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A Case Study on Identificatiom and Assessment of Postharvest Losses of Tomato (*Lycoperisicon escuentum* Mill)

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ABSTRACT. *A study was undertaken to quantify and identify the causes of the postharvest losses of tomato during the Maha season of 1991. In the first phase of the study a survey was carried out using random samples to collect information on the present system of postharvest handling of tomato. Four major stages of the postharvest marketing sequence were identified, namely; farm gate, collection agent, Manning wholesale market (Colombo) and exporter respectively. Loss assessments were conducted at these stages. The survey revealed that pest and diseases such as pod borrer (Heliothis zea) attack and blight (Alternaria solani and Phytophthora infestans) are the major contributions for postharvest losses at the farm gate. Over maturity at harvest, bird attack and losses due to sun scorch were also observed. Cultivating small extents of land (66% of farmers possess less than half acre) increases the harvesting interval which resulted in a high percentage of over maturity. The above factors subsequently made considerable losses at the collection agents when sorting the product for transportation. Significant losses were observed at the Manning market due to long distance of transportation with improper handling and transportation. The main problem with exporters was the lack of uniformity of product with respect to maturity and size. Cumulative loss at the Manning wholesale market was observed to be close to 54%. Contributions to the major causes of loss were as follows; mechanical damage due to over ripening 17.3%, pod borrer attack 23%, blight 4.8% and mechanical damage due to other factors 15%. The cumulative loss and rejections after export quality selection was as high as 96%. Rejects due to non conformity to export specifications with respect to maturity, size and shape were 27.52% and 7.34%, respectively.*

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INTRODUCTION

Tomato is a nutritive, versatile and perishable fruit. The reason for its popularity and importance, is that it is a good source of vitamins C and A and certain minerals such as Fe and Cu (Siemers, 1971). It may be used as a fresh vegetable and as a processed product. It has a high demand both in local and foreign markets. In 1991, the total foreign exchange earning from fresh tomato was 1.34 million rupees (Sri Lanka Customs Returns, 1991).

Tomatoes are especially vulnerable to postharvest loss due to their highly perishable nature and to a combination of factors such as pre-harvest diseases and inefficient postharvest handling procedures. The present case study was undertaken to identify the causes of loss and quantify the postharvest losses of tomato through the various stages of the marketing chain from the farm gate through to export channels.

MATERIALS AND METHODS

The case study was carried out in two phases.

1st phase

In order to identify the specific postharvest problems through the marketing channel, a field study was carried out using a survey. The study was conducted during the *Maha* season of 1991. The farm level survey was conducted in the Bandarawela and Welimada areas which contribute the largest volumes of product for the export market. Ninety-two farmers were randomly selected from 7 villages of the selected area.

Postharvest handling at the wholesaler and collecting agent level was observed at the village fairs (*Pola*) of Bandarawela and Welimada. It was also observed at the Colombo Manning Market and Exporter level.

2nd phase

Postharvest losses were quantified at 4 different levels of the marketing chain by removing random samples. Twelve farmers were

randomly selected by drawing numbers from the 92 farmers questioned. Three replicates of 300 fruits/replicate was obtained from each farmer. Losses were categorized according to the causes of spoilage and loss of quality. At the collection agent/wholesaler level, 12 tomato boxes were randomly selected and observed. A further 12 boxes were randomly selected after transportation to the Manning market. Two leading companies handling tomatoes were selected to asses the losses at exporter level. A sample of 200 fruits was randomly picked from each exporter totalling 1200.

RESULTS AND DISCUSSION

1st phase

Marketing chain

Figure 1 shows a sketch of the existing marketing channel of tomato from farm gate to exporter.

A. Postharvest handling at farm level

Extent of cultivation

Most of the tomato cultivators were small scale farmers. Among them more than 66% farmers cultivate less than 1/4 acre, while only approximately 6% of farmers cultivated more than 1 acre.

Cultivation pattern

There are two distinct farming patterns among the farmers. Upland farming called "*kandu kannaya*" commences in mid September with the on – set of rain fall, with crops being ready for harvest during December and February. The second season starts in January with a peak harvest during March and May. Uplands are not farmed from April to August due to the effect of "*kachchan*" winds.

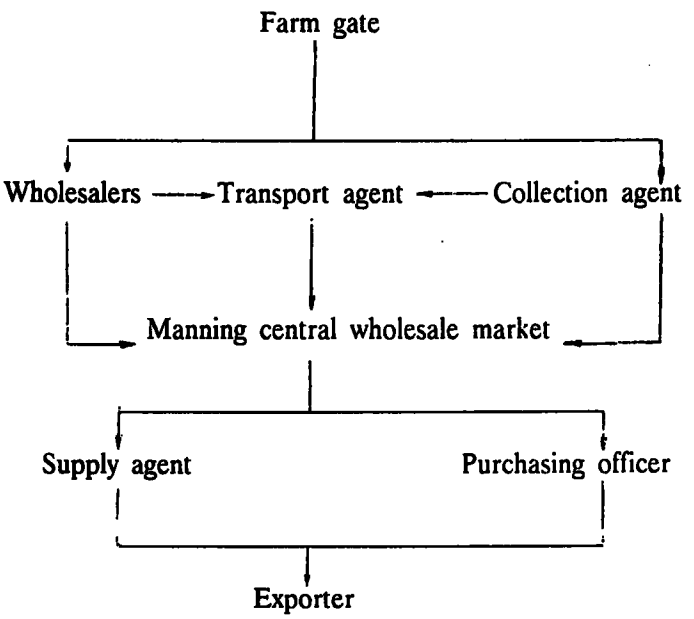

Figure 1. Marketing channel of tomato from farm gate to exporter

Normally farmers use paddy fields for tomato growing from June to December. However, farmers equipped with supplementary irrigation facilities cultivate throughout the year without considering seasonal patterns.

