POSTHARVEST LOSS ASSESSMENT OF MANGO (*Mangifera indica* L.) FRUITS-CAUSES, LOCATION AND QUANTITY

R. N. SRINIVAS

DIVISION OF HORTICULTURE
UNIVERSITY OF AGRICULTURAL SCIENCES
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R. N. SRINIVAS

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Affectionately Dedicated to

My Beloved Parents

UNIVERSITY OF AGRICULTURAL SCIENCES
DIVISION OF HORTICULTURE

BANGALORE

CERTIFICATE

This is to certify that the thesis entitled POSTHARVEST LOSS ASSESSMENT OF MANGO (*Mangifera indica* L.) FRUITS - CAUSES, LOCATION AND QUANTITY" submitted by Mr. R.N. SRINIVAS in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE (HORTICULTURE) in POSTHARVEST TECHNOLOGY OF HORTICULTURAL CROPS to the University of Agricultural Sciences, Bangalore, is a bonafide record of research work carried out by him during the period of his study in this University under my guidance and supervision and that no part of this thesis has been submitted for the award of any other degree, diploma, associateship, fellowship or other similar titles.

Bangalore
January 11 ,1994

(Dr. T.V. REDDY)
(Major Advisor)
Associate Prof.of Horticulture
(Postharvest Technology)

APPROVED BY :
Chairman : (T.V. REDDY)

Members : 1. (K.R.THIMMARAJU)
: 2. (P.C. RAVI)
: 3. (LALITH ACHOTH)
: 4. (B.V. CHINNAPPA REDDY)

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

INTRODUCTION

I INTRODUCTION

Mango (Mangifera indica L.) which belongs to the dicotyledonous family Anacardiaceae, is a native of Indo-Burma region and grows wild in the forests of India. In the Indian sub-continent it is under cultivation for over 4000 years. Mango is decidedly the most popular tropical fruit in the world and has been rightly described as "King of Fruits". It is greatly relished for its succulence, exotic flavour and delicious taste. It is also a rich source of vitamins A and C.

Mango is grown at altitudes from sea level up to 1000 metres. The optimum temperature range for better growth and production is 24°C to 27°C and it can tolerate temperature as high as 48°C. It can perform well in areas having an average rainfall of as low as 25cm and as high as 200cm. Owing to its good performance in dry tracks it is becoming popular as a dryland horticultural crop. Mango thrives well on a wide variety of soils, while water logged condition and too alkaline or rocky soils are unsuitable. Thus there is scope for large scale planting of mango in areas receiving less rainfall in the country provided the temperature and soil conditions are favourable for its growth.

India is the leading mango growing country in the world. At present, in India, mango occupies an area of 10.63 million hectares out of total fruit crop area of 24.87 million ha and production of 9.33 million metric tonnes out of the total fruit

production of 22.16 million metric tonnes (Chadha,1990). Mango occupies about 40 per cent of the total area under fruit crops grown in India. India contributes about 65 per cent of the total mango production in the world. Ripe fruits are eaten as a dessert fruit and are also used in the preparation of juice, squash, jams, jellies and preserves and they can also be canned in syrup. Unripe fruits are used in the preparation of pickles, chutney and other culinary preparations. Mature raw fruits are sundried and seasoned with turmeric to produce "anchur" which is ground into powder and is used in flavouring soups.

Though there are more than 1000 named varieties of mango in India only a few varieties like Alphonso, Pairi,Dashehari,Langra, Fazli, Chausa, Baneshan, Totapuri and Neelum are commercially important. Of these, Dashehari ,Langra and Chausa are popular varieties of Northern region; Langra and Fazli are popular varieties of Eastern region; Alphonso and Pairi are popular varieties of Western region; and Totapuri, Neelum and Baneshan are the important varieties of South India.

The leading mango growing states in India are Uttar Pradesh (44.48%), Andhra Pradesh (13.13%), Bihar (12.29%), Orissa (7.64%), Kerala (5.07%) and Karnataka (4.82%), which together account for 87.4 per cent of total area under this fruit. In Karnataka it is mainly grown in Kolar (35%) followed by Tumkur (9.3%), Bangalore rural (8%) and Dakshina kannada (5%).

Mango is a high value commodity grown extensively in Srinivaspur taluk (45-50%) in particular and Kolar district in general. The other mango growing areas in Kolar district are Chintamani, Mulbagal, Bangarpet and Kolar taluks with some area in Chickballapur, Malur and Bagepally taluks.It has considerable export potential both in its processed and raw forms. Due to lack of precise appraisal of the extent of loss in quantity and consequent value due to the faulty postharvest practices, the farmer is ignorant of the extent of loss he is incurring as a result of neglecting the postharvest technology.

The postharvest loss of fruits and vegetables in developing countries have been reported to vary between 15 and 50 per cent with an estimated minimum of 20 per cent at different stages of marketing (Subramanyam, 1986), i.e., at the time of harvest, during transportation, storage, processing,packing and marketing. The work done so far relates to only very few horticultural crops and that too in a few states and has indicated that there is considerable loss after harvest in all these crops, but we do not know the extent of losses in each for various fruits in different locations. In this direction, not much work has been done on mango, banana and other tropical and sub-tropical fruits.

This study would shed light on the nature and extent of losses being sustained by the mango growers and traders at various stages, so that necessary correct measures may be advocated which may go a long way in reducing the magnitude of such losses. In

view of this the present study was designed with the following specific objectives.

1. To estimate the extent of fruit loss and its value during marketing, transportation and at various stages of marketing.

2. To study the nature of the postharvest losses.

3. To identify the factors responsible for postharvest losses.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

A number of studies have been conducted on postharvest losses of fruits and vegetables but there are few studies relating to the postharvest losses of Mango. However, a brief review of the literature pertaining to postharvest losses of various fruits and vegetables is presented under the following headings.

2.1 Postharvest losses in mango.

2.2 Postharvest losses in other fruit crops.

2.3 Postharvest losses in vegetables.

2.1 Postharvest losses in mango

A survey on mango in Malda district (West Bengal) shows an average loss of 6.72 to 9.54 per cent of total plucked fruits and 6.9 to 15.35 per cent of transported produce (Anon,1964 & 1965).

Ratnam and Nema (1967) have assessed loss from stores and markets in Jabalpur (MP) for the period between July 1964 and March 1965 and determined an overall loss of 23.3 to 29.8 per cent of the total mango fruits handled.

A survey was conducted on postharvest diseases in mango in Warangal district (AP) during April to July in two successive years 1975 and 1976. The reported losses may be summarised as follows for 1975 and 1976 respectively: April (5.3%,5.9%), May (11.4%,11.5%), June (21.4%,21.5%) and July (26.5%,25%) (Lakshminarayana and Reddy,1977).

The survey conducted on `Banganapalli' variety of mango in Andhra Pradesh showed that around 20.8 per cent (5% field/orchard, 15.8% market) of the mangoes were lost due to faulty handling in the distribution system. Economic loss on account of this was around Rs. 500/- per tonne (Madan,1988).

A survey conducted on the postharvest loss of Dashehari variety of mango in U.P and Totapuri variety in Karnataka and Tamilnadu has shown total postharvest loss of 29 per cent (14% field and 15% at the time of ripening) valued at Rs. 337 per tonne and 9per cent (3.5% field and 5.6% at the time of ripening) valued at Rs.140 per tonne for the two varieties, respectively (Madan and Ullasa,1988).

2.2 Postharvest losses in other fruit crops

Le Clerg (1964) reported an average total loss of about 12 per cent in fruits in USA.

Braverman (1949) reported that citrus cullage loss was upto 30per cent even in more developed counties of the mediterranean region.

Bractly and Wiant (1950) reported that losses due to decay was more in grapes (3.5%), apples (2.5%), strawberries (2.4%), peaches (1.9%) and oranges (1%)

A survey on Mandarin orange in Malda district (West Bengal)

reported an average loss of 20 per cent (13% alone at the terminal point) (Anon,1964 and 1965).

Ratnam and Nema (1967) have assessed the losses from stores and markets in Jabalpur (M.P) for the period between July 1964 and March 1965 and estimated fruitwise as well as monthwise overall losses separately.

Their results may be summarised as follows. The postharvest loss in apples was 12.4-26.7 per cent, in banana 15.3-26.7 per cent, in citrus 14.05-23.2 per cent.in pear 10.32-23.4 per cent and month wise overall loss for July was 19.2 per cent, August 23.05 per cent, September 26.72 per cent,October 24.5 per cent, November 21.15 per cent, December 13.96 per cent,January 17.97 per cent and March 21.97 per cent.

Biswas (1969) in a study on transport losses of oranges to Varanasi found that losses varied from 6 to 30.7 per cent depending upon the transport, transit time and season. A recent study conducted by the directorate of marketing and inspection put the transit losses of oranges at 8-28 per cent depending upon the mode of transport.

Ceponis and Butterfield (1974d) studied the condition of western grown pears in metropolitan Newyork super markets and in consumer samples. Retail losses totalled 4.9 per cent, 2.5 per cent and 1.9 per cent in Bose, d'Anjou and Bartlett pears respectively, and wastes in consumer samples were 5.2 per

cent,1.6 per centand 4.0 per cent, respectively. Most of the loss was caused by mechanical injury in retail samples and by internal breakdown in consumer samples.

Sparks (1976) reported that market losses of various fruits in Chicago area ranged from 41.2 per cent in strawberries, 28.9 per cent in peaches, 8.2 per cent in apples and 5.9 per cent in oranges. At consumer level, the losses were more when compared to the wholesale and retail market and the losses due to the physical factors were more when compared to the parasitic and nonparasitic factors.

In developing countries postharvest losses of individual fruits have been reported and vary from minimum of 14 per cent in apples to as high as 100 per cent in papaya (Anon., 1978).

