

Full Length Research Paper

## Post-harvest losses in mandarin orange: A case study of Dhankuta District, Nepal

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Worldwide postharvest fruit and vegetables losses are as high as 30 to 40% and even much higher in developing countries like Nepal. A systematic survey was conducted to assess the extent of loss due to post harvest conditions in oranges at field, transport, storage and market levels during October to January, 2011. The survey data were collected using oral questionnaires, personal interviews, group discussions and informal observation in the field and *Krishi Bazar*, Dharan. The production of oranges in Dhankuta this year was found to be reduced by 40 to 50% than previous year which was observed to be followed by alternate pattern. Consequently, the price was doubled this year. The post harvest loss was found to be 46% from harvesting to distribution. The losses during harvesting, transportation, grading, packaging and marketing were found to be 7, 25, 3, 1 and 5% maximum, respectively. The storage losses were found to be 5% during 2 to 4 days in *Krish Bazar* while 40.1% during 21 days experimental condition in room. The losses in experimental condition comprised 15.02% evaporation loss, 14.34% pathological loss and 10.74% other losses. The most observed disease was fungal attack in oranges. Reducing postharvest losses is very important; ensuring that sufficient food, both in quantity and in quality is available to every inhabitant in our planet. Postharvest horticulturists need to coordinate their efforts with those of production horticulturists, agricultural marketing economists, engineers, food technologists, and others who may be involved in various aspects of the production and marketing system.

**Key words:** Orange, survey, post harvest loss, storage, loss reduction, Nepal.

### INTRODUCTION

Fruits constitute an important item of our food and they play a significant role in the human diet through the supply of vitamins and minerals (Prabhakar et al., 2004). There is a growing need of fruit and vegetables on world market. Therefore, fruit and vegetables have a fast growing market share (Kabas, 2010). Post-harvest losses during handling, transport, storage and distribution are the major problems in agrarian economy, especially in perishable fruits and vegetables. Besides resulting in low

per capita availability and huge monetary losses, these increase transport and marketing costs also (Subrahmanyam, 1986). In Nepal, post harvest loss for fruits is 20 to 35% (Kaini, 2000). The mid-hill region (1000 to 1500 m altitude) has a comparative advantage in the cultivation of citrus fruits, especially mandarin and sweet orange. These are grown in almost all mid-hill areas (900 to 1400 m) of the country between 26° 45' and 29° 40' latitude and 80° 15' and 88° 12' longitude. The mid-hill

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region of Nepal, which accounts about 1.5 million ha is quite suitable for citrus cultivation (Shrestha and Verma, 1998). Mandarin orange contributes to augmenting food availability, improvements in nutrition, generation of employment and income and also helps in maintaining the environment (Anonymous<sup>1</sup>, 2009).

Citrus, particularly the mandarin orange is the most important and highly commercial fruit crop in the hills of Nepal Anon<sup>1</sup>, 2009. Mandarin is a group name for a class of oranges with thin, loose peel. These are treated as members of a distinct species, *Citrus reticulata* Blanco. Mandarins include a diverse group of citrus fruits that are characterized by bright coloured peel and pulp, excellent flavor, easy-to-peel rind and segments that separate easily (Parashar, 2010). In Dhankuta district, the area under oranges production is 652 ha and the major VDCs producing oranges are *Khoku*, *Chhintang*, Dhankuta, *Khuaphok*, *Belhara*, *Maunabudhuk* (*Statistical information on Nepalese Agriculture, MOAC, 2006-2007*). Significant damages are being occurred in the process of growing, harvesting, and post-harvesting on oranges. According to Kabas (2010) this causes losses on farmers and also on country's economy. This also causes decrease in food availability. Dhankuta is a major citrus producing area with superior quality mandarin oranges. To the best of our knowledge, the recent data on post harvest loss of mandarin orange of Dhankuta district is not available. Similarly, the survey data on production and quality of mandarins produced now is not available. No information regarding the post harvest losses during harvesting, transportation and storage is available for mandarin grown in Dhankuta. Similarly, losses due to disease and pests are not known till date. The present study thus was to estimate the post harvest loss of oranges particularly in trade route of Dhankuta-Dharan.