Tomato cultivars grown

Table 1 gives the number of farmers according to the cultivar grown.

Most of the farmers preferred to grow *cv. Marglobe*. Unfortunately farmers did not have any knowledge about the selection of cultivar in relation to postharvest losses. Only 6% of the farmers stated that they select *cv. Marglobe* because of its relative resistance to mechanical damage.

Table 1. Different types of tomato cultivars grown by the farmers in Bandarawela and Welimada areas.

Cultivar	Number of Respondents	%
1. *Marglobe*	48	52.2
2. *Tessary*	14	15.2
3. Katugasthota	6	6.5
4. *Marglobe/Tessary*	15	16.3
5. Katug:/*Marglobe/Tessary*	7	7.6
6. AVR/*Marglobe/Tessary*	2	2.2

Among the farmers 17.4% used seed materials from commercial producers, while others used seeds selected from their own crop.

Manuring and agro-chemical applications

Another important finding of the survey was that farmers did not use the recommended mixtures/ratios of fertilizer for both basal dressing and top dressing (Table 2).

Handling of agro-chemicals by the farmers was also studied. Table 3 reveals that most farmers used agro-chemicals against pests and diseases of tomato while 79% of the farmers did not follow recommended application procedures.

Harvesting

Harvesting interval of tomato varied from farmer to farmer as indicated in Table 4 and depended on the age of the crop and extent of the cultivation. Farmers seemed to base harvest intervals on the total crop that could be collected at a given time. This was often done at the expense of the stage of maturity of the product. According to the survey only 19.5% of the farmers took maturity into consideration at the time of harvest.

Table 2. The type of manure/fertilizer using pattern by the farmers.

Manure/Fertilizer	Number of Respondents	%
1. Basal dressing organic manure followed by Inorganic fertilizer as top dressing	42	45.6
2. Basal dressing organic manure and inorganic fertilizer followed by Inorganic fertilizer as top dressing	28	30.4
3. Only organic manure	6	6.5
4. Inorganic fertilizers not used in rainy seasons	16	17.4

Organic Fertilizer = Poultry manure, cow-dung, compost
Inorganic Fertilizer = TDM, Urea, Maxicrop

Table 3. Handling of agro-chemicals by the farmers.

Selection criteria	Number of Respondents	%
1. Not used	00	00
2. Use recommended types of Agro-chemicals in recommended dosage	19	20.6
3. Over dosage on their experience	42	45.6
4. Not read any description given	32	34.7

Table 4. Different Harvest intervals used by the farmers.

Harvest interval	Number of Respondents	%
1. Daily	18	19.5
2. 3 – 4 days (twice/week)	32	34.7
3. 5 – day	24	26.0
4. 6 – day	08	8.7
5. 7 – day (weekly)	06	6.5
6. No response	04	4.3

Upto 76% of the farmers took time of day into consideration when planning harvest. Among them 15% preferred to harvest between 9.00 – 10.00 a.m. and 61% harvested after 9.00 a.m.

Cleaning and grading

About 10% of the farmers did not practice any kind of cleaning after harvest. Upto 50% of farmers cleaned fruits using a piece of cloth, while others (13%) used this method only during the rainy season. Some farmers wiped only those fruits with patches of chemical residues on them as seen in Table 5.

Storage

Storage of tomato at the farmer level was very rare. The product was usually sold as soon as possible after harvest. However, some farmers were observed to store green tomatoes. Nineteen per cent of farmers harvest green tomatoes in order to prevent loss due to bird attack in the field. Ripening is induced prior to transportation. Fruits were ripened in the home by covering with a gunny. Alternately they were spread on the ground and exposed to sunlight for this purpose. Another group of farmers was found spraying an over dosage of agro – chemicals or spraying dissolved "Disprin" to induce ripening.

Table 5. Response according to the different basis used for grading.

Basis of grading	Number of Respondents	%
1. Not practiced	22	23.9
2. According to size	48	52.1
3. According to cultivar	4	4.3
4. According to size/cultivar	10	10.8
5. No response	8	8.7

B. Postharvest handling at the collection agent/wholesaler level.

Of the collection agents/wholesalers questioned in this study, more than 85% regraded and packed fruits after farm collection. The packaging was done in wooden boxes. Total fruit weight in a box varied from 18.5 to 24 kg. The main drawback with handling at this stage was poor condition of the wooden boxes.

