

*Full Length Research Paper*

# Post-harvest losses in tomato and fresh bean production in Tokat province of Turkey

Esen Oruc Buyukbay\*, Meral Uzunoç and H. Sibel Gulse Bal

Department of Agricultural Economics, Faculty of Agriculture, Gaziosmanpasa University, 60240, Tokat, Turkey.

Accepted 1 April, 2011

**In the present study, behaviors of farmers in Tokat Province towards marketing of tomato and fresh bean were studied. Basic material of the study was the data obtained from tomato and fresh bean producing farmers in Central District of Tokat Province using a face-to-face questionnaire. Simple Randomized Sampling Method was used to determine the sample size. Available marketing facilities, problems related to them and losses due to these problems were determined. The level of farmers' awareness in marketing and their efforts to gain more information about it were also revealed. Findings showed that, annual income level had an effect on harvest and storage in tomato. The producers with higher incomes made better harvest and transportation. They also stored their product after the harvest. According to the results, advanced techniques and alternatives in tomato and fresh bean harvest and marketing were not known by the farmers in the area. The farmers were not aware of the benefits of alternative techniques. Even if they were in need of making changes in marketing, they were not informed and equipped about how they could do it. After an efficient training program, effects of experience, educational level and annual income could be more apparent.**

**Key words:** Post-harvest losses, marketing losses, tomato, fresh bean, storage, packing, grading.

## INTRODUCTION

Thanks to its climate and geography, Turkey is one of the world's leading producers of fresh fruits and vegetables. Turkey ranks the third globally in total tomato production (Cakiroglu, 2009). Based on 2009 data, about 10.7 million tons of tomato and 604,000 tons of fresh beans were produced in Turkey. Tomato ranks first in Turkey in terms of production, accounting for 39.08% of all vegetable production. Share of fresh bean in total production is 2.04% (FAO, 2009). Tomato production has almost doubled in the last ten years as a result of production increases (Sarisacılı, 2009). Tomato production has considerably increased in January to April 2009 period, compared to the previous year. It was suggested that when the weather conditions are right, there could be a yearly production increase of 25% in this crop (Cakiroglu, 2009). Tokat province accounts for 5.13% of tomato and 6.18% of fresh bean production of Turkey. Tomato makes

up 47% of total vegetable production area of Tokat. About 13,000 families are engaged in tomato farming in the province (MARA, 2009).

Tomato and fresh bean are two significant vegetables for Turkish domestic market because of their common use in traditional Turkish cookery. More than one-third of average daily vegetable consumption of 630.14 g in Turkey's is constituted by tomato alone (232.88 g), which makes it the leading vegetable in Turkey (FAO, 2009). Tokat Province has considerable amount of fresh fruit and vegetable production. Especially tomato is gaining importance in the province because of its export possibilities in recent years. Tomato and fresh bean have significant shares in agricultural production and income in the province. Marketing strategies and practices could make significant difference in the revenue obtained through them. In other words, where and under what conditions these crops are produced and whom they are sold to affect the revenue from them. Some of the first steps to develop solutions for the problems about these two crops, are to determine the harvest and post-harvest applications as well as to detect losses which occurred in

\*Corresponding author. E-mail: [eoruc@gop.edu.tr](mailto:eoruc@gop.edu.tr). Tel: +90 356 252 16 16/2276. Fax: +90 356 252 14 88.

these stages. Post-harvest loss is a “measurable quantitative and qualitative loss of a product at any moment during the post-harvest chain” and includes the “change in the availability, edibility, wholesomeness or quality of the food that prevents its consumption” (Troger et al., 2007).