## MATERIALS AND METHODS

A systematic survey was conducted to assess the extent of loss due to post harvest conditions in oranges at field, transport, storage and market levels during October to January, 2011. The survey data were collected using oral questionnaires, personal interviews, group discussions and informal observation in the field and *Krishi Bazar*, Dharan. The questions and discussions dealt about losses during harvesting, transportation, storage and distribution of oranges. It also included information on past and present orange production and price fluctuation. The loss due to evaporation and disease was assessed at 3 days intervals for a month (December to January 2012) at room. The fruits were bought and kept in storage conditions for a month in room and accessed for storage losses. As regards phyto-pathological disorders, the Laboratory examination was not done. Only visual examination of infected surface was carried out.

The nature and extent of postharvest losses due to insect, mechanical damage and spoilage were quantified by obtaining on the samples from harvesting, collection centers and retail market. Lots of 30 to 40 kg was randomly sampled in three replications at collection center. Similarly samples were collected in triplicate from retail market.

## RESULTS AND DISCUSSION

### Survey findings

The data on losses during harvesting, transportation, storage and distribution of oranges were collected. Most orange producers in Dhankuta district reported that the production of oranges this year was about 40 to 50% less than previous year. Consequently, the price of orange was increased by two times. The reason for less orange production this year was reported by most farmers to be due to climatic changes like environment, soil and rainfall. They also reported that oranges are generally produced in alternate years. They expected that more oranges will be produced next year compared to this year. The most preferable orange from survey was found to be from *Khoku* and it was highly priced. These oranges in *Khoku* are pesticide free. Generally orange tree gives fruit in five years and in *Khoku*, orange tree of 200 years old was also found. About 50% of surveyed producers reported that the qualities of oranges are declining. According to survey, this was due to over farming, use of grafting to produce new variety and diseases like scaling, *kharane* (Power Mildew), etc. The survey findings on losses during harvesting, transportation, storage and distribution are given subsequently.

### Losses during harvesting

The nature, causes and percentage of losses in field visit during harvesting are given in Table 1.

### Losses during transportation

The oranges were found to be transported from field to *Krishi Bazar* in mini trucks or tractors or *doko* (a basket made of bamboo) covering with plant leaves for cushioning. The dealers in *Krishi Bazar* reported that each day they receive 4 to 5 trucks of oranges having 15 to 25 quintals from different areas. From the survey, the losses in transportation of Mandarins from field to *Krishi Bazar* was observed to be around 25% from all areas and from *Krishi Bazar* to consuming markets/ terminal markets was negligible (about 1%). The main nature of transportation losses were reported to be damage, bursting, peeling, shrinkage, etc.

### Losses during packaging

Improper handling, overloading and dropping of the fruits during weighment are the main factors of losses during packaging. The dealers generally sell the produce after packing in polythene bags in loose condition and overload the bags. So losses of upto 0.2 to 1% occurred.

**Table 1.** Nature, causes and percentage of losses.

S/N	Area	Losses during harvesting		Percentage
		Nature/type	Cause	
1	Khoku	Bruises, injuries, rotting	Improper handling, falling of fruits, fungal attack	2.5
2	Chhintang	Scratches, puncture of fruits, insect infestation	Improper harvesting, infestation	2-3
3	Dhankuta	Physical damage, bruises, cuts, over ripen, immature	Improper harvesting, falling of fruits, improper handling, monkey attack	4-5
4	Budhimorang and Khuaphok	Bruises, scratches	Improper handling	1-2
5	Bhirgaon	Damaged, insect infestation, bruises	Due to fall of fruits, cracked and spoiled fruits	4-7
6	Maunabudhuk	Bruises, softness, puncturing of fruits	Falling from height, open stacking, Improper plucking	5.5

### Losses in the markets

The sellers generally do not undertake any special preparation for markets. They simply keep the fruits for sale in the markets. Most of the losses in the markets are at wholesaler, commission agents and retailers level. This may be due to the fact of over ripening of fruits, improper handling during packaging, falling of the fruits; shrinkage and rotting of fruits etc. according to market survey, losses upto 5% were reported.