The most current and accurate measures of postharvest losses may be obtained based on estimates from samples of fruits taken in the New York metropolitan area at wholesale, retail and consumer levels. The losses were severe in strawberries (22.9%), heavy in peaches (12.6%) and pears (10%), lowest in apples (3.6%) and oranges (4.2%) (Harvey,1978).

Fresh fruits purchased during 1978 and 1979 at retail in a major midwestern market included substantial proportions that had to be trimmed or discarded, because they showed defects of parasitic(PA), physiological(PL) and physical(PY) origins. Of the commodities studied,the losses measured in the portions discarded

or trimmed and the major factors responsible for losses were as follows; Western apples - 9.4 per cent(PL & PY), Pears - 4.85 per cent (PL & PY), Cherries - 15.8 per cent (PL), Grapefruit - 0.3 per cent (PL), Peaches - 17.4 per cent (PL), Florida oranges 13.5 per cent (PL) and Navel oranges 7.2 per cent (PL) (Beraha et al., 1981).

Ceponis and Butterfield (1981) estimated the retail and consumer level losses of western sweet cherries in metropolitan New York during 1977-80 at 9.9 and 12 per cent, respectively. More loss was observed in store-prepacked consumer samples than in consumer samples obtained from bulk displays. Half of the loss at each level resulted by mechanical injuries.

Mandal and Dasgupta(1981) conducted a survey of six markets in West Bengal during 1977 and 1978. They reported that loss in any particular commodity on any particular date of survey was as high as 60 per cent. The crops which suffered an overall loss of 25 per cent or more included mandarin orange, sweet orange, banana, guava, apples, pear, grape and papaya(green).

In consumer samples, an average of 15.2 per cent defective fruit of blueberries was observed in greater New York super markets during 1978-1980. Fungal decay ,overripe, shrivelled and mechanically injured berries accounted for much of the remainder (Cappellini et al.,1982).

At New york and Chicago markets, the losses in fruits at

consumer level were generally two fold greater than the losses for the same crops at retail level. In case of Red Delicious apples the losses were 0.2 per cent in retail level and 2.4 per cent at consumer level, for oranges 0.8 per cent in retail level as against 3.7 per cent in consumer level and for strawberry 5.5 per cent in retail level and 18 per cent in consumer level. Physical damage was the leading cause of loss at retail level whereas parasitic diseases were responsible for most of the losses in the consumer samples. (Cappellini and Ceponis,1984).

The wholesale and retail losses in grapefruit marketed in metropolitan Newyork market area varied from 2.7 per cent to 3.1 per cent (Ceponis and Cappellini, 1985).

Adikaram (1987) conducted survey on postharvest losses of some fruits and vegetables in the central province of Srilanka. The total losses ranged from 5 to 25 per cent for most of the crops. A part of these losses occured during transport of the product to the market but a large proportion of this took place during storage on the market shelves. The average loses varied with the type of fruit, the method of harvest and postharvest handling, the mode of transport and storage practices. Fruits such as grape, banana, guava, and papaya etc., were usually subject to higher postharvest losses in the market shelves.

A survey conducted in Andhra Pradesh, Maharastra and Karnataka to document the package of practices, to assess postharvest losses and to identify the causes of losses in banana,

in the 'commodity movement system' had revealed that 9-15 per cent (2-3% field, 3-5 per cent primary market, 4-7 per cent in ripening/retail) of the harvested produce goes out of the regular marketing and the rest was sold for 60 per cent reduced price. The observed losses at retail level were due to quality of pre-ripening and postharvest practices followed (Madan,1988).

2.3 Postharvest losses in vegetable crops

Bractly and Wiant (1950) reported that losses due to decay was more in case of lettuce (11.5%) when compared to peppers (3.6%), cucumbers(2%) and potatoes(1%).

According to Pushkarnath and Srivastava (1966) losses in plains were upto 100 per cent under ordinary storage conditions, while in hills such losses amounted to only 20-25 per cent in potatoes.

Coursey and Booth (1972) reported a total loss of 50 per cent in case of chillies.

Ceponis and Butterfield (1974a) stated that bacterial softrot and mechanical injury caused most of the culls in shipment of Florida bell peppers to the Newyork city terminal market. These conditions along with desiccation also were most damaging in greater Newyork retail stores. Cull incidence rose from 7.1 per cent in wholesale market to 9.2 per cent in retail level.

Ceponis and Butterfield (1974b) reported that retail losses in Florida cucumbers and bell peppers in seven metropolitan Newyork retail stores totaled 5 per cent and 9.2 per cent,respectively, in the three marketing seasons of 1970-1973. Wastage in consumer samples held for 3 days at 39°F totaled 2.9 per cent and 1.4 per cent in cucumbers and peppers, respectively. Decay, mechanical injury and chilling were the major causes of losses. Desiccation also caused significant losses in bell pepper.

Retail losses totaled 5.9 per cent in dry type and 5.4 per cent in moist type sweetpotatoes in seven representative metropolitan Newyork super markets during 1970-73. Losses in consumer samples purchased in 6 stores were 10.7 per cent in dry type and 8 per cent in the moist type after being held for 4 days at 21°C. Rhizophus softrot, mechanical injury and desiccation were the leading causes of losses in retail stores. Rhizophus softrot and hardcore disorder caused most of the loss in consumer samples (Ceponis and Butterfield,1974c).

Postharvest loss in tomato range from 15 to 20 per cent in Maharastra and 4 to 10 per cent in Uttar Pradesh (Jamaludin and Tandon,1976).

Parpia (1976) stated that loss estimation is a tedious task and in perishables the estimations are not as precise as they are in the durable commodities. The available statistics on post harvest losses are limited and fragmentary. The losses are highly

locality specific, level of loss acceptable and perception about loss differs greatly from market to market.

Veno (1976) evaluated the margins of profit during winter and summer in 3 kinds of enterprises. Highest losses occured in super markets. Green onions, tomatoes, sweetpotatoes and watermelons were among the products exposed to greater losses. Tomatoes showed an average loss of 0.16 kg per kg during trading (sorting and marketing).

Postharvest losses of individual vegetables in India have been reported for various crops which ranged from as low as 5 per cent in potato to as high as 100 in plantain (Anon., 1978).

A study made on problems of marketing of vegetables in Bangalore indicated that retail level loss was 6 to 9 per cent depending upon the Vegetable (Gopal,1978).

The most current and accurate measures of postharvest losses were those derived from samples of vegetables taken in the Newyork metropolitan area at whole sale, retail and consumer levels. The losses were heavy in lettuce (11.7 %) and tomatoes(14.2%), moderate in cucumber (7.9%), lowest in potatoes (4.3%) (Harvey,1978).

Asuncian and Cungihas (1984) reported that as the distance increased by 100 km the transport loss is correspondingly increased by 9 per cent in cabbage, 5.03 per cent in carrots,

2.75 per cent in potatoes and 13.4 per cent in lettuce. Type of transport such as Jeep or truck had no significant effect on the transport loss of the vegetables. The main factors contributing to transport losses were packaging materials, weather conditions and delayed marketing.

A survey made at New York and Chicago markets in vegetables indicated that retail level losses ranged from 14.6 per cent in lettuce, 9.2 per cent in bell peppers to 6.7 per cent in tomatoes. For most crops parasitic diseases were the important cause of loss both at retail and consumer level (Cappellini and Ceponis, 1984).

Salunke and Desai (1984) reported that postharvest losses of perishable crops in developing countries have been estimated to be 5 to 50 per cent or even more because of their high moisture content. Fresh fruits and vegetables are very susceptable to the attack of pathogenic fungi and bacteria during the period between harvest and consumption.

Pantastico and Bautista (1986) reported that the postharvest waste among vegetables may range from 22 to 78 per cent. When movement was delayed on a daily basis losses ranged from 3 to 11 per cent. The major loss was due to decay, overripening, mechanical injury, weightloss, sprouting,browning and culls.

Vijaysethi and Maini (1989) reported that in India due to improper handling, transport, storage and marketing conditions

about 20-30 per cent net postharvest loss occurs. The major causes of loss in order of importance are mechanical injury, waterloss, shrivelling, overripening, sprouting, rooting, high respiration rate and decay.

Nevertheless, experts with long experience in the field have estimated 20-30 per cent losses in fruits and vegetables under Indian conditions (FAO,1977).

The extent of loss is highly varying depending on number of factors. The perishable foods such as fruits and vegetables spoil quickly unless given special treatment such as canning and freezing (Anon., 1981).

Madan (1990) reported that in onion the estimated loss at the farm level ranged from 5 to 14 per cent of the total produce harvested in the form of unmarketable size and shape, injured and rotten bulbs. Percentage of loss due to rotting ranged from 2 to 4 per cent at the field and 2 per cent at retail level.

METHODOLOGY

III METHODOLOGY

This chapter describes the procedure adopted in investigating the various aspects of estimating the postharvest losses in mango at different stages starting from harvesting until the fruit reached the consumer under the following headings.

3.1 Description of the study area

3.2 Sampling Procedure

3.3 Data collection

3.4 Method of analysis.

3.1 Description of study area

The study was undertaken in Srinivaspur taluk of Kolar district, one of the important mango growing taluks in the state (Fig-1). It is located at a distance of 104 km from Bangalore and 30 km North of Kolar, bordering Andhra Pradesh in North East. The total area of the taluk is 855.6 sq km.

The population of the taluk is 1,62,846 persons out of which 82,785 are ,males and 80,061 females. The source of irrigation is mainly through tanks and bore wells.