Losses during and after the harvest result in major problems in marketing. These losses were studied by many investigators. Turan (2008) reported that improper harvest and post-harvest practices result in losses due to spoiling of the product before reaching the market, as well as quality losses such as deterioration in appearance, taste and nutritional value. The investigator mentioned that, such improper practices risk the marketability of the product, lower the prices and shorten the duration in which the product can be stored. In a survey made by State Planning Organization in 2007, about 6.46 million tons of tomato produced annually is sold in markets as fresh. A great majority of this amount (6.24 million tones) is sold in domestic markets, and only about 227 thousand tons were exported. According to the same study, 1.75 million tons of tomato was processed in that year. The remaining 1.5 million tons of tomato was mentioned as losses (SPO, 2007). This amount, accounting for 15.00% of total production, can be considered as the losses during the marketing, since they occurred after the production.

Ozcan (2007) mentioned that, the losses occurred during harvest, preparation for market, transportation and consumption of fruits and vegetables vary from 15.00 to 50.00%. Kumar et al. (2004) stressed that main limitations about marketing of the tomato in India were insufficient processing capacity, poor communications about market conditions, erroneous measuring and pricing policy, delayed sales and payments, lack of information and organization in the marketplace and lack of projection about sale volume. They also added that development of vegetable production is only through the prevention of marketing losses except for increasing of the acreage. Reddy (2004) reported that, post-harvest losses should be eliminated in order to have vegetables in the market for all year round. The investigators mentioned what should be done under the headings of cold storage, vacuumed packaging and lactic acid fermentation.

In two different studies conducted in Ayaş and Nallıhan districts of Ankara, it was found that the losses in tomato during the harvest period varied from 5.15 to 9.83%. It was pointed out that, precautions taken by producers until the harvest maturity are not sufficient, and necessary measures should also be taken during harvest and after harvest period, in order to decrease or eliminate the losses (Tatlıdıl et al., 2003; Demircil et al., 2005). Singh et al. (2004) reported post-harvest losses varying from 6.70 to 33.50% for tomato and about 7.50% for fresh bean in India. In addition to the aforementioned studies, many other studies and sources refer to the substantial losses occurred during production, harvest

and post-harvest operations in fresh fruit and vegetables. Especially during marketing, about 20 to 30% of fresh fruit and vegetable product is wasted before reaching the consumer (Kumar, 2004; Reddy, 2004; Klein and Lurie, 1991; Sabir et al., 2009). As in many other fruits and vegetables, there are studies about the harvest time and method to decrease or eliminate yield and quality losses, and the measures to be taken to prolong the storage period and their effects on the quality in tomato and fresh bean (Kaynaş et al., 1997; Batu, 1999; Şahin and Erkan, 2009). However, studies, especially local ones, to reveal the importance of the losses for producers and regional, as well as national economies are still needed.

In the present study, behaviors of farmers in Tokat province towards marketing of tomato and fresh bean were studied. Available marketing facilities, problems related to them and losses due to these problems were determined. The level of farmers' awareness in marketing and their efforts to gain more information about it were also revealed. Therefore, the aims of the present study were to determine losses during and after the harvest in tomato and fresh bean and to reveal relationships between practices and some socio-economical features of producers.

## MATERIALS AND METHOD

This study was carried out in Tokat province in Mid-Black Sea Region of Turkey. Tokat province is located between 35°27' and 37°39' East longitudes, and 39°52' and 40°55' North altitudes. The province has a climate with a transition feature between Black Sea Maritime climate and Anatolian Continental Climate. Long term average annual temperature varies from 8.1 to 14.2°C. Long term annual precipitation varies from 381.8 to 586.2 mm. Average relative humidity is between 56 and 73% (MARA, 2006). Tokat province has an intensive tomato production and account for 5% of tomato production of Turkey (Gunduz and Esengun, 2007; MARA, 2009).

Basic material of the study was the data obtained from tomato and fresh bean producing farmers in central district of Tokat province using a face-to-face questionnaire in 2008 production year. Simple Randomized Sampling Method was used to determine the sample size using the following formula (Yamane, 2001):

$$n = \frac{N\sigma^2 t^2}{(N-1)d^2 + (\sigma^2 t^2)}$$

Where:

$n$  = number of farmers to be sampled,  $\sigma^2$  = variance of the population,  $d$  = acceptable error,  $t$  =  $t$  value of standard normal distribution.