### Losses during grading in *Krishi Bazar*, Dharan

Scientific grading of Mandarins is not done by any of the dealers. At the most, the fruits are sorted out according to size, shape and color. There are hardly any losses in the process of grading, but due to improper handling of the fruits or due to over ripened fruits, there are likely losses of the fruits at the time of grading. The percentage of losses may be 0.5 to 3.

### Evaluation of losses in oranges during storage

Storage losses were evaluated in two ways. In

one way, survey was performed in *Krishi Bazar* and in other; simulation of storage condition was done in room. During survey, no cold storage facility was reported. The dealers in *Krishi Bazar* store oranges in cemented floor on plastics, straw bed, *doko*, crates, and sacks and on plant leaves bed. The oranges do not remain there for long time. Only storage for 2 to 4 days was observed. During this time, losses upto 5% was reported by dealers. This loss was due to evaporation loss, rotting, breakage, etc. For the assessment of post harvest storage losses in room condition, oranges were evaluated according to the following categories:

- a. Oranges without shrinkage or diseases and disorders.
- b. Oranges without pathological diseases.
- c. Oranges without disorders or evaporative loss.

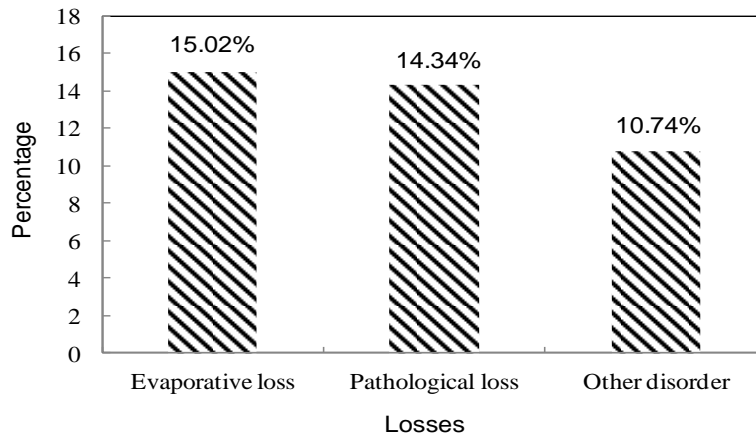
In every case, losses were evaluated after having divided oranges visually. The results obtained are shown in the Figure 1. They represent the average of some measurements carried out in December to January 2012 in storage. The total loss during storage for 21 days was found to be 40.1%. Paudel et al. (2004) verified that the

maximum loss in mandarin oranges stored in improved cellar stores was 23% on a weight basis and 15% in number for a 120-day storage period. The pattern of evaporative losses during storage is given in Figure 2.

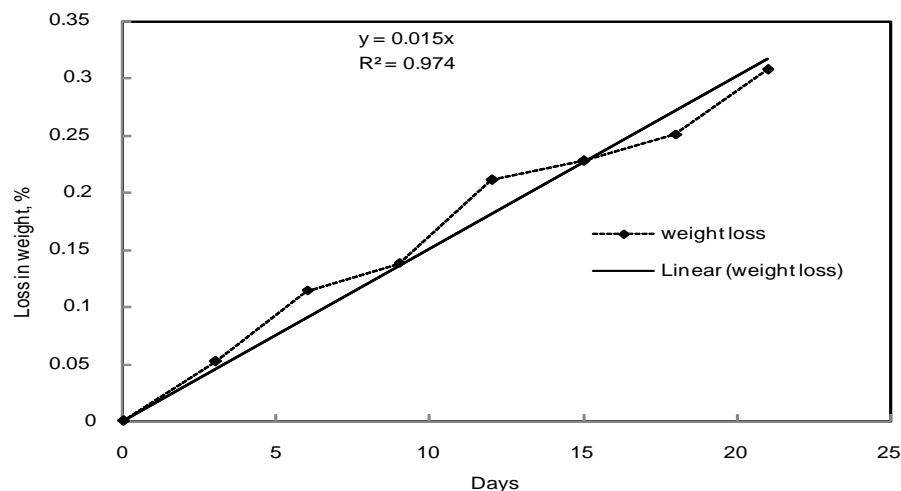
### Losses due to diseases in oranges during storage