Most of the cultivated area is under rainfed. The soils mostly fall under red, sandy and gravelly types, they are well drained, fairly high in plant nutrients. The rainfall is moderate and ranges from 786.4mm to 800mm. The major portion of rainfall is

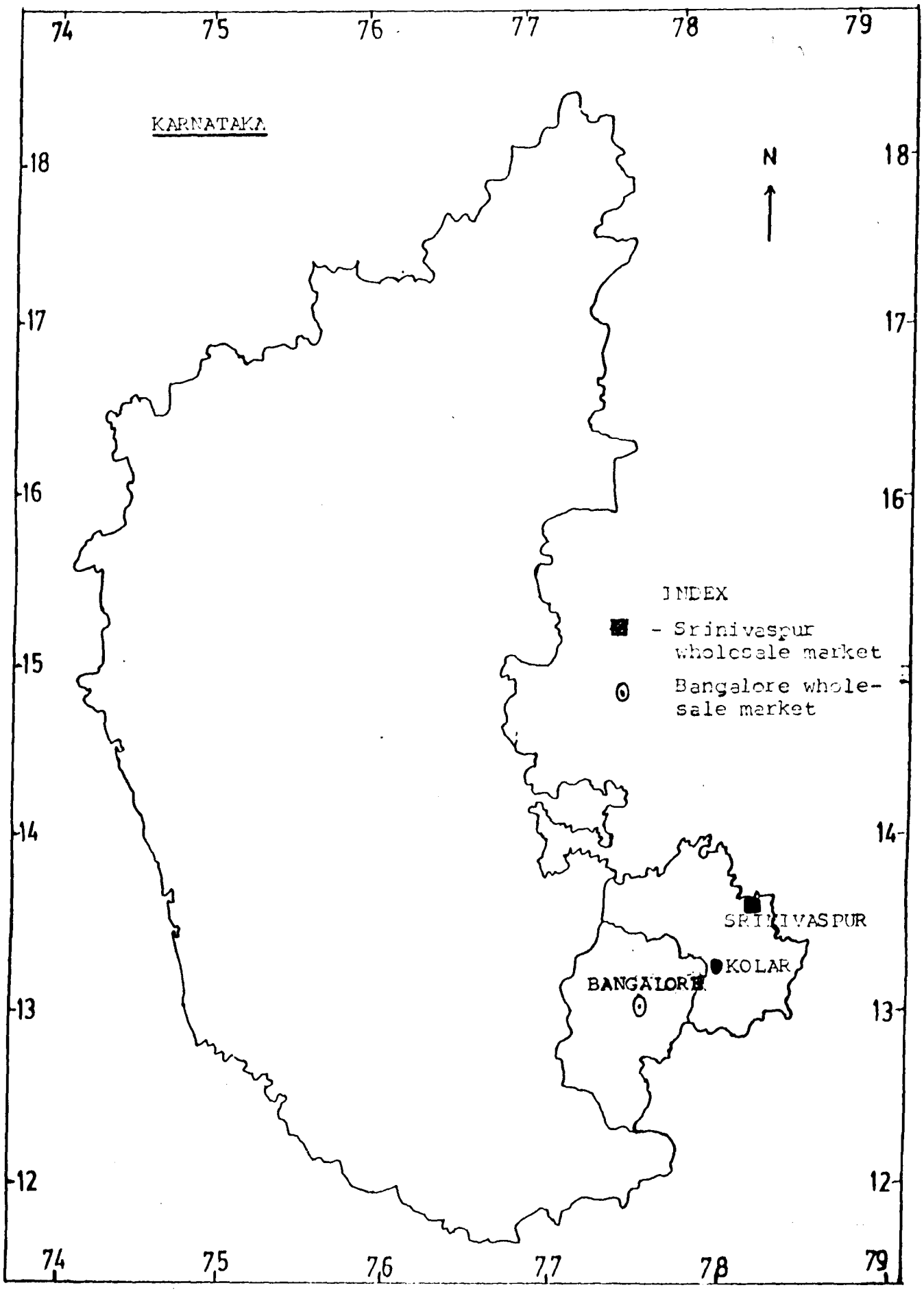


FIG.1 Area selected for study, was Srinivaspur Taluk of Kolar district in Karnataka State.

received from South-West monsoon which usually commences during May and persist till the end of November. The cold weather sets usually in November and lasts till February. This is followed by hot weather which reaches peak towards the end of May. The average maximum and minimum temperatures recorded are in the range of 32.9 degree celcius and 14.5 degree celcius, respectively.

The main cropping season starts from May and close by September end and the second season, being considered as rabi or summer, usually lasts upto March. The major crops grown in the taluk are ragi (12,283 ha), paddy (615 ha), hybrid maize (182 ha), groundnut (8,211 ha), minor millets (176 ha), and some pulse crops like red gram (1,112 ha), cowpea (280 ha), avare (876 ha), horse gram (513 ha). The important vegetable crops like tomato (62 ha), potato (160 ha), chilli (20 ha), brinjal (18 ha), french bean (20 ha), cabbage (15 ha) and onion (45 ha). In addition to these crops several perennial crops like mango (11,898 ha), sapota (78 ha), tamarind (1996 ha), cashew (330 ha) are also grown. Among fruit crops mango is an important one which is grown on an area of 11,898ha out of 12,038 ha of total area under fruit crops in the taluk with an estimated production of 65,439 tonnes. The agroclimatic conditions prevailing in the taluk favours the large scale cultivation of mango.

3.2 Sampling Procedure

The present study was focusses on estimating the magnitude of

Table 1 Taluk wise area and production of mango in Kolar district during 1992 - 93

Taluk	Area (ha)	Production (tonnes)
Bagepally	500	2,750
Bangarpet	1,433	7,881
Chickballapur	542	2,981
Chinthamani	5,202	28,611
Gowribidanur	1,242	6,831
Gudibande	60	330
Kolar	1,825	10,037
Mulbagal	2,050	11,275
Malur	500	2,750
Sidlaghatta	542	2,981
Srinivaspur	11,898	65,439
Total	25,794	1,41,866

(State Department of Horticulture)

postharvest losses in mango. It was ascertained from the state department of horticulture that Srinivaspur taluk ranked first in the area as well as production of mango (Table-1) in Kolar district.

A list of 12 mango growing villages in Srinivaspur taluk were selected at random. Further enquires from the preliminary visits to the selected villages indicated that atleast 50-60 per cent of the farmers were having mango orchards. To have a better representation of mango growing farmers, it was decided to select atleast 5-6 mango growing farmers from each of the selected villages. A total of 50 mango growing farmers as well as preharvest contractors were selected for the purpose of the study. The list of selected villages and number of farmers selected from each village is presented in Table 2.

3.3 Data collection

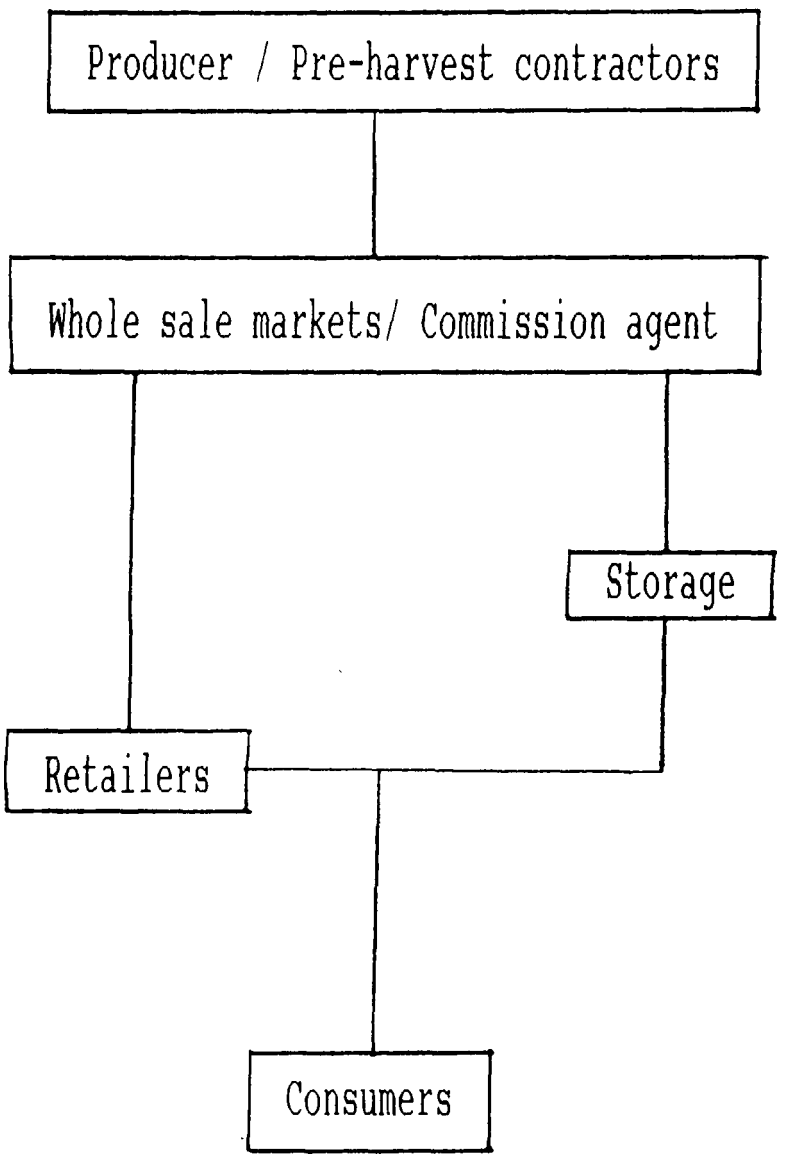
The study was conducted in Srinivaspur taluk of Kolar district as it is one of the important mango growing taluks in the state. The study was carried out at three stages. The first stage was immediately after harvest at the farm itself. The second stage was during transit to the markets both to Srinivaspur and Bangalore. The third stage was at the market itself including wholesale and retail markets. The postharvest channel of distribution of mango in the study area is shown in Fig.2.

The nature and extent of loss due to damage, spoilage etc.,

Table 2 Details of sample selected for the study

Name of the Village	No. of farmers selected
Arikunte	5
Champally	5
Chikkathimmnahalli	5
Dimbala	5
Doddapally	5
Kaniganally	5
Kotapally	4
Locharuvapally	4
Naramakalahally	4
Ronur	4
Seegahally	4
Grand Total	50

Fig. 2 . Postharvest channel for distribution of mango in Kolar and Bangalore districts in Karnataka State



and loss in value associated with these losses were quantified by drawing samples and also based on perception of the marketing functionaries. The analysis covered two important varieties grown in the selected area viz., Totapuri (Bangalora) and Alphonso (Badami). Packing,mode of transportation and method of harvesting followed were evaluated separately by drawing samples at each stage to identify possible reasons for the deterioration and damage of fruits.