The number of farmers to be randomly sampled was calculated 92 for tomato and 40 for fresh bean at 90% of confidence level ( $t = 1.65$ ) and with 10% acceptable error. Based on the data from interviewed farmers, harvest processes of tomato and fresh bean were assigned points. Farmers were given points for each of the following four criteria: 1) harvest time, 2) harvest method, 3) packing in boxes or bags and 4) transporting to point of marketing. Thus, each farmer had a total point. Using this point, relationships

between harvest operations and some factors such as farming experience, annual income and education level were investigated.

Besides, chi-square analysis was employed to determine if significant relationships were present between such factors and some storage, sizing and marketing considerations. Based on assigned points, the farmers had point totals varying from 6 to 16. The farmers who harvested all of the products in correct harvest maturity period using the best method, performed filling the cases or sacks, and transportation without any losses took 16 points. For each missing or faulty operation, two points were subtracted. Producers were categorized into two groups based on the total points they got.

## RESULTS AND DISCUSSION

Some characteristics of interviewed producers such as age, experience in farming and educational criteria were evaluated at the beginning of the investigation. Tomato and fresh bean farmers were evaluated together. Average age of the producers was 45 and experience in farming was 31.14 years. Primary school was the predominant educational level (60.64%) among the farmers, followed by secondary school (23.40%), and high school and over (10.64%). There were some illiterate (3.19%) and some unschooled but literate farmers (2.13%). Average land size was 3.419 ha. Majority of the land (77.95%) was irrigated. Acting collectively through farmers unions make farmers stronger against third parties or groups. Membership of farmers in any union or cooperatives was also investigated. Based on the results, 63.83% of the producers were members of at least a cooperative.

### Harvest, placing in cases, filling cloth bags, and transportation

As in many other fresh fruit and vegetable, there could be considerable losses in product amount and quality in tomato during harvest and post-harvest practices. It is crucial to pick the tomato in correct developmental stage using the best method and not to cause harm during placing into the containers to be transported (cases, boxes, etc.). Transportation method and conditions are also significant. There could be product and/or income losses in early, as well as late, picked product. Some of the investigated topics were whether the producers made the harvest at the correct stage of development, whether they made the harvest without causing damage to the product or the plant, whether they filled the cases or boxes carefully without damaging the product and whether they transported the product in good conditions. The percentage of the producers who made the harvest early was very low (1.09%), while that of the ones who reported to have made it late was 41.30%. Based on farmers' accounts, an average of 12.97% loss occurred due to the delays in harvest.

Producers mentioned that, these losses are greater in the years when marketing the tomato is difficult due to

imbalances in supply and demand for the product. In those years, the product is not harvested until a buyer appears.

Losses due to early harvest seemed to be lower (5.00%). More than half of the tomato producers (57.61%) maintained that, they harvest the tomato at the right time and occasionally have to keep the crop in vines without harvesting in the years when the demand for the crop is very low and marketing is really difficult (Table 1). Tomato has a soft and easily damageable tissue. Therefore, it is important that the tomato should not be harmed while picking and should be in a good appearance. Based on the interviews, 30.43% of the farmers reported that, there could be some deterioration in product during picking, that some damages were done to plants and that some of the product were too damaged to be marketed. Based on their experience, the average income loss was 6.92% (Table 1). Tomato is placed in cases and taken to market place after the harvest. In the region, wooden or plastic cases are used for tomato. Product and income losses occur due to old cases whose surface is rough and to excess loading in cases. About one third of the producers (32.61%) said they experienced such losses. According to these producers, erroneous practices during case filling result in product losses of about 6.56%.

