

Farmers perception about yield losses of kinnow (*Citrus reticulata*) during its harvesting and post harvesting operations: A case study of tehsil Sargodha, Pakistan

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Key Message During this research, various factors causing yield losses of kinnow during its harvesting and post-harvesting operations were studied in tehsil Sargodha Pakistan, which is famous for high production of kinnow.

ABSTRACT Kinnow is one of the major fruit crops of Pakistan and it is produced at a large scale in Punjab province of Pakistan. In Punjab province, the district Sargodha is famous for high production of kinnow. Unfortunately, during harvesting and post harvesting operations, the losses of kinnow yields in Pakistan are higher than that of other kinnow producing countries of the world. Therefore, this research study was conducted to observe various factors leading to yield losses of kinnow during harvesting and post harvesting. For it, 20 union councils of tehsil Sargodha were selected and from each union council, 10 kinnow growers were selected randomly. A total of 200 farmers were selected for the sample. The results revealed that 91% farmers reported fruit injuries during picking. A majority of farmers (67%) reported that 20% losses of the total yield occurred during picking. (51%) and 70% farmers did not have transport capabilities and storage facilities, respectively so losses occurred during these stages. Rough handling should be avoided during harvesting operation. Due to the defective marketing system, the farmers get low income which discourages the farmers from adopting recommended orchard management practices. Therefore, government should pay due attention to the establishment of an effective citrus marketing system.

Keywords: Harvest and post-harvest, Kinnow, Sargodha, Yield losses

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INTRODUCTION

Fruits are an important part of Pakistan's agricultural exports. The environment and soil of Pakistan is very favorable for the production of fruits. Due to the favorable environment approximately 30 types of fruits are commonly produced in Pakistan. The most common fruits produced in the country are citrus, mango, apple, dates, grapes, banana, melons and guava (Khan & Shaukat, 2006; Government of Pakistan, 2008-2009; Shahzad et al., 2015). In terms of area utilized, production and export, citrus are at the top among all other fruits produced in Pakistan (Ghafoor et al., 2008).

In Pakistan, it has been reported that 29.55% of the total area under fruit cultivation accounts for citrus, while 60% of total acreage under citrus cultivation is being used for kinnow cultivation (Government of Pakistan, 2003-2004). Likewise, due to more area under cultivation, the production and export of kinnow leads among the citrus fruits. In Pakistan, the highest citrus yielding province is Punjab that covers 95% of the total area of the country under citrus farming (Tahir, 2014). Pakistan is among the top ten kinnow producing countries. In Pakistan, citrus is playing a significant role in creating employment by engaging manpower in several activities ranging from its production to its harvesting. In an estimate, more than 75,000 people secure jobs by performing activities of kinnow production and its marketing in Pakistan (Sharif et al., 2005).

Pakistan exports kinnow to Kuwait, Saudi Arabia, Dubai, Bahrain, Oman, Qatar, Netherlands, Singapore, Indonesia, UK, Russia and Malaysia.

There are various harvesting and post-harvesting problems which citrus industries in Pakistan are facing. Due to these problems, the quality and quantity of the citrus fruits are being adversely affected. As a result, there is less export of the fruit that brings high economic loss to the country. In Pakistan, the common practice of mandarin harvesting is plucking of fruit along with pedicels and clusters of leaves that account for major injury during transportation.

The highest post-harvest loss of citrus especially kinnow has been reported in January to February. It is due to less usage of cold storage at domestic level of marketing, as severe cold prevails during these two months. The contractor tries to secure high price of fruit due to delayed plucking, but on the other hand, this delayed plucking highly affects the flowering of plants for the coming season. The producers like to prepare their orchards as early as possible. This situation produces clashes between these parties. Moreover, less use of cold storage also causes losses due to frost and diseases that cause significant financial loss for kinnow producers (Shah et al., 2015). Lack of knowledge about marketing results in pre-harvesting of citrus. The commission agents are not interested in transferring information about market price to producers and it is a great barrier for producers to participate actively in the process (Sharif et al., 2005).

The other major factors that contribute to post-harvest losses of citrus include operational efficiency, pre-cooling, treatments such as fungicides and waxes, and storage conditions (Kader & Arpaia, 2002). Ali (2004) investigated the marketing of citrus fruits in Pakistan and reported that traditional methods of citrus cultivation and non-technical harvesting were the core reasons affecting the production potential of citrus. In addition, these activities were also causing post-harvest losses. There is an immediate need to stabilize the market and guide farmers to adopt sustainable and effective harvesting methods. Keeping in view these facts, the present study was carried out to identify the causes of yield losses of kinnow (Mandarin) during harvesting and post harvesting (2011-2012). In this study, district Sargodha was selected as a study area because it is the main district of kinnow production in Pakistan.