A multistage sampling technique was employed. At the first stage about 50 farmers were interviewed and the extent and value of loss was estimated. About 50 lots were examined both at Srinivaspur and Bangalore wholesale markets, separately for periods extending from time of loading in the market upto 4-5 days (till it was sold). The loss due to spoilage and loss in value were documented both at Srinivaspur and Bangalore markets. A random sample of 20 retailers selected from Bangalore was drawn who were interviewed to estimate the losses at the retail level. Data were collected using standard questionnaire, a copy of which is reproduced in Appendix I.

3.4. Method of analysis

Simple tabular analysis and regression analysis were employed to quantify the losses and to identify the factors contributing to the loss in value both for Totapuri (Bangalora) and Alphonso (Badami).

RESULTS

IV RESULTS

The study was conducted with the primary objective of assessing the postharvest losses in mango. Three important postharvest stages have been identified and the losses are assessed at each step. These are harvesting, transportation and marketing. The results of the study are presented under the following headings.

4.1 Losses during harvesting

4.2 Losses at wholesale market including transportation

4.3 Losses during storage

4.4 Losses at the retail level

4.5 Overall losses

4.6 Factors influencing postharvest losses.

4.1 Lossess during harvesting

In Srinivaspur Taluk most of mango growing farmers follow manual harvesting, where labourers harvest the fruits using bamboo wooden stick with hook at the end with which the fruits are pulled down from the tree (Plate No. 1). Some labourers shake the branches during the harvesting. After harvesting the entire orchard, the fruits are collected (Plate No. 2) with the help of baskets and heaped (Plate No.3) temporarily in common place. At the time of harvesting, the damaged, over ripened and spoiled fruits are discorded (Plate No. 4).

Plate No. 1: Harvesting operation in mango in Srinivaspur taluk
In Srinivaspur taluk most of mango growing farmers follow mannual harvesting, where labourers harvest the fruits using bamboo wooden stick with hook at the end with which the fruits are pulled down from the tree.

Plate No. 2 : collection of fruits after harvest.
After harvesting the whole mango orchard, the fruits are collected with the help of baskets.

Plate No. 3: Temporary heaping of fruits in the orchard.
After harvesting, the fruits are collected and temporarily heaped in the orchard.

Plate No. 4 : Overripened, spoiled and damaged fruits (due to birds and harvesting)
At the time of harvesting, the damaged, overripen.d and spoiled fruits contribute to major losses

Table 3 Losses during harvesting in Totapuri (Bangalora) and Alphonso (Badami) varieties of mango

	Qty. (Kgs)	Per cent loss	value @ (Rs.)
	Totapuri (Bangalora)		
Quantity harvested	3,66,500		10,99,500
Losses due to			
Mechanical Damage/breakage	2,695	0.73	8,085
Diseases/spoilage	5,185	1.41	15,555
Damaging by birds	730	0.20	2,190
Over ripening	2,515	0.68	7,545
Pilferage	775	0.21	2,325
Hail storm	1,025	0.28	3,075
Total loss	12,925	3.52	38,775
	Alphonso (Badami)		
Quantity harvested	84,200		5,89,400
Losses due to			
Mechanical Damage/breakage	673	0.80	4,711
Diseases/spoilage	577	0.68	4,039
Damaging by birds	220	0.26	1,540
Over ripening	112	0.13	784
Hail storm	30	0.04	210
Total loss	1,612	1.91	11,284

@ Rs.3 per kg for Totapuri and Rs.7 for Alphonso

Losses during harvest were quantified and were based on the damages sustained at the time of harvesting. It was observed that in case of Totapuri out of 3,66,500 kg (366.5 tonnes) harvested in the samples about 12,925 kg (12.925 tonnes) were wasted which accounted for about 3.52 per cent (Table 3).

The major loss was due to diseases or spoilage. About 5,185 kg of Totapuri fruits were spoiled which accounted for about 1.41 per cent. The loss due to breakage or mechanical injuries was 2,695 kg (0.73 %), due to overripening 2,515 kg (0.68%), due to damage by birds 730 kg (0.20 %), pilferage 775 kg (0.21%) and due to hailstorm 1,025 kg (0.28%). The estimated total loss in terms of value was about Rs. 38,775 out of total harvested fruit valued at Rs.10,99,500 (Table 3).

In case of Alphonso variety, out of 84,200 kg harvested in the samples about 1,612 kg was wasted which accounted to about 1.91 per cent. The losses due to mechanical damage was 673 kg (0.8%), due to spoilage 577 kg (0.68%), overripening 112 kg (0.13%) and due to hailstorm 30 kg (0.04%). The total loss in terms of value was around Rs. 11,284 out of a total harvested fruit value of Rs. 5,89,400 (Table 3)

In Srinivaspur taluk the disposal of crop is done in two ways. One method is by selling the entire orchard at the time of fruit set to pre-harvest contractors, some time by open auction also, in such cases the pre-harvest contractors who purchases the orchard will look after all the necessary operations such as plant

Plate No. 5 : Loading of mango fruits at the orchard
The fruits are directly dumped into lorry without any packing

protection sprays (if necessary), watch and ward and harvesting of the fruits. The second method of crop disposal is by the farmers themselves, who take up for the necessay operations such as plant protection sprays, watch and ward and harvesting. Only after harvesting the farmers sell the produce to wholesalers. Currently about 75 per cent of mango growers are harvesting the produce themselves. While hardly 25 per cent orchards are being sold to the pre-harvest contractors.

In case of pre-harvest contractors, out of 1,51,500 kg fruits harvested, 5,145 kg were lost which accounted for nearly 3.39 per cent which is in terms of value, was about Rs. 15,435 for Totapuri (Table 4). In Alphonso, out of 33,250 kg fruits harvested, 675 kg (2%) were wasted. The loss in terms of value was about Rs. 4,725.

In case of postharvest sellers, out of 2,10,500 kg of Totapuri harvested, nearly about 7,635 kg (3.62%) fruits were lost, which in terms of value was about Rs. 22,905. In Alphonso out of about 50,950 kg harvested in the sample farms nearly 1,022 kg (2%) fruits valued at about Rs. 7,154 was lost (Table 4).

4.2 Losses at wholesale market including transportation

After harvesting, most of the farmers transport the fruits to the markets in lorries, some times in trucks. While loading, the fruits are directly dumped into lorry without any packing (Plate No.5). At the time of unloading the fruits in the wholesale

Table 4 Comparison of mode of marketing and loss in Totapuri and Alphonso varieties of mango

Mode of marketing	Quantity harvested	Loss in Qty.(Kg)	Percentage loss	Loss in value (Rs)
1. Preharvest contractors				
Totapuri	1,51,500	5,145	3.39	15,435
Alphanso	33,250	675	2.03	4,725
2. Postharvest selling (Farmers)				
Totapuri	2,10,500	7,635	3.62	22,905
Alphanso	50,950	1,022	2.00	7,154

Plate No. 6 : A view of Srinivaspur wholesale market
At wholesale market, at the time of unloading, the damaged, overripened, immature and unsized fruits are sorted out.

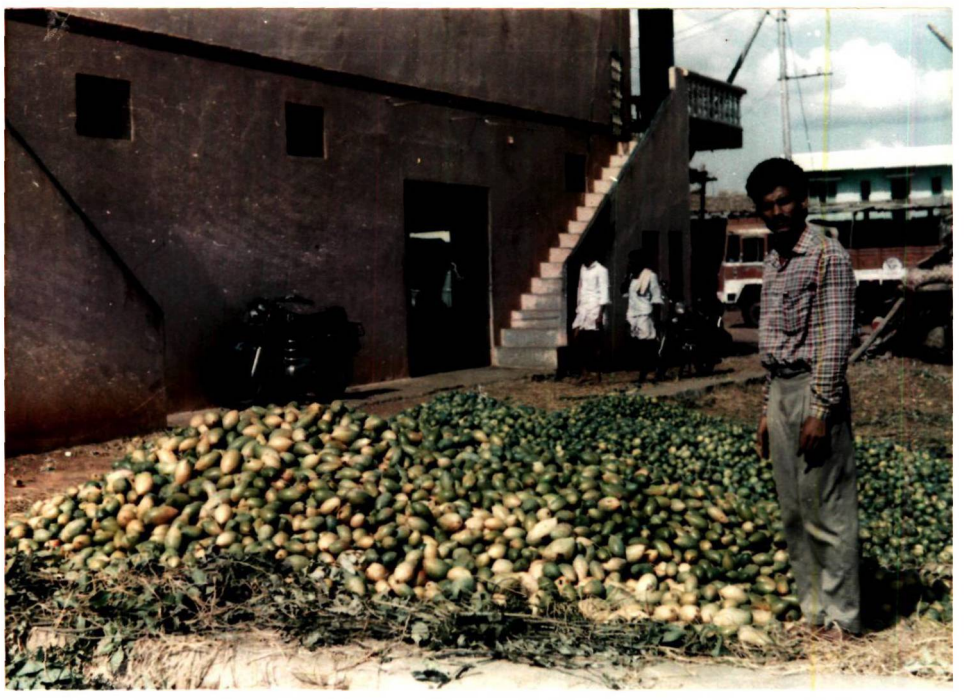


Plate No. 7 : Damaged and sorted fruits at wholesale market
At wholesale market damaged, overripen, immature and unmarketable size fruits contribute to major losses.

market, the damaged, over ripened, immature and unmarketable size fruits are seperated out (Plate No. 6&7).

Losses in the wholesale market including transportation were quantified in both Srinivaspur and Bangalore wholesale markets. In case of Totapuri the total quantity transported was 3,38,500 kg out of which 16,690 kg (4.93 %) was lost (Table 5). The major loss was due to mechanical damage 4,230 kg (1.25 %), followed by overripening 3,620 kg (1.07 %) and spoilage 2,615 kg (0.77 %); immature and unmarketable sized fruits were 6,225 kg accounting to 1.84 per cent. The total loss in terms of value was around Rs. 50,070 accounting for 4.93 per cent of the total value (Table 5).

In case of Alphonso out of 93,800 kg transported in the sample, totally about 3,450 kg was lost which was around 3.67 per cent. The major loss during transportation was due to mechanical damage or breakage which was about 1,545 kg (1.64 %) followed by spoilage 1,240 kg (1.32 %), overripening 495 kg (0.52 %), immature and unmarketable size 170 kg (0.18 %). The total loss in terms of value was around Rs. 24,150 (Table 5).

When mangoes were transported to Srinivaspur wholesale market, the losses were less when compared to Bangalore wholesale market due to shorter distance (Table 6). When farmers brought their produce within the radius of 15 km to the Srinivaspur market, the time taken including loading and unloading took a minimum of 2 hours and a maximum of 3 hours and 30 minutes. Out of 2,02,500 kg Totapuri mango fruits transported to Srinivaspur

Table 5 . Postharvest losses including transporation in Totapuri and Alphonso varieties of mango at wholesale market

	Quantity (Kgs)	Per cent loss	value (Rs.)
	Totapuri		
Quantity harvested	3,38,500		10,15,500
Losses due to			
Mechanical Damage/breakage	4,230	1.25	12,690
Spoilage due to diseases	2,615	0.77	7,845
Over ripening	3,620	1.07	10,860
Immature and unmarketable size	6,225	1.84	18,675
	16,690	4.93	50,070
	Alphonso		
Quantity harvested	93,800		6,56,600
Losses due to			
Mechanical Damage/breakage	1,545	1.64	10,815
Spoilage due to diseases	1,240	1.32	8,680
Over ripening	495	0.52	3,465
Immature and unmarketable size	170	0.18	1,190
	3,450	3.67	24,150

Table 6 Comparison of transportation losses in mango fruits between two selected markets

To Srinivaspur Wholesale Market

Variety	Mode of Transportation	Distance (km)			Time taken(hrs)			Qty. transported	Loss in Qty.	% loss
		Min.	Max.	Avg.	Min.	Max.	Avg.			
Totapuri	Lorries/Trucks	5	15	12	2	3.5	2.45	2,02,500	7,935	3.91
Alphonso (Badami)	Lorries/Trucks	5	15	12	1.5	3	2.00	46,800	1,372	2.93

To Bangalore market

Distance (km)			Time taken(hrs)			Qty. transported	Loss in Qty.	% loss
Min.	Max.	Avg.	Min.	Max.	Avg.			
30	100	71.5	4	8.5	6.17	1,36,000	6,800	5
30	100	70.25	4	8	5.5	47,000	2,150	4.57

market, around 7,935 kg was lost, which accounted to 3.9 per cent. Similarly, for Alphonso out of total quantity of 46,800 kg transported about, 1,372 kg (2.93 %) was lost. When fruits were brought to Bangalore market which was around 100 km, the time taken for transportation was 4 to 8.5 hours. Out of 1,36,000 kg of fruits transported to Bangalore, 6,800 kg (5 %) was wasted in Totapuri. In Alphonso about 2,150 kg (4.57 %) was wasted out of 47,000 kg transported.

4.3 Losses during storage

The fruits are stored in the market yard or some times in rooms, where fruits are arranged in several layers on the ground spread with paddy straw and the top of the lot is also covered with straw. Fruits are kept for about a week for uniform ripening. Then the fruits are distributed to retailers. Retailers purchase the fruits directly from the wholesale agent. They classify the fruits into different sizes and sell within two or three days.

The data collected on storage losses in both Totapuri and Alphonso varieties are presented in Table 7. For a sampled quantity of 1,58,500 kg stored, 6,500 kg fruits were lost in Totapuri valued at about Rs. 19,500 and amounting to 4.1 per cent of the fruits stored. The major loss was due to spoilage which contributed to a loss of about 3,840 kg (2.42 %). The loss due to overripening and shrivelling was about 2,660 kg (1.67 %) in Totapuri. In Alphonso out of a total quantity of 69,250 kg

Table 7 Storage losses in Totapuri and Alphonso mango fruits

	Quantity (Kg)	Per cent loss	value (Rs.)
Totapuri			
Quantity stored	1,58,500		4,75,500
Losses due to			
Over ripening and shrivelling	2,660	1.67	7,980
Spoilage due to diseases	3,840	2.42	11,520
	6,500	4.1	19,500
Alphonso			
Quantity stored	69,250		4,84,750
Losses due to			
Over ripening and shrivelling	970	1.40	6,790
Spoilage due to diseases	1,472	2.12	10,304
	2,442	3.52	17,094

stored, about 2,442 kg were wasted which worked out to 3.52 per cent valued at about Rs. 17,094. While losses due to overripening and shrivelling accounted for 970 kg (1.4 %), the losses due to spoilage was about 1,472 kg which was around 2.12 per cent.

The effect of the number of days stored in both Totapuri and Alphonso varieties and its effect on wastage was studied. The fruits were required to be stored for a maximum period of one week and a minimum of four days (Table 8). In case of Totapuri when fruits were stored for four days the loss was 2.72 per cent, when stored for five days the loss was 4.48 per cent, when kept for 6 days the loss went upto 4.49 per cent and when stored for seven days the losses were as high as 5.45 per cent, irrespective of the quantity stored. In case of Alphonso when fruits were stored for four days the loss was 2.69 per cent, when stored for 5 days the loss was 3.13 per cent, when stored for 6 days the loss went upto 3.45 per cent and when stored for 7 days the loss was as high as 4.65 per cent (Table 8).

4.4 Losses at the retail level

When data were collected at the retail level it was found that the losses were about 5.46 per cent in case of Totapuri, i.e., out of 5,950 kg sampled nearly about 325 kg were wasted valued at about Rs. 975 (Table 9). The major loss was due to spoilage accounting to about 2.58 per cent. The loss due to over ripening and shrivelling, was about 2.08 per cent and pilferage

Table 8 Influence of storage duration on postharvest losses in mangoes

Variety	Type of storage	No.of days stored	Qty. stored	Loss in Qty(kg)	per cent loss	Loss in value(Rs)
Totapuri	Common Storage	4	49,500	1,350	2.72	4,050
		5	37,500	1,680	4.48	5,040
		6	29,500	1,325	4.49	3,975
		7	36,500	1,990	5.45	5,970
Alphonso	Common Storage	4	18,800	507	2.69	3,549
		5	19,000	595	3.13	4,165
		6	22,000	780	3.54	5,460
		7	10,750	500	4.65	3,500

Table 9 Postharvest losses in Totapuri and Alphonso mango fruits at retail market

	Qty. (Kgs)	Per cent loss	value (Rs.)
Totapuri			
Fruits purchased	5,950		17,850
Losses due to			
Over ripening and shrivelling	124	2.08	372
Spoilage due to diseases	154	2.58	462
Pilferage	47	0.78	141
	325	5.46	975
Alphonso			
Fruits purchased	3,310		23,170
Losses due to			
Over ripening and shrivelling	45	1.35	315
Spoilage due to diseases	112	3.38	784
Pilferage	19	0.57	133
	176	5.31	1,232

accounted for 0.78 per cent. In case of Alphonso the total loss at retail level was 176 kg out of 3310 kg fruit purchased which worked out to 5.31 per cent and valued at Rs.1,232. The major loss was due to spoilage accounting to 3.38 per cent, over ripening and shrivelling contributed to 1.35 per cent.

4.5 Overall losses

Three important postharvest stages were identified in the postharvest handling chain and losses were estimated at each stage in order to obtain the overall losses on a 100 tonne basis (Table 10). The stages were harvesting, transportation and marketing. In case of Totapuri the overall loss accounted for was 16.76 per cent (3.52 % field 4.86 % wholesale market, 4.1 % in storage and 5.44 % retail level). The loss in terms of value was around Rs. 50,293.44. In case of Alphonso the overall loss was around 13.67 per cent (1.91 % field, 3.65 % wholesale market, 3.51 % storage and 5.3 % Retail level). This loss in terms of value was around Rs. 95,756.57 (Table 10).

4.6 Factors influencing thepostharvest losses

a)Transportation losses

Losses in transportation is common in perishable agricultural commodities, which is true of mango as well. In this study , an attempt was made to quantify the losses during transportation of mangoes. Due to limitation of data only three

Table 10 Overall loss and value during various stages of marketing of Totapuri and Alphonso

(Converted to 100 tonnes)

Stages of loss	Totapuri (kg)	Per cent loss	Value (Rs)	Alphonso (kg)	per cent loss	Value (Rs)
a) Harvesting:						
Qty. harvested	100000.0		300000.0	100000.0		700000.0
Mech. damage	735.0	0.73	2205.0	779.0	0.80	5493.0
Diseases/ spoilage	1414.0	1.41	4242.0	685.0	0.68	4795.0
Damages by Birds	199.0	0.20	597.0	261.0	0.26	1827.0
Over ripening	686.0	0.69	2058.0	133.0	0.13	931.0
Pilferage	211.0	0.21	633.0	-	-	-
Hailstrom	279.0	0.28	837.0	35.0	0.03	245.0
Total loss	3524.0	3.52	10572.0	1913.0	1.91	13391.0
b) Wholesale market including transporation:						
Qty.transported	96476		289428	98087.0		686609.0
Breakage	1204.98	1.24	3614.94	1608.62	1.63	11260.34
Spoilage	744.80	0.77	2234.40	1294.74	1.31	9063.18
Over ripening	1031.32	1.07	3093.96	510.05	0.51	3570.35
Immature & un-marketable size	1707.62	1.77	5122.86	176.55	0.17	1235.85
Total loss	4688.72	4.86	14066.16	3589.96	3.65	25129.72
c) Storage:						
Qty. Stored	91787.28		275361.84	94497.04		66147.28
Over ripening and shrivelling	1540.20	1.67	4620.60	1322.95	1.39	9260.65
Spoilage	2223.08	2.42	6669.24	2003.33	2.11	14023.31
Total loss	3763.28	4.10	11289.84	3326.28	3.51	23283.96
d) Retail level :						
Qty. Purchase	88024.00		264072.0	91170.76		638195.32
Over ripening & shrivelinng	1830.90	2.08	5492.7	3081.56	3.37	21570.92
spoilage	2271.00	2.57	6813.0	1230.80	1.34	8615.60
Pilferage	686.58	0.78	2059.74	537.90	0.58	3765.30
Total loss	4788.48	5.44	14365.44	4850.26	5.30	33951.82
Overall loss	16764.48	16.76*	50293.44	13679.51	13.67*	95756.57

* The overall loss figure does not tally with the total fruit loss at different stages since the initial quantity of 100 tonnes of fruits taken at harvest goes on decreasing as it moved from the harvest to retail level.

determinants were considered, namely distance travelled, mode of transport i.e., whether the mangoes were transported by trucks or lorries and quantity transported. The regression equation was estimated with quantity of loss during transportation as dependent variable and the aforesaid variables as exogenous variables and the results are presented below.