Tomato filled in cases can be damaged during transportation, too. Although, the producers who thought that they had less chance of selling the product or they had income loss was not very high (13.04%), they thought the income loss could be considerable (12.58%). Most of the farmers did not think they had significant income loss because a great majority of the farmers sold their products in the market areas established in their villages rather than transporting it to long distances. Fresh bean losses its water and its freshness after the harvest. When the harvest is not made properly, both plant and the product are damaged, and product and income losses occur (Karagol, 2007). Fresh bean producers in the experimental region fill the product in cloth bags and gives to buyers. During the process, careless or excess filling and leaving the bags in unsuitable areas, etc. cause losses in the amount and quality of the product. 27.50% of the producers interviewed reported an average income loss of 9.18% due to losses and deteriorations during bag filling. Some of these producers reported that, buyers make some reductions in the weight of fresh bean packed in cloth bags. 15.00% of the producers reported that, they experienced an average of about 15.00% income loss due to spoiling of the product and other losses during transportation (Table 1).

### Grading

For many products, grading based on appearance before sending to the market increases selling chance and the

**Table 1.** Practices about harvest, placing in cases, filling cloth bags, and transportation in tomato and fresh bean production.

|                   |               | Tomato    |        |                  | Fresh bean |        |                 |
|-------------------|---------------|-----------|--------|------------------|------------|--------|-----------------|
|                   |               | Farmer    |        | Product/         | Farmer     |        | Product/ Income |
|                   |               | Frequency | %      | Income loses (%) | Frequency  | %      | loses(%)        |
| Harvest time      | Early         | 1         | 1.09   | 5.00             | ---        | ---    | ---             |
|                   | Late          | 38        | 41.30  | 12.97            | 11         | 27.50  | 18.44           |
|                   | At right time | 53        | 57.61  | ---              | 29         | 72.50  | ---             |
| Harvest method    | Suitable      | 64        | 69.57  | ---              | 25         | 62.50  | ---             |
|                   | Unsuitable    | 28        | 30.43  | 6.92             | 15         | 37.50  | 7.20            |
| Casing            | Suitable      | 62        | 67.39  | ---              | ---        | ---    | ---             |
|                   | Unsuitable    | 30        | 32.61  | 6.56             | ---        | ---    | ---             |
| Filling cloth bag | Suitable      | ---       | ---    | ---              | 29         | 72.50  | ---             |
|                   | Unsuitable    | ---       | ---    | ---              | 11         | 27.50  | 9.18            |
| Transporting      | Suitable      | 80        | 86.96  | ---              | 34         | 85.00  | ---             |
|                   | Unsuitable    | 12        | 13.04  | 12.58            | 6          | 15.00  | 15              |
| Total             |               | 92        | 100.00 | ---              | 40         | 100.00 | ---             |

price, and make marketing easy. The results about grading made by the farmers in the region are given in Table 2. Results showed that, 68.48% of the producers grade all or some part of the tomato based on size and discard the ones not suitable for marketing. Producers grade some of the tomato based on size on buyers' demand.

Percentage of farmers who sold the tomato without making any grading was 31.52%. 82.76% of these producers thought that, they had income losses of about 19.05%, while 17.24% of the producers said that they did not have any income loss. Buyers who demanded grading were dominantly exporters or middlemen who sell the product in high-price markets. These buyers demand better quality products.

According to Turkish Standards Institute's criteria, size grading in fresh bean is made based on the maximum width of the pod with 3 mm intervals, measured as inclined towards the veins, and expressed in cm. In addition to size grading, there are also other grade features defined by the Institute. There are four grades namely 1) Extra, 2) Grade I, 3) Grade II and 4) Grade III based on product quality (UPMFD, 2006). Farmers in the region, on the other hand, fill the fresh bean in sacks and sell without making any size-grading. They think that size-grading is not necessary for fresh bean. There was only one producer thinking to have income loss due to lack of size-grading. However, even that producer did not do this practice because of high labor costs involved and lack of buyers who would pay better prices for size-graded fresh bean (Table 2).

## Storage

Storage facilities are very advantageous for marketing agricultural produces. Though limited, tomato could be stored. When harvested in green maturity stage, it can be kept in cold storage for 30 to 40 days. This period can be prolonged to 60 days in controlled storage conditions. Pre-chilling and high CO<sub>2</sub> treatment before storage can extend this period to 70 to 75 days (Kaynaş et al., 1997). Tomato picked in pink maturity stage can be stored for 20 to 25 days using modern storage techniques. This period is 15 to 20 days for tomato picked in light red and red maturity stages. Some practices can prolong these periods for about five days (Kaynaş et al., 1988). Although available storage techniques do not allow the storage of tomato for very long periods, they eliminate farmers need to sell the product at a very short time and thus allow them to use some preference to search for better markets.