METHODOLOGY

The descriptive method of research was used for this study. Purposively, 20 union councils from tehsil Sargodha were selected, and 10 kinnow growers from each union council were taken on a random basis. (200) farmers were interviewed through interview schedule. The farmers were interviewed by a researcher personally at their homes and farms. Busy hours of the farmers were respected, and interviews were conducted at their free time. The objective of the research study was explained to the farmers before starting the actual interview. The data collected was tabulated systematically and analyzed statistically. Statistical Package for Social Sciences (SPSS) was used for data analysis. All the results were presented in counts and percentages in different tabular form. The associations of picking, storage, and post-harvest factors with yield of kinnow were tested with the help of chi-square test at 0.05 level of significance. Significance level is the probability of rejecting the null hypothesis when it is true. In this survey research, the data was analyzed at significance level of 0.05 which indicates a 5% risk of concluding that a difference exists when there is no actual difference.

RESULTS

The main objective of this research project was to study the yield losses of kinnow (Mandarin) during harvesting and post harvesting operations. Therefore farmers were asked various questions regarding the factors that cause kinnow losses.

Distribution of farmers for harvesting of kinnow fruits

The harvest season of citrus starts from September with harvesting of Feutral's Early and ends up to March with the harvesting of kinnow, of which sometimes the harvesting continues up to April. The appropriate time of harvest determines the net profit of the producers. The methods of harvesting of citrus are being changed from time to time and farmers tried to make improvements keeping in mind the resources and

technical knowledge. The farmers were asked about the method of picking of kinnow (Mandarin) fruit. The data in table 2 shows that all farmers were picking the fruit by hand with cutter.

Losses of kinnow fruits during picking

Farmers were asked about the fruit injury caused during picking of kinnow fruits. A majority of the farmers (91%) reported injuries of kinnow fruit during the picking. While 9% respondents answer was “No” about injuries of fruit during the picking, our study found a clear association of fruit injuries with yield of kinnow fruit (Table 3).

Percentage of losses of kinnow fruit during picking

The farmers were asked about percentage losses of kinnow fruit of the total yield during picking. The data presented in table 4 shows that a majority of the farmers (67%) reported that up to 20% losses of the total yield occurred during picking, followed by the farmers (20%) who reported losses between 21-35% during picking. Only 4% reported losses above 50% during picking, and 9% farmers reported no loss during picking. There was significance difference ($P < 0.05$) between percent fruit losses and yield of kinnow.

Distribution of farmers according to their access to kinnow market

In Pakistan traditional marketing of agricultural products is not functioning efficiently in the modern market place. There are differences between prices paid by the consumers and prices received by the growers. In this way, marketing affects the production of kinnow fruits. Interviews were conducted to learn about the marketing problems and their effects on the yield of kinnow. The farmers were asked about the access to the kinnow market. The data presented in the table 5 shows that a large majority of the farmers (89%) had access to market. Only 11% farmers had no access to the market.

Type of kinnow market/selling of kinnow fruit

The farmers were asked about the type of kinnow market. The data given in table 6 shows that a majority of the farmers (68.5%) sold their fruit to the local agent.

Ways of selling kinnow fruit

Farmers were asked about their strategies for selling their fruit. A large number of the farmers (78%) sold their fruits through cash payment (Table 7). There was significance difference ($P < 0.05$) between the way to sell kinnow fruit and the yield of the kinnow fruits. Late payment by the dealers and lower prices in the market discourage the growers, while reasonable prices and cash payments encourage the growers to adopt recommended harvesting and post harvesting technologies to get high citrus yield.

Distribution of farmers with access to transport facilities

The farmers were also asked about the transport facilities to carry fruit to the market. A majority of the farmers (51%) replied that they did not have transport facilities to carry fruit from the field to the market (Table 8). They hired transport to the market place.

Fruit storage facilities

Storage facilities for citrus are an important factor for stabilizing the price of citrus fruits. The farmers were also asked about the storage facilities of kinnow fruit. A majority of the farmers (70%) reported that they did not have storage facilities, while 30% farmers had storage facilities (Table 9). There was significance difference ($P < 0.05$) between storage facilities and the yield of kinnow (Table 9). Proper storage facility is very important for marketing of kinnow. Non-availability of refrigerated transport facilities and poor condition of the roads, are responsible for high losses of kinnow. The farmers hire the cold storage at very high rate. Due

to the absence this storage facility, the yield of kinnow is adversely affected and thus loss to Pakistan Economy.

Preference to have fruit storage facilities

When farmers were asked if they would like to have better storage facilities, a majority of the respondents (67%) reported that this would benefit them. There was also significance difference ($P < 0.05$) between the preference of the farmers to have storage facilities and the yield (Table 10).

Table 1 Provincial wise area and production of citrus cultivation in Pakistan

Province	Area (Hectares)	Production (Tones)
Punjab	182558	2328090
Sindh	4930	29668
Khyber Pakhtunkhwa	3840	30871
Baluchistan	1504	6921

Source: Fruit, Vegetables and Condiments Statistics of Pakistan, 2014-15

Table 2 Distribution of farmers for harvesting of kinnow fruits

Fruit picking	Frequency	Percentage	Total
Manual	200	100	200
Any other method	-	-	-

Table 3 Losses of kinnow fruits during picking

Response	Frequency	Percentage	Chi-square significance level
Yes	182	91.0	0.001
No	18	9.0	
Total	200	100	

Table 4 Percentage of losses of kinnow fruit during picking

Response	Frequency	Percentage	Chi-square significance level
No losses	18	9.0	0.000
Up to 20%	134	67.0	
21-35%	40	20.0	
36-50%	8	4.0	
Above 50%	-	-	
Total	200	100	

Table 5 Distribution of farmers with access to kinnow market

Response	Frequency	Percentage
Yes	178	89
No	22	11
Total	200	100

Table 6 Type of kinnow market/selling of kinnow fruit

Response	Frequency	Percentage
No access to market	22	11.0
Local agent	137	68.5
Wholesale	31	15.5
Personal order	8	4.0
Any other	2	1.0
Total	200	100

Table 7 Ways of selling kinnow fruit

Response	Frequency	Percentage	Chi-square significance level
Cash payment	156	78.0	0.000
Advance payment	32	16.0	
Loan	8 (4.0)	4.0	
Any other	4 (2.0)	2.0	
Total	200 (100.0)	100	

Table 8 Distribution of farmers with access to transport facilities

Response	Frequency	Percentage
Yes	98	49.0
No	102	51.0
Total	200	100

Table 9 Fruit storage facilities

Response	Frequency	Percentage	Chi-square significance level
Yes	60	30.0	0.000
No	140	70.0	
Total	200	100	

Table 10 Preference to have fruit storage facilities

Response	Frequency	Percentage	Chi-square significance level
Had facility	60	30.0	0.002
Yes	134	67.0	
No	6	3.0	
Total	200	100	

DISCUSSION

Pakistan is among the top ten kinnow producing countries. Kinnow is produced at a large scale in province Punjab, Pakistan. In addition to providing income, it also generates employment for the poor masses involving them in diverse activities from production to marketing. But its yield is reduced drastically during harvesting and post harvesting operations. The highest loss of kinnow production occurs in January-February due to unavailability of cold storage at domestic level resulting in severe diseases that cause significant financial loss for kinnow growers (Shah et al., 2015). We were interested to learn about the farmers perceptions about the yield losses of kinnow during harvesting and post harvesting activities. Therefore, a descriptive method of study was employed in tehsil Sargodha because in Punjab province, Sargodha is at the top in kinnow production.

Coherent with our findings, Ghafoor et al. (2010) conducted a study to investigate harvesting and marketing problems faced by citrus growers. They reported that lack of storage facility and non-availability of packaging materials like carton were the major constraints of harvesting and post harvesting of citrus being faced by the farmers. In addition, farmers were of the view that late payment by dealers, low price of kinnow in domestic market, middleman monopoly, high handling charges, inadequate storage facility, packaging and loading factors were hampering the productivity potential of citrus. Our findings were in agreement with the earlier research report by Ahmed et al. (2015) who conducted a study to quantify the post-harvest losses of kinnow at various stages i.e. at farm, wholesale market and retail levels of district Sargodha Pakistan. They reported that post-harvest losses at farm, wholesale market and retail levels were 72, 25 and 3% of the total post-harvest losses of kinnow, respectively. Overall post-harvest losses (45%) of the total production were reported in the study area. Their study suggested a scientific approach to minimize losses and this empirical study estimated the major determinants of post-harvest losses at transportation and retail level, as well as farm level.

Vadivelu and Kiran (2013) defined agricultural marketing as commercial functions which are involved in transporting agricultural products from producer to user. Another dimension reflected by agricultural marketing is supplying the products from rural areas to rural, urban and industrial areas. In modern era with the introduction of latest technologies and agricultural revolution, many stakeholders like farmers, middlemen, commission agents and customers are involved which have completely re-shaped the process. Various activities are involved in the whole process from planning production to the sale. It covers the phases of growing, harvesting, grading, packaging, transporting, storing, food processing, distributing and advertising. Hence agricultural marketing is a complete and vast process that requires a complete system of exchanging information. Anjum (2000) reported that there are two types of marketing systems in Pakistan. One is primitive marketing system and the other is traditional marketing system with little degree of scientific approach. During the study, it was found that the marketing structure was diversified and flexible in nature depending upon commodity's problems and conditions prevailing in various parts of the country. Market is still controlled by merchants, village traders and commission agents and there is not improvement in the marketing system. The physical infrastructure in the markets like cold storage, adequate transport arrangements and processing plants are also inadequate.

Our findings coincided with the earlier proposition by Farooq et al. (2016) who studied the problems of fruit growers to their access to market in district Neelum Azad Jammu and Kashmir. It was an imperative phase to see the lives of masses, while spending a reasonable time period of life in the plantation of fruit trees and expecting the margins in the long run. The fruit production in Pakistan is expanded and more than 21 varieties of fruits are being produced in the country. The study drew attention to the problems faced by fruit growers towards the market access. The study concluded that fruit growers faced numerous problems in the process of fruit growth. The rudimentary apathy evaluated so far is the absence of basic civic facilities i.e. awareness, sprays, fertilizers, market related issues and road access which might not be difficult task for the government to access such fertile area and support people for the revenue generation activity. However, there is a need of special attention i.e. provision of pesticides, protection of fruit trees and provision of new varieties of fruit trees and adequate irrigation facilities along with the packing and pricing factors which impeded the small scale fruit growers specifically and large scale fruit growers generally to access market and restrict the fruit growers to produce a reasonable revenue for their livelihood. A similar nature of study was conducted by Basra and Farooq (2006) who revealed that there are many marketing problems in Pakistan

such as monopoly of middlemen, false weighing, illegal dues and deductions, involvement of local contractors, lack of marketing extension service and lack of advance marketing loans to small farmers. Abdullah and Hossain (2013) revealed that markets are located at urban areas so the farmers usually try to sell the produce at farm gate to avoid the transportation and other costs. As a result, they have to depend upon the commission agents who make payments to farmers at the spot or make promise to pay money within a stated time period. These middlemen pay lower price as compared to the market price.

CONCLUSION

All the farmers were picking the fruit by hand with cutter. The most of the farmers (91%) reported injuries of the fruit during picking. A majority of farmers (67%) reported 20% losses of the total yield during picking. There was close association among fruit injury, fruit losses and the yield. (89%) of the farmers had access to kinnow (Mandarin) market. (68.5%) of the farmers sold their fruit to the local agent. 78% farmers sold their fruits by cash payment. A majority of the farmers (51%) did not have transport facilities. A majority of farmers (70%) did not have storage facilities. 67% of farmers wanted to have storage facilities.

RECOMMENDATIONS

1. The kinnow picker must be trained to avoid any loss or injury of fruit during picking. Rough handling should be avoided during harvesting operation. The fruit should not be pulled from the branches during harvesting as the skin from the stem end can be ruptured. Long stems left on the fruit must be removed during packing, as the stem left on the fruit can damage other fruits, thereby causing spoilage and fruit loss. Ladders should be used to reach fruits born on high branches. Ladder placement in the tree should do carefully to avoid damaging fruit on the tree and limb breakage.
2. Due to the defective marketing system, the farmers get low income which discourages the farmers to adopt recommended orchard management practices. Therefore, government should pay due attention to the establishment of effective citrus marketing system.
3. Cold storage facilities should be made available in the vicinity of kinnow growing areas. Due to the lack of proper warehouses to store kinnow and existing storage facilities, all the fruits and vegetables are being kept in a similar temperature under one roof, which reduces the shelf life of the fruits.

Author Contribution Statement Nowshad Khan generated the idea and supervised the research. Farhat Ullah Khan conducted the research project and analyzed the data. Fouzia Anjum helped in manuscript writing. All the authors read and approved the manuscript.

Conflict of Interest The authors declare that they have no conflict of interest.

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