Totapuri:

$$\ln Y = -96.881\ln + \underset{(9.52)}{0.046\ln x_1} + \underset{(5.337)}{1.6680\ln x_2} - \underset{(-0.262)}{5.463\ln x_3}$$

$$R^2 = 0.92$$

Alphonso:

$$\ln Y = -18.2191\ln + \underset{(4.096)}{0.0408\ln x_1} + \underset{(0.436)}{0.1631\ln x_2} + \underset{(0.973)}{16.369\ln x_3}$$

$$R^2 = 0.59$$

Where, Y = Quantity lost

X_1 = Quantity transported

X_2 = Distance transported

X_3 = Mode of transportation

ln = linear

(Figures in parenthesis are the calculated 't' values)

Based on the results it can be inferred that the quantity transported is an important factor having a bearing on transportation losses. For 10 per cent increase in the quantity

tranported per load the losses increased by 0.4 per cent over the mean level in both Totapuri and Alphonso. This may be due to more compaction on the bottom fruits, which may be crushed, broken or bruised. This co-efficient was found to be highly significant. Longer the distance transported the greater the losses sustained in Totapuri but it was not so in case of Alphonso. The mode of transport, however, did not have any significant influence on the losses during transportation. The adequacy of the fitted curvilinear regression equation was testified by high R^2 value.

b) Storage losses

The losses due to storage has been quantified using the quantity stored and number of days stored as explanatory variables. The results of the regression are presented below:

Totapuri:

$$\ln Y = -2.4879 + \underset{(6.92)}{1.4833 \ln x_1} + \underset{(4.65)}{0.602 \ln x_2}$$

$$R^2 = 0.65$$

Alphonso:

$$\ln Y = -2.9019 \ln + \underset{(3.632)}{0.6605 \ln x_1} + \underset{(4.65)}{0.7759 \ln x_2}$$

$$R^2 = 0.64$$

Where, Y = Quantity lost

x_1 = number of days stored

x_2 = Quantity stored.

ln = linear

(Figures in parenthesis are the calculated 't' values)

The losses in Totapuri due to storage was found to be greater than Alphonso, which is evident by the high coefficient of 1.4833 storage days in case of Totapuri as against 0.6605 in case of Alphonso. This implies that for one per cent increase in storage time the loss in Totaputi increased by 1.48 per cent Vis-a-vis 0.66 per cent in case of Alphonso. Quantity stored also significantly influenced the storage losses. The magnitude of quantity impact on the storage losses was more or less same for Totapuri and Alphonso at around 0.66. Both co-efficients were highly significant implying that both quantity as well as the duration of storage accounted to positively for storage losses. The adequacy of the fitted model is explained by reasonably high R^2 values.

DISCUSSION

V DISCUSSION

As defined in the previous chapter, our main focus was to identify and assess the various postharvest losses in mango. Three important postharvest stages have been identified and the losses are assessed. They are harvesting, transportation and marketing. This chapter discusses the results presented in Chapter IV. The discussion is presented under the following headings.

5.1 Method of harvesting and handling on the farm

5.2 Mode of transportation and marketing

5.3 Method of storage and number of days stored

5.4 Losses at retail level

5.5 Overall losses

5.6 Factors influencing the postharvest losses

5.1 Method of harvesting and handling on the farm

The study was undertaken in Srinivaspur taluk of Kolar district, as it is one of the important mango growing taluks in the state. Mango was grown in an area of 11,898 ha, with an annual estimated production of 29,745 tonnes. The harvesting season starts from the last week of April and extends upto middle of June. The major varieties grown are Totapuri and Neelum, which are late season varieties and Alphonso, Pairi and Sindhura, which are early season varieties.

Among these varieties,Totapuri and Alphonso were selected for study, since Totapuri occupies a larger area and Alphonso is one of the commercially important varieties and is highly valued.

Based on the observations made at the time of harvest, the losses amounted to 3.52 per cent in case of Totapuri. Out of 3,66,500 kg harvested, about 12,925 kg were wasted. In case of Alphonso out of 84,200 kg harvested, about 1,612 kg were wasted, which accounts for about 1.91 per cent. Similar results were reported by Madan (1988) in Banganpalli variety of mango and in banana in Andhra Pradesh where he reported a field loss of 5 and 2-3 per cent, respectively. The major causes of losses were mechanical injuries, diseases, overripening, hailstorm and damages by birds. In case of Totapuri the losses were more when compared to Alphonso because, Alphonso are highly priced and perhaps the farmer takes greater care during harvesting when compared to Totapuri. Further more, Totapuri is a late season variety which is more prone to attack of pests and diseases.

In general, manual harvesting is undertaken by labourers. Labourers handled the fruit roughly and there are more chances of damage or breakage of the fruit. Most of the farmers follow traditional method of harvesting using the minimum mechanical aid. They are also unaware of the right maturity stage at which the fruits are to be harvested to get good postharvest quality.

In case of preharvest contractors, the loss was less when

compared to harvesting and selling by the farmers themselves. The farmers and workers may be indifferent to the condition of the produce after harvest. The harvesting procedures are often careless. In case of preharvest contractors, the broker supervises the harvesting and may exert strict supervision of this operation, because he is more conscious about quality of the produce than the farmer in order to obtain maximum profit.

5.2 Mode of transportation and marketing

During the transportation of the fruits to the markets, the losses were quantified at the wholesale market. Based on the results obtained during the survey at wholesale market, the losses recorded were to the extent of 4.93 per cent and 3.67 per cent respectively, for Totapuri and Alphonso varieties. This result is in accordance with Madan (1988) who has observed about 3.5 per cent loss in banana in the primary market. Similar results were reported by Ceponis and Capellini (1985) in grapefruit at wholesale market of metropolitan New York, where the losses varied from 2.7 to 3.1 per cent.

The major loss was due to mechanical or physical damage, spoilage, overripening, immature and unmarketable size. Usually farmers bring their produce in lorries and some time in trucks. When the quantity was less than one tonne usually they transport by bullock carts. While transporting fruits, the fruits are dumped into lorries without packing. This increased the risk of physical

damage of fruits. At the wholesale market, while unloading the fruits, the damaged, overripened and immature and unmarketable sized fruits were seperated, which directly contribute to the loss.

During the survey, the losses both at Srinivaspur and Bangalore markets were quantified and analysed seperately to compare the losses at the two markets. The losses were quite less in Srinivaspur market when compared to the Bangalore market. In Srinivaspur market the losses were upto 3.91 per cent in Totapuri and 2.93 per cent in Alphonso. Usually fruits arrived from within a radius of 15 km and the time taken from loading till unloading was about two to three and half hours. When the fruits were brought to Bangalore market the losses were quite high in both the varieties. Usually fruits arrived at Bangalore market from within a radius of 100 km or in some cases even more. The time taken from loading till unloading was about four hours minimum and eight and half hours maximum. In general, the road facilities are poor. During transportation the fruits were not packed and the same was directly dumped into the lorries. As a result there were more chances of mechanical damage to the fruits. Moreover, the labourers who are engaged in loading and unloading of fruits are not aware of the implication of the damage to the fruits on their postharvest life and quality. The existing marketing facilities are very poor. There were no storage facilities to handle the fruits at the time of large scale arrivals during the peak season, and the nonavailability of proper storage facilities has led to increased loss of valuable material.

5.3 Method of storage and number of days stored

Based on the results obtained during the survey, the storage losses amounted to 3.52 per cent in Alphonso and 4.1 per cent in Totapuri. Similar results were reported by Madan and Ullasa (1988), who have observed about 5.6 per cent loss in case of Totapuri during the time of ripening, and 4-7 per cent loss was reported by Madan (1988) in banana. The major causes of losses were due to spoilage, overripening and shrivelling. During storage larger quantum of loss occured due to spoilage. As a result of damages and primary infections occurred during harvesting and on further handling more avenues for the entry of microorganism were established. Once infection occurs, the same becomes latent and during storage symptoms will be exhibited and later the fruits start decaying. Most of the agents stored the fruits on the ground in the market yard itself and a few stored in rooms or godowns using paddy straw as a cushioning materials.

The existing storage conditions are rather poor and unscientific. Fruits were stored for about 4 to 7 days. As the storage days increased the fruit losses also increased correspondingly. Thus the fruit loss is directly proportional to the volume stored and number of days stored.