Producers of the region did not store tomato harvested in red maturity stage. 30.43% of the producers harvested 19.46% of the tomato in green harvest stage and stored in open under nylon covers or in basements for a given period. This kind of storage is common especially after the latest harvest, and the product is sold within 20 to 30 days until becoming mature enough to be marketed (Table 3). The main purpose of this storage is to save the crop from the early frosts in the fall, rather than extending the marketing period. About 70.00% of the producers did not consider storing the tomato, and about half of them (48.44%) thought that, they would not have any income

**Table 2.** Producers practices of grading in tomato and fresh bean.

| Grading   |   | Tomato    |        |                   | Fresh Bean |        |
|---|---|-----------|--------|-------------------|------------|--------|
|   |   | Farmer    |        | Income losses (%) | Farmer     |        |
|   |   | Frequency | %      |                   | Frequency  | %      |
| Grading all of the product                        |   | 44        | 47.83  | ---               | ---        | ---    |
| Grading some part of the product                  |   | 19        | 20.65  | ---               | ---        | ---    |
| No grading at all                                 |   | 29        | 31.52  | 19.05             | 40         | 100.00 |
| Total   |   | 92        | 100.00 | ---               | 40         | 100.00 |
| Because of not making grading                     | Thinks that there are income losses         | 24        | 82.76  | ---               | 1          | 2.50   |
|   | Thinks that there are not any income losses | 5         | 17.24  | ---               | 39         | 97.50  |
| Total   |   | 29        | 100.00 | ---               | 40         | 100.00 |
| Reason for not grading despite knowing the losses | There is no demand of buyers                | 17        | 70.83  | ---               | ---        | ---    |
|   | Labor costs                                 | 9         | 37.50  | ---               | ---        | ---    |
| Total   |   | 24        | 100.00 | ---               | ---        | ---    |

loss when they did not store the tomato. About 50.00% of the producers picked the tomato in green maturity stage. These producers thought that they did not have any income loss due to lack of better storage conditions. Other 50.00% of the producers maintained that a loss of 15.64% occur during this storage practice. Here, it seemed that the producers did not have enough information about storage facilities and techniques for tomato. On the other hand, the fact that tomato could be grown under greenhouse conditions in Southern Turkey for a major part of the year decreases the advantages of storage in this product.

It was reported that fresh bean could be stored in areas with 80% relative humidity and under 4 to 5°C temperature conditions for about 10 days. When controlled conditions or modified atmosphere conditions are used this period could be somewhat extended (Karagol, 2007). However,

most of the farmers interviewed said that they would have incurred substantial product losses if they did not sell the product on the day when harvest was made or the following day. All of the farmers maintained that, they did not have any income loss when they did not store the fresh bean because they thought fresh bean could not be stored.

Therefore, they immediately sent the product to the market. Producers were not aware of the fact that, they can store the product for a considerable time period under proper storage conditions. Considering the storage costs and limited storage period even under the optimum conditions, it can be concluded that storing fresh bean is not feasible. On the other hand, new studies about what economical effects the proper storage conditions might have in fresh bean can reveal significant findings.

