, any disinfestation to be conducted after such infestation shall not be confirmed for export to Japan.
- c. Upon confirming that the vapor heat treatment has been carried out completely in accordance with IV(1) and that no quarantine pests are present in accordance with IV(2) A, the Japanese Plant Quarantine Officer shall sign and put the seal on the blank space of Phytosanitary Certificate.

- (3) Confirmation Procedure: As a rule the confirmation procedure set forth in IV (1) and IV (2) shall be conducted jointly with Indian Plant Quarantine Authority

**V. Indication:** Indication of the fruit and the package of the Notification shall be according to the following format. Each package shall bear a mark at easily recognized place such as on its sides.

- A. Indication for the fruit which passed export
- B. Indication for the package showing its destination

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| <p><b>CLEARED BY<br/>PQ INDIA FOR<br/>JAPAN</b></p> |
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## **VI. Inspection of Imports**

- (1) Inspection of imports shall be conducted at the port of entry after confirming that a phytosanitary certificate is accompanying the fruit consignment.
- (2) Non conformity of the notification in the following cases would lead to an order by Import Inspection authority for the fruit concerned to dispose off or sent back: -
  - i) Phytosanitary certificate does not accompany the fruit consignment.
  - ii) No confirmation by the Japanese plant quarantine inspector.
  - iii) The package is not sealed and stamped.
  - iv) No proper marking has been made.
  - v) The package is broken.
- (3) In addition to the specific inspection procedures and methods outlined in VI(1) and VI(2), all other applicable requirements provided for under the Plant Quarantine Law Enforcement Regulations and the Imported Plant Quarantine Regulation shall also be enforced.
- (4) In case fruit fly is found, the following measures shall be taken:
  - (A) It should be ordered that package concerned be disposed of or sent back
  - (B) The cause of any such infestation of fruit fly shall be examined jointly with the India Plant Quarantine Authority and any import inspection made thereafter shall be suspended until the cause of such infestation is clarified.

**VII.** Food safety and hygiene is one of the important aspect for Import of mangoes by Japan. Hence, residue testing is mandatory through lab's accepted by Japan.