5.4 Losses at retail market

At retail level the fruits suffered an overall loss of 5.46

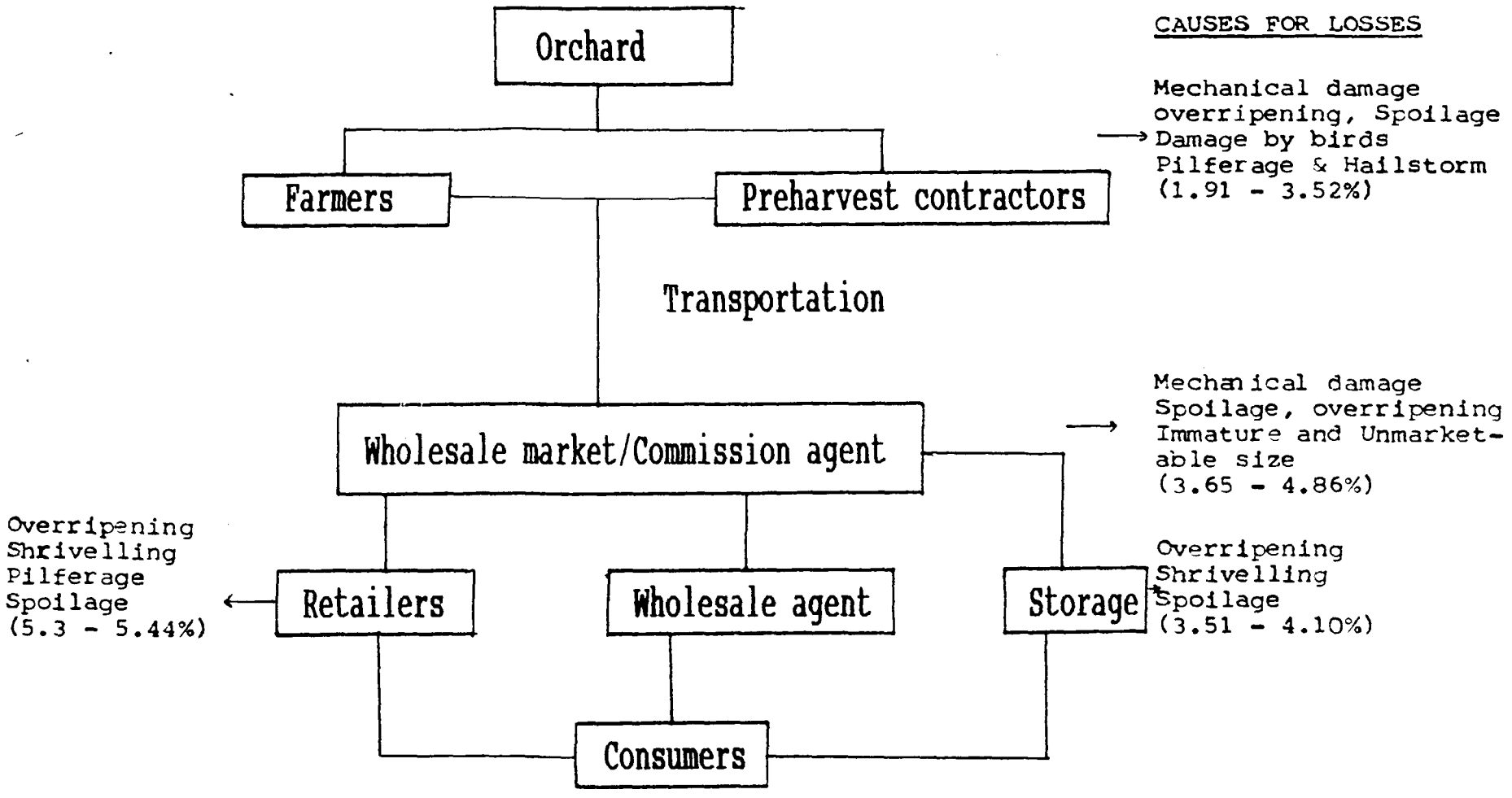
per cent in case of Totapuri and 5.31 per cent in Alphonso. Similar results were reported by Cappellini and Ceponis (1984), who recorded about 5.5 per cent loss in strawberries and 6.7 per cent loss in tomato at retail level. The major causes of losses were spoilage, overripening and shrivelling.

At the retail level the losses were more when compared to other stages of marketing for both Totapuri and Alphonso varieties. More than 50 per cent of losses at the retail level was due to spoilage.

5.5 Overall losses

In order to measure the overall postharvest losses in mangoes, the losses at three important stages of marketing were assessed. They were harvesting, transportation and marketing. The stages of postharvest handling and the losses at the respective stages are presented in Fig.3. The assessment made at all the three stages indicated an overall loss of 16.76 per cent in Totapuri. On the basis of 100 tonnes fruits harvested, the overall postharvest losses were estimated which included all the stages of marketing from the point of harvesting till it reached the consumer. Thus per 100 tonnes of fruits harvested, the total estimated losses worked out to the extent of 16,764.48 kg which was valued at Rs.50,293.44. However, retail level losses were the highest when compared to the other stages of marketing. The losses estimated are comparative with the losses recorded in

Fig. 3 : Postharvest loss profile for mango



Total loss (13.67 - 16.76 %)

similar studies for fruits and vegetables. For example, Jamaludin and Tandon (1976) reported losses to the extent of 15 to 20 per cent in tomatoes in Maharashtra and 4-10 per cent in Uttar Pradesh. Similarly, Harvey (1978) quoted an estimated postharvest loss of 11.7 per cent in lettuce, 14.2 per cent in tomatoes and 12.6 per cent in peaches. In another study Madan (1988) reported about 9-15 per cent loss in banana and 20.8 per cent loss in Banganapalli mangoes.

In case of Alphonso the overall loss amounted to 13.67 per cent. On the basis of 100 tonnes fruits harvested about 13,679.51 kg were wasted at various stages of marketing valued at about Rs.95,756.57. At the field/orchard the losses were low when compared to other stages of marketing. However, the retail level losses were the highest. In case of Totapuri the losses were more when compared to Alphonso in physical terms, but loss in value was more in case of Alphonso, because of high prices. During the study period the price in case of Totapuri was ruling at Rs.3 per kg and in case of Alphonso it was about Rs.7 per kg because of the superior quality of the fruits. Even the loss in quantity was also low in case of Alphonso, because more care is taken in harvesting and handling of the fruits when compared to the Totapuri variety because of the high price associated with the superior quality.

5.6 Factors influencing postharvest losses

The results of the regression analysis employed to explain the factors influencing transportation losses indicated that

quantity transported and the distance travelled significantly increased the postharvest losses. The influences can be diminished by packing the fruits before transporting over long distances, which would also help in transporting a larger quantity.

Storage losses were also influenced by time and quantity stored. Therefore better storage facilities should help in reducing the magnitude of losses.

SUMMARY

VI SUMMARY

Mango, one of the most important tropical fruit crops of India, is grown on a large area. Itoccupies an area of 10.63 million ha out of total fruit crop area of 24.87 m.ha and with an estimated production of 9.33 million metric tonnes. In India, Uttar Pradesh stands first in area as well as production. Karnataka occupies sixth position in area as well as production. In Karnataka mango is grown in 62,529 ha with an estimated production of 5,94,026 tonnes. In Karnataka, Kolar has the largest area under mango and it occupies an area of 25,794 ha with an annual estimated production of 1,41,348 tonnes. In Kolar district, mango cultivation is mainly concentrated in Srinivaspur taluk with an estimated area of 11,898 hectares and an annual estimated production of 65,439 tonnes. After harvest there is a considerable loss of fruit at various stages of marketing, but the extent of loss in each stage and the factors responsible for loss at different stages of marketing are not known clearly. No studies have been conducted so far in this region to estimate the postharvest losses in mango.

Therefore, this study was mainly undertaken to assess the postharvest losses in mango at different stages of marketing starting from harvesting till it reached the consumer, and also to find out the factors responsible for postharvest losses in mango. Detailed information was collected through personal interview with 50 mango producers as well as preharvest contractors, 50 trader

cum wholesalers and 20 retailers. Following are the findings of the study.

1. In the orchard, at the time of harvesting, there was a total loss of 3.52 per cent in Totapuri and 1.91 per cent in case of Alphonso. The total loss in terms of value was around 3.52 per cent in Totapuri and 1.91 per cent in Alphonso. The major causes of losses were mechanical injuries, diseases, overripening, damage by birds, pilferage and hailstorm. In case of preharvest contractors the losses were comparatively low in both the varieties compared to the practice of harvesting and disposing by the farmers.

2. The losses recorded including transportation and wholesale marketing were to the extent of 4.93 per cent and 3.67 per cent in case of Totapuri and Alphonso, respectively. The loss in terms of value is 4.93 per cent in Totapuri and 3.67 per cent in Alphanso. The major loss was due to mechanical/physical damage, spoilage, over ripening, immature and unmarketable size. Usually fruits are transported in lorries and trucks. However, the fruits were transported by bullock carts whenever the quantity harvested was low. Packaging is not done during transportation. Transportation distance and time taken for transportation played a greater role in fruit loss during transportation. In Srinivaspur market, the losses were less when compared to Bangalore market.

3. Storage is usually done in the open yard and for nearly a

week. As the storage period increased the fruit losses also increased proportionately. The estimated losses during storage were to the extent of 4.1 and 3.51 per cent in case of Totapuri and Alphonso respectively.

4. At the retail level,losses were comparatively high. The estimated losses in physical volume at this level were 5.46 per cent and 5.31 per cent, respectively, in case of Totapuri and Alphonso varieties.

5. The overall losses in the entire channel of postharvest handling of fruits amounted to the extent of 16.76 per cent of the total quantity or value in case of Totapuri and 13.67 per cent in Alphonso.

Recommendations and conclusions

In mango, after harvest, there are considerable losses at all stages of marketing due to improper harvesting, rough handling, transportation, storage and distribution. Principle causes of losses are mechanical injuries or breakage, overripening shrivelling,decay and damage by pest.

By adopting some simple and low cost techniques for proper management of fruits at pre-and postharvest level of marketing more remunerative returns can be ensured to the growers and resonable price to the consumers. Hence, the following recommendations have been made to reduce the losses.

Careful handling of the fruits at the time of harvest to avoid the bruises, cuts and scratches since mishandling of the fruits result in injury during harvesting and shortens the life of frutis. Sound and clean produce should be selected for packing and storage.

Proper packaging of fruits can reduce not only bruising and crushing but also reduces moisture loss, prevents contamination of fruits with spoilage organisms, reduces pilferage, maintains sanitory environment during transportation and marketing.

Losses due to glut in the market during peak supply period can be brought down by proper storage condition to store the produce for longer times. Improved storage and market facilities are to be provided to reduce the disease and overripening of the fruits.

REFERENCES

VII REFERENCES

Adikaram, N.K.B., 1987, A survey of postharvest losses in some fruits and vegetables and fungi associated with them. Ceylon J. Sci. (bio.sci.), 19 and 20 : 1-10.

*Asuncian, L.M. and Cungihas,E.B., 1984, Assessment of transport losses in marketing of selected high land vegetables. MSAC Research Journal, 16 : 100-125.

Anonymous, 1964, "Darjeeling Oranges" A study in quantitative loss.Market research section. Agril. Mktg. Br. DAWB (Directorate of Agriculture West Bengal) Govt.of West Bengal,Calcutta.

Anonymous, 1965, Malda Mangoes- A study in quantitative loss Market research section. Agril. Mktg. Br. DAWB Govt of West Bengal.

Anonymous,1978, Postharvest Food Losses in Developing Countries. National Academy of Sciences, Washington DC.

Anonymous, 1981, Food Loss Prevention in Perishable Crops. FAO, Agriservices Bull. 43, pp. 72.

Beraha, L. Kwolek, W.F. and Apple, R.E., 1981, Nature and factors influencing consumer losses in fruits and vegetables in the Chicago market. Phytopathology. 71 :860(abst)

Biswas, M.K., 1969, Wastage of oranges in transit to Varanasi Agricultural Marketing, 12 (4) : 11-16.

Braverman, J.B.S., 1949, "Citrus Products". Interscience NewYork.

Bractly, C.O. and Wiant, J.S., 1950, Diseases of fruits and vegetables found on market and means of controlling them. Econ. Bot. 4 : 177-191.

Chadha, K.L., 1990, Mango research in India - New developments. Indian Journal of Horticulture 46 : 279-294.

Cappellini,R.A.and Ceponis,M.J., 1984, Postharvest losses in fresh fruits and vegetables.In postharvest pathology of fruits and vegetables. USDept.Agric.Pub.WE-87.PP24-30.

Cappellini, R.A., Ceponis,M.J. and Koslow,G., 1982, Nature and extent of retail and consumer grade samples of blueberries in greater NewYork. HortScience, 17 : 55-56.

Ceponis, M.J.,and Butterfield, J.E., 1974a, Causes of cullage of Florida bellpeppers in New York wholesale and retail markets. Plant dis.Reptr. 58 : 367-369.

Ceponis, M.J.and Butterfield, J.E.,1974b, Market losses in Florida cucumbers and bell peppers in Metropolitan New York. Plant Dis. Reptr. 58 : 558-560.

Ceponis,M.J. and Butterfield,J.E., 1974c, retail and consumer losses in sweet potatoes marketed in Metropolitan NewYork. HortScience, 9 : 393-394.

Ceponis, M.J.and Butterfield J.E., 1974d, Retail and consumer losses of Western pears in Metropolitan New York. HortScience,9 : 447-448.

Ceponis.,M.J. and Butterfield, J.E., 1981, Cull losses in Western sweet cherries at retail and consumer levels in Metropolitan New York. HortScience. 16 (3) : 324-326.

Ceponis, M.J. and Capellini,R.A., 1985, Wholesale and retail losses in Grapefruit marketed in Metropolitan New York.HortScience. 20 (1) : 93-95.

Coursey,D.G. and Booth,R.H.,1972, The postharvest phytopathology of perishable tropical produce Rev. Plant Path.51 : 751-765.

FAO, 1977, "Analysis of an FAO survey of postharvest crop losses in developing countries. "AGPP MISC. 27. FAO. ROME.

Gopal, K.N., 1978, An analysis of problems of marketing of fresh vegetables in Bangalore City. M.Sc. (Agri) thesis submitted to University of Agricultural Sciences, Bangalore.

Harvey, J.M., 1978, Reduction of losses in fresh fruits and vegetables. Ann. Rev. Phytopathology, **16** : 321-341.

Jamaludin, K.A. and Tandon, M.P., 1976, Some new market diseases of fruits and vegetables. Indian Phytopathology, **29** : 74-75.

Le Clerg, E.L., 1964, Crop losses due to plant diseases in the United States. Phytopathology, **54** : 1309-1319.

*Lakshminarayana, P. and Reddy, S.M., 1977, Postharvest pathology of perishables. Egyptian J. Phytopathology, **9** : 23-33.

Mandal, N.C. and Dasgupta, M.K., 1981, Postharvest disease of perishables in West Bengal. Ann. Agri. Res., 2 : 73-85.

Madan, M.S., 1988, Economic assesment of harvest and postharvest losses in horticultural crops. Annual Report Indian Institute of Hort. Res. Bangalore, pp.93.

Madan,M.S. and Ullasa, B.A., 1988, Economic assesment of harvest and postharvest losses in horticultural crops. Annual report. Indian Institute of Hort. Res. Bangalore.

Madan, M.S.,1990, Marketing fresh onion in Karnataka systems and perception of postharvest losses. National Symposium on onion and garlic. 2nd.June Solon(HP).

Parpia, H.A.B., 1976, Postharvest losses-impact on their prevention on good supplies,nutrition and development in Symposium on nutrition and agricultural and economic development in the tropics. PP.145-206.Plenum, New York, USA.

Pantastico, E.B. and Bautista,O.K., 1986, Postharvest handling of tropical vegetable crops.HortScience, 11 (2) : 122-124.

Pushkaranth, D.S. and Srivastava, S.N.S., 1966, The rot and deterioration of potatoes in storage. In plant disease problems. IPS New Delhi.PP:324-328.

Ratnam, C.V. and Nema,1967, Studies on market diseases of fruits and vegetables. Andra Agric. J. 14 : 60-65.

Salunke, D.K. and Desai,B.B., 1984, Postharvest Biotechnology of fruits, Vol.11 CRC press INC.Bocaraton Florida, PP:27-38.

Sparks, W.C., 1976, Losses in potatoes and lesser fruits and vegetables. Proc. Nat. Food Loss. Canf. Boise. ID. pp.7-16.

Subramanyam, K.V., 1986, Postharvest losses in horticultural crops. An appraisal, Agriculture situtation in India, 41 : 339-349.

Vijaysethi and Maini, S.B., 1989, Appropriate technology for reducing postharvest losses in fruits and vegetables. Indian Fd. Packer, 43 (2) : 42-56.

*Veno, L.H., 1976, Losses in marketing of horticultural products in city of Saopaulo. Informacoes Economicas, 6 : 7-8.

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* Original not seen

APPENDIX

APPENDIX - 1

POST-HARVEST LOSS ASSESSMENT OF MANGO FRUITS IN SRINIVASAPUR TALUK OF KOLAR DISTRICT

A. Farm

I. General information

a) Name of the respondent :
b) Name of the village :
c) Age and education :
d) Category of the farmer :
e) Whether member of any organisation :
f) Farm size:

Type of land	Area in acres	Source of irrigation
Dryland		
Wetland		
Garden		
Orchard		

II. Establishment of Mango Orchard

a) Area planted :
b) Age of the orchard :
c) Rainfed/Irrigated :
d) Whether pure/mixed :

If mixed crop used	No. of trees
1) Tamarind	:
2) Cashew	:
3) Others	:

e) Varieties grown in the Orchard:

Varieties:	No. of trees
1)	:
2)	:
3)	:
4)	:
5)	:

f) Cultural operations followed :

1) Ploughing Yes/No. If yes No. of times

2) Manure/fertilizer - Time of application - Dosage

N

P

K

FYM

3) Irrigation - Frequency Method

4) Plant protection :

Time Chemical Concentration Mode of spray

III. Marketing

a) Preharvest contract :

b) Postharvest selling :

c) Method of sale - Whole lot

- Sale as weight basis -

IV. Harvesting

a) Basis of harvesting (Maturity indices followed)

Size, shape, colour, Firmness, Tapka, Anyother

b) Type of harvesting

- Mechanical harvesting

- Manual harvesting

c) Method of handling on the Farm

- How do you collect/unitise harvested fruits

- Do you sell immediately after harvest - Yes/No

d) Losses during harvesting : (Orchard).

	Totapuri		Alphonso	
	Quantity	Value	Quantity	Value
1. Quantity harvested				
2. Quantity waste				
a) Mechanical/physical damage/breakage				
b) Diseases/Rotting				
c) Damage by birds				
d) Any other loss				
a) Pilferage				
b) Overriping				

e) **Losses during transportation** (wholesale market)

Mode of transportation	Qty. transported	Distance to the market	Time taken from loading to unloading	Approximate loss Totapuri.		Alphonso	
				Type	Qty.	Type	Qty.
1. Card loads				Sorted out Mechanical damage			
2. Trucks							
3. Lorries				Over ripening			
				Spoilage			

B. Markets (Storage)

Storage	Qty. stored	Method of storage	No. of days stored	Loss due to			
				Mechanical damage	Over ripeing	Pest disease	Others
Totapuri							
Badami							

C. Losses during retailer level

Qty. purchased	Sale of pattern D1	D2	D3	D4	Qty. unsold	Nature of loss or damage	Extent of loss D1	D2	D3	D4	D5
							Price				
							Qty. sale				
						Mechanical/ Physical damage					
						Spoilage					
						Over ripening					
						Pilferage					
						Others					

D : Days