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POST-HARVEST TRANSPORTATION LOSSES IN TOMATO AS INFLUENCED BY MATURITY STAGES OF FRUITS

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ABSTRACT

Losses of tomato fruits during transportation from the area of production to the market place are very great in Nepal. An experiment conducted at Outreach Research Site, Dhunubanse, Syangja District, Nepal showed that total loss of tomato fruits in transportation over a distance of 73 km from the site to Pokhara was 16 percent. Losses during the transportation were significantly different depending upon maturity stages of the fruit. Fruit harvested at mature green stage had the lowest loss (5.3%). The losses at pink and full red ripe stage were 19.3 and 24% respectively. There was also year x time of picking interaction due to high loss in 1994 season and insignificant difference between pink and full ripe stage fruit on the same year. In total the loss due to machanical damage to fruit was higher than the physiological losses. Hence, reduction of post harvest losses in tomato during transportation can be made by transporting fruit at the mature green or pink stages and reducing the mechanical losses during handling and transportation.

Additional Key Words: *Lycopersicon esculentum*, physiological loss, mechanical loss

INTRODUCTION

Tomato (*Lycopericon esculentum* Miller) is one of the most important vegetable crops grown throughout Nepal. Agricultue Research Centres in the past had concentrated on the varietal evaluation of tomato intensively. As an effect identification of suitable varieties for spring (Jan-Feb), rainy (May-Aug) and winter season (Nov-Feb) production in open field conditions has been achieved (LARC, 1997). Variety Pusa Ruby dominates all other varieties for winter planting in Terai. Where as Pusa Ruby, Roma, Monprecos, Moneymaker and some local varieties are used for commercial production in hills during the spring season. However, for the rainy season NCL-1, *Lapsigede*, Pusa Ruby and other local varieties are recommended as `appropriate varieties. Even though variety Pusa Ruby is the most widespread variety of tomato grown both for winter, spring, and rainy season production. With the availability of suitable technologies for growing winter, spring and rainy season tomatoes, the area, production and involvement of farmers in this crop have been noted to be increasing in the hills and Terai of Nepal.

Tomatoes produced in truck and market garden need to be safely transported to the market centres. From field to the market, a high rate of loss during transportation occurs. Very high rate of transportation loss in tomato up to 50 percent have been reported by National Academy of Science (1978), FAO (1983), and many local papers published in Nepal like Werner and Shakya (19982), Werner and Subedi (1991a) and Werner and Subedi (1991b), and Werner and Kaini (1997). Apart from this direct observation on tomato transportation, and feed back from farmers and traders, also suggest heavy losses during transportation. Minimizing the loss in transportation is, therefore, very important.

Loss of tomatoes during transportation is affected by variety, climate, plant nutrient, type of container, means of transport and distance of transportation. Estimate made in other areas under different situations of transportation may not represent to the local situation of Nepal. Post harvest loss assessment should be a benchmark study to devise means and ways for reducing

such losses. At the same time, the maturity stage of the fruit which also affect transportability, was considered useful for study. Therefore, this study attempted to focus on estimating losses over a transportation distance of between 70-80 km, and also to determine the effect of maturity stage upon the transport losses of tomatoes.

MATERIALS AND METHODS

The study was carried out at Dhanubanse, Syangja District Nepal, Outreach Research (OR) site of Lumle Agriculture Research Centre, which is 73 km by road from Pokhara on the Siddhartha Highway. The tomato crop variety Pusa Ruby was a popular variety of planted during February 1993 and 1994, local farmers. Fruits of three different maturity groups (mature green, pink and dull ripe) were harvested on the same day (1st June 1993 and 94), packed in different bamboo baskets, lined with jute sack, and covered on the top. A Completely Randomized Block Design (CRD) with five replications was used. Before packing, the numbers and weight of fruits per Doko was counted. Uniform weight was maintained per Doko, which in 1992/93 was 25 kg/Doko, and during 1993/94 was 20 kg/Doko. The packed tomatoes were transported on the same day of harvest on the top of a bus over the 73 km from Dhanubanse to Pokhara. Next day the sealed Doko were opened, and the marketable fruit, mechanically bruised and physiologically damaged tomamto fruits were separated and weighed.

RESULTS

Physiological Loss

Physiological losses of fruits comprised of a weight loss due to transpiration, rotting of fruits, and change in fruit colour statin. The mean physiological loss combined over maturity groups and years was 5.8% (Table 1). Combined analysis showed that the physiological weight loss in matured green fruits was significantly (P=0.00) less as compared to pink and full ripe fruits (Figure 1). However losses between pink and full ripe fruits did not differ significantly. The high proportion of physiological losses in 1994 season, associated with the presence of was dew on the f ruit, which when encountered the raised temperature of mid day, produced more heat inside the Doko, and thereby favoured quick rotting. Another cause for the same situation was also due to the fact that fruits in the early development stage of 1994 season were damaged by hailstorms, which resulted the significant (P=0.000) year x treatment interaction. In 1994 physiological loss (9.5%) was found significantly higher than in 1993 (1.9%). The wounding of fruits upon harvest, and being transported under high temperature and reduced oxygen regime resulted in rapid rotting.

Mechanical Loss

Losses caused by mechanical damage to tomato consist of bruising, wounding and squeezing of fruits due to rough handling, and inappropriate containers and transportation means. These types of loss are visible losses, which can both be counted and weighed. Mechanical loss averaged over years and maturity groups of the fruits accounted for 10.4% Figure 1). For the mature green fruit mechanical loss was significantly (P=0.018) less compared with the fruit at pink and full ripe stage fruits at these latter two stages did not differ significantly. The same trend of loss was observed for the individual season analyses of 1993 and 1994. The alone or its interaction with maturity stage was not observed for mechanical loss (Table 1).

Total loss

The total losses were the sumation of physiological and mechanical damages. Total loss averaged over years and treatments was 16.2% (Figure 1). In both combined and individual analysis mature green fruits had significantly less total loss during transport as compared to the pink and full ripe (red) stages. Compared to 1993, total fruit loss in 1994 was 8.2% more. This increase was mainly due to the high proportion of physiological losses in the second year (1994). The reason for high physiological loss in this year was indicated by a highly significant year x treatment interaction (Table 1).

Table 1. Post harvest losses in tomatoes harvested at three different maturity stages during transportation from Dhanubanse to Pokhara.

Maturity stag	Fruit loss during transportat (%) in 1993			Fruit loss during transportat (%) in 1994			Fruit loss during transportation (%) combined over years		
	Physio-logic	Mecha-nic	Total	Physio-logical	Mecha-nic	Total	Physio-logic	Mecha-nica	Total
Mature green	1.2	1.9	3.1	2.1	5.4	7.5	1.6	3.7	5.3
Pink	0.7	12.8	13.6	13.0	12.0	25.0	6.9	12.4	19.3
Full Ripe	4.0	15.6	19.6	13.6	14.8	28.4	8.8	15.2	24.0
Mean	1.9	10.1	12.1	9.5	10.7	20.3	5.8	10.4	16.2
SEp (8df)	2.9	3.6	2.5	2.8(8df)	4.1	2.86	2.9 (16df)	3.9	2.7
SEm	1.3	1.6	1.1	1.2	1.8	1.2	Yr: 0.55	1.32	1.39
							Ms:0.91	1.23	0.85
							YrxMs 1.82	2.54	1.20
SEd	1.8	2.2	1.6	1.7	2.6	1.8	Yr: 0.78	1.87	1.97
							Ms: 1.29	1.73	1.2
							YrxMs 1.82	2.54	1.7
Prob	0.218	0.000	0.000	0.000	0.018	0.000	Yr: 0.000	>0.50	0.003
							Ms: 0.000	0.000	0.000
							YrxMs 0.000	0.378	0.030

Note: Yr = Year, Ms = Maturity stage, YrxMs = Year x Maturity stage

DISCUSSION

Total loss over the transportation period was much lower for the mature green stage (5.3%) as compared to pink (19.3%) and full ripe (24%). Relatively low physiological and mechanical losses in mature green fruit compared to pink and full ripe was the result of a series of changes in composition of the fruit as ripening takes place. Degradation of starch and production of glucose and fructose, loss of chlorophyll, synthesis of pigments such as B-carotene and Lycopene, and an increase in soluble pectin resulting from cell wall softening and degradation makes the ruit more susceptible to physiological and mechanical losses during transportation. The same result was reported by Grierson and Kader (1986). Though Tiwari and Chaudhary (1986) defined six distinct maturity stages in tomatoes (Immature, mature green, turning, pink, hard ripe and over ripe) they also reported minimal losses in immature green, these immature fruits did not develop good colour subsequently upon ripening, whereas the mature green fruits do develop the proper colour when kept under similar conditions. Mature green fruits in this trial transported over 73 km on the top of a bus and stored for two days under mean ambient temperatures of 24-28 °C, produced normal and attractive colour; these could be easily sold and consumed. This means immature green fruit of tomato using ordinary transportation and storage systems connot be marketed, as they are unlikely to ripen properly.

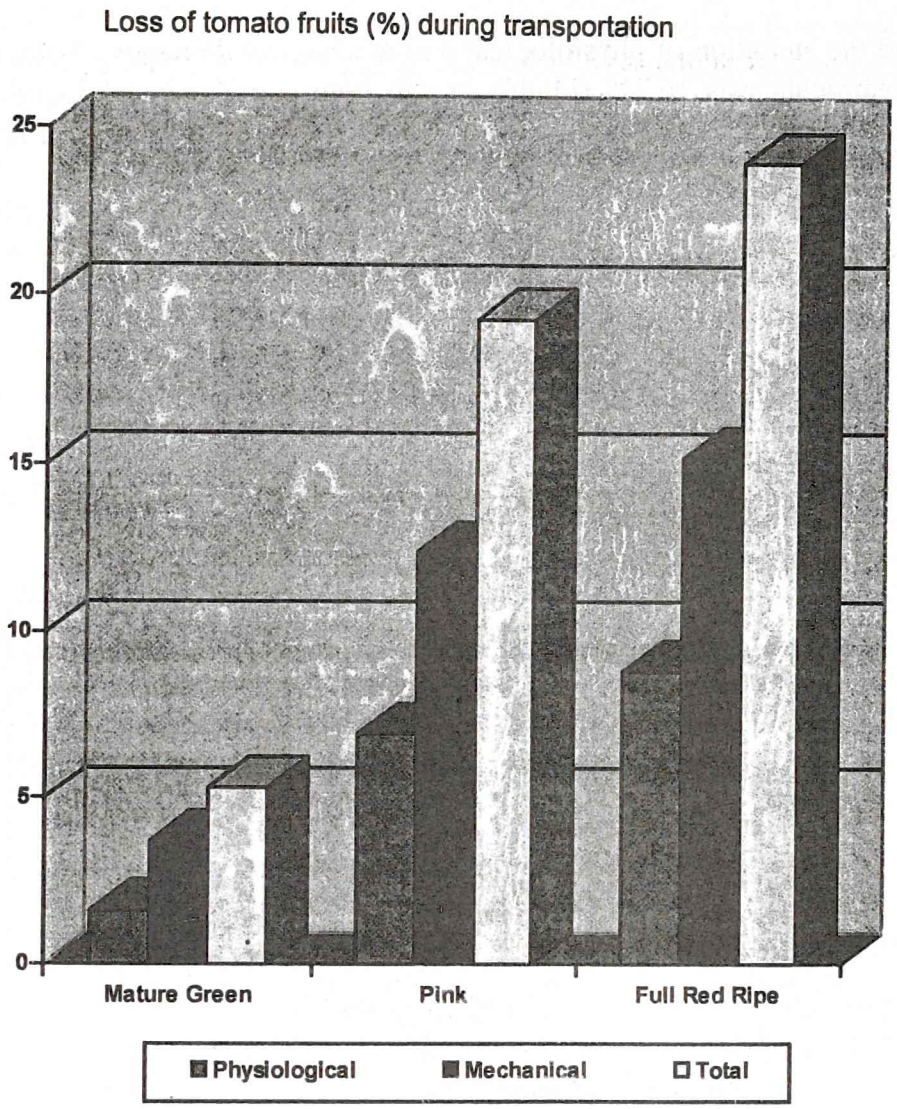

Figure 1: Transportation losses of tomato fruits (%) through different modes in three maturity groups (Mean over two years).

CONCLUSION

On the basis of two years experiment in the small sample that mature green fruit have relatively minimum losses of 5% contrast to 19-24% for pink and full ripe. So it shows that mature green fruits experience least transportation loss than pink and full ripe tomato fruits.

It is not only the maturity stage of fruits which determines the extent of transportation and other post harvest losses of tomato. The shape, and size of basket as is important as is the method of transportation, time and method of picking, materials used for the basket and use of lining materials, which also play key role in reducing post harvest and transportation loss of tomato fruits. These are other topics for future research.

The stage of maturity at which tomato should be harvested depends upon the purpose for which they are to be used and the distance over which they are to be transported. It also depends upon who transports the tomatoes, farmers, middle men or traders. Consumers who buy tomatoes prefer full ripe and pink types of fruits rather than mature green, as the last look unattractive and less appealing when used in dishes. However, the full ripe fruits do not transport well, and heavy losses occur, so this practice should be discouraged. Keeping the fruit

on the plant till full ripening stage also exhausts the plants quite early, and so contributes to low yield. Hence, considering distance and market purposes, only mature green and pink fruits are considered suitable for harvest. However, traders are reluctant to buy an enntire consignment of mature green, pink or full ripe fruit, and need fruits of all three maturity group, so that they can better meet their consumers needs. Mixing the three different maturity groups of fruits together, and studying the transportation losses may go some way to meeting these requirements.

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