About 89% of the traders followed a systematic way of filling the boxes. Green tomatoes were at the bottom while over mature fruits were placed at the top of the boxes. Different types of materials were used to cover the boxes such as Banana *pseudostems*, chickenmak bag papers, newspapers, pieces of bamboo sticks, *"hana"* leaves *etc.*

C. Postharvest handling at the Manning wholesale market, Colombo.

Further sorting out of fruits was practised at the Manning market. The traders graded them according to size, maturity and, less frequently, export quality. Losses were observed due to unloading in a haphazard way, and during re-packing.

Phase 2

Assessment of postharvest losses of tomato

A. At the farm gate

Table 6 shows the postharvest losses of tomato with respect to each cause of loss. The range of losses was 10.3% to 32% with the average value of 20.04%. Pre-harvest diseases such as pod borrer attack and blight contributed to more than 50% of losses at this stage. Losses due to over maturity at harvest and sun scorch damage were the secondary causes of loss.

B. At collection agent/wholesaler level

The most extensive cause of losses at this stage was mechanical damage due to over ripening, amounted to close on 52.8% of the total loss at this stage of the sequence as shown in Table 6. Due to further sorting out a loss of approximately 3% of fruits was recorded due to pod borrer attack. Losses due to sun scorch and blight disease were not significant.

C. At the Manning wholesale market

When fruits are packed for the local market, the losses at this point ranged from 17.9% to 57% with an average of 34%. About 35% of the total loss at this stage was due to poor packaging during transportation. A 19.7% loss was recorded due to mechanical and physiological damage of over ripe fruit.

With fruit destined for export, only 12.33% of fruits sorted were acceptable for despatch to overseas markets. More than 50% of fruits were rejected due to the unacceptable stages of maturity and size with respect to export market requirements.

Table 6. Assessment of postharvest losses of tomato at different marketing sequences.

Marketing sequences		Causes losses							Total loss	Cumulative total
		over maturity	bright	pod borrer	sun scorch	other	unacce: maturity	unacce: size/shape		
Farm	%	4.03	1.25	10.82	2.28	1.37[a]	-	-	19.75 + 5.7	19.75
gate	$1	20.1	6.23	53.99	11.37	6.84	-	-	100	
Wholesaler/ collect	%	7.73	0.67	3.17	1.21	1.86[b]	-	-	14.64 + 4.8	
agent	$2	52.8	4.57	21.65	8.26	12.7	-	-	100	
Actual	%	7.41	0.66	2.83	0.97	1.83	-	-	11.74	31.49
Manning market										
(A) Local	%	6.62	2.92	10.59	-	11.94[c]	-	-	33.57 + 13.3	
market	$3	19.7	11.49	31.54	-	35.53	-	-	100	
Actual	%	5.86	2.86	9.14	-	11.55	-	-	22.99	54.48
(B) Export	%	6.62	2.92	10.59	-	11.94[c]	39.45	10.41	81.92 +6.4	
market	$4	7.58	3.34	12.13	-	13.67	45.17	11.92	100	
actual	%	8.08	3.56	12.92	-	14.57	48.15	12.76	63.59	95.08
Exporter	%	-	-	-	-	2.0[d]	5.87	2.16	10.03	
	$5	-	-	-	-	19.41	58.52	21.53	100	
actual	%	-	-	-	-	0.17	0.5	0.18	0.85	95.93

$1 - Percentage losses with respect to total loss of farm gate
$2 - Percentage losses with respect to total loss of Wholesaler/Collecting agent level
$3 - Percentage losses with respect to total loss of Manning market when local market concerned
$4 - Percentage losses with respect to total loss of Manning market when export market concerned
$5 - Percentage losses with respect to total loss of exporter level

a - Birds attack, mechanical damage during harvesting and other minor causes of losses
b - Mechanical damage during transportation and other minor causes of losses
c - Mechanical damage during transportation, losses during unloading at the manning market and other minor causes of losses
d - Mechanical damages and other minor causes of losses

D. At the exporter level

Further selection based on maturity, size, shape and mechanical injury was carried out at the exporter level. Over – ripening was the significant factor when compared to the other criteria of selection (Table 6).

CONCLUSIONS

Total loss – local market

The total loss through the marketing channel from farm gate to Manning market was close upon 54%. The highest loss amounting to 22.9% occurred at the Manning market. With respect to causes of loss, pod borrer attack was the most significant, while mechanical damage of over ripe fruit and mechanical damage through transportation were observed to be the other significant causes of losses.

Total loss – export market

Finally only 4.07% of the tomato harvested is selected for quality and exported. Of the total losses/rejections 28.17% was due to unacceptable maturity for export. The above factors emphasise that it is very important to develop appropriate methods to reduce postharvest losses during the marketing sequence.

Effective extension service to educate farmers regarding pre – harvest techniques such as control of pest (pod borrer) and diseases (blight) is urgently needed in order to reduce post – harvest loss. Furthermore, development of suitable packaging and transport systems for tomato is very important to prevent losses from mechanical damage through the marketing channel. As quality selection is based on size, shape and maturity, with respect to local and export markets, further research should be initiated for the determination of maturity indices for tomato varieties of commercial importance in Sri Lanka.

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