No significant disease attack was found during storage in *Krishi Bazar*. This may be due to short storage period in that area. But the dealers reported that sometimes if storage is for long period due to strike and low demand, blackening and rotting occurred. In our experimental study, a pathological loss of 14.34% was observed which was due to surface infection by fungus. Prabhakar et al. (2004) reported that the extent of loss in local mandarin varied from 15.1 to 22.1% in which spoilage due to green mold ranged from 8.5 to 12.0% followed by blue mold of 4.3 to 7.0%. Other diseases of lesser importance were sour rot, anthracnose and stem end rot. The lower value in present study may be due to storage performed in small batch.

During storage, *Penicillium digitatum* and



**Figure 1.** Losses in oranges during storage. The values are means of three batches.



**Figure 2.** Trend in evaporative loss during storage. Values are means of three batches.

*Penicillium italicum* account for severe losses in mandarin worldwide (Prabhakar et al., 2004). Mandal (1981) has reported from West Bengal as high as 35% loss due to *Penicillium* spp. alone in mandarin orange. Losses from post-harvest diseases in oranges 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 the tissue systems, followed by subsequent attack of weak pathogens. High temperature and humidity accelerate the process of post harvest decay by microorganisms.

### Technology for reducing post-harvest losses

A systematic analysis of each commodity production and handling system is the logical first step in identifying an

appropriate strategy for reducing postharvest losses. Also, a cost-benefit analysis to determine the return on investment in the recommended postharvest technologies is essential (Kader, 2005).

Post-harvest losses can be minimized by adopting certain pre-harvest strategy and post-harvest management/technology. The principal pre-harvest strategy and postharvest technology for reducing the post-harvest losses are as follows (Parashar, 2010):

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

- (vi) Cold storage
- (vii) Suitable means of transport and
- (viii) Efficient marketing.

## Conclusions

Minimizing postharvest losses of oranges is a very effective way of reducing the area needed for production and/or increasing food availability. The production of oranges in this year was reduced by 40 to 50% than previous year. Consequently, the price was doubled. Production follows alternate cycle each year.

The losses during harvesting, transportation, grading, packaging and marketing were found to be 7, 25, 3, 1 and 5% maximum respectively. The storage losses were found to be 5% during 2 to 4 days in *Krish Bazar* while 40.1% during 21 days experimental condition in room. The losses in experimental condition comprised 15.02% evaporation loss, 14.34% pathological loss and 10.74% other losses. The most observed disease was fungal attack in oranges.

During the process of distribution and marketing, substantial losses are incurred which range from a slight loss of quality to total spoilage. Post-harvest losses may occur at any point in the marketing process, from the initial harvest through assembly and distribution to the final consumer. The causes of losses are many: Physical damage during handling and transport, physiological decay, water loss, pathogens, etc. Reduction of post-harvest losses reduces cost of production, trade and distribution, lowers the price for the consumer and increases the farmer's income.

Reducing postharvest losses in oranges is very important; ensuring that sufficient food, both in quantity and in quality is available to every inhabitant in our planet. Postharvest horticulturists need to coordinate their efforts with those of production horticulturists, agricultural marketing economists, engineers, food technologists, and others who may be involved in various aspects of the production and marketing system.

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