### Packaging

Packaging is defined as an artifact where science and art meets and which satisfies the one inside as well as outside. Since food products are live organisms, proper storage is significant, and packaging has a crucial role in the storage. An indispensable part of the system, in which consumer is correctly informed and protected is packaging. When placed in correct packaging, fresh tomato can be maintained in prolonged periods (Kuruc, 2005). Producers in the region could obtain benefits from packaging the tomato. Currently, only a small part of the producers (5.43%) make this practice. The most common type of packaging in the region is in the form of putting tomato in cardboards between paper layers. Producers selling about one third of their products in these kind of packaging mentioned

**Table 3.** Storage of tomato and fresh bean.

| Storage                                     |                              | Tomato    |        |                   | Fresh bean |        |
|---|------------------------------|-----------|--------|-------------------|------------|--------|
|   |                              | Farmer    |        | Income losses (%) | Farmer     |        |
|   |                              | Frequency | %      |                   | Frequency  | %      |
| Storing                                     |                              | 28        | 30.43  | ---               | ---        | ---    |
| Not storing                                 |                              | 64        | 69.57  | ---               | 40         | 100.00 |
| Total                                       |                              | 92        | 100.00 | ---               | 40         | 100.00 |
| About the effect of not storing the product | Results in income loss       | 16        | 25.00  | 14.17             | ---        | ---    |
|   | Results in no income loss    | 31        | 48.44  | ---               | 40         | 100.00 |
|   | No idea                      | 17        | 26.56  | ---               | ---        | ---    |
| Total                                       |                              | 64        | 100.00 | ---               | ---        | ---    |
| Storage facilities                          | Outdoor, under plastic cover | 20        | 71.43  | ---               | ---        | ---    |
|   | Basement of houses           | 8         | 28.57  | ---               | ---        | ---    |
| Total                                       |                              | 28        | 100.00 | ---               | ---        | ---    |
| About primitive storage facilities          | Results in income losses     | 14        | 50.00  | ---               | ---        | ---    |
|   | Results in no income losses  | 14        | 50.00  | ---               | ---        | ---    |
| Total                                       |                              | 28        | 100.00 | ---               | ---        | ---    |

that, exporters demand such an application and they provide the packaging material (Table 4). Producers mentioned that, products packaged in this way could be sold for a better price.

Tomato producers sold all of their products in wooden or plastic cases without using any packaging. More than half of the producers (57.47%) thought that they had income loss due to such practice, while 12.64% thought they did not. About 30.00% of the producers, on the other hand, replied that they had no idea about the issue. Based on the average of the producers who thought that they could get better income using packaging, the income loss due to lack of

packaging was 26.91%. Although they knew that the packaged product is sold for a better price, farmers selling the product as bulk made this because there was no demand, they were unfamiliar with the practice, they lacked the resources, they believed that the cost of packaging is high, and they did not believe that their product had enough quality to be packaged (Table 4).

None of the producers interviewed packaged and sold fresh bean. However, 35.00% of them believed that they could get higher income from packaged fresh bean. Their average estimated income increase from packaged fresh bean was 25.00%. About 15.00% the producers thought that

their income would not increase with packaged product, while almost two thirds of the producers (62.50%) had no idea about the effect of packaging on their income from tomato. The producers who believed that packaging increases their incomes sold their product as bulk because of lack of demand and enough resources for packaging

#### **Reflections of producers on current marketing conditions and available information sources**

When the farmers were asked about their

**Table 4.** Packaging in tomato and fresh bean.

| Packaging  | Tomato                                      |        |                   | Fresh bean |        |                   |       |
|--|---|--------|-------------------|------------|--------|-------------------|-------|
|  | Farmer                                      |        | Income losses (%) | Farmer     |        | Income losses (%) |       |
|  | Frequency                                   | %      |                   | Frequency  | %      |                   |       |
| Making   | 5   | 5.43   | ---               | ---        | ---    | ---               |       |
| Not making                                       | 87  | 94.57  | ---               | 40         | 100.00 | ---               |       |
| Total  | 92  | 100.00 | ---               | 40         | 100.00 | ---               |       |
| Because of not making packing                    | Thinks that there are income losses         | 50     | 57.47             | 26.91      | 14     | 35.00             | 25.00 |
|  | Thinks that there are no income losses      | 11     | 12.64             | ---        | 6      | 15.00             | ---   |
|  | Have no idea                                | 26     | 29.89             | ---        | 20     | 62.50             | ---   |
| Total  | 87  | 100.00 | ---               | 40         | 100.00 | ---               |       |
| Reason of not packing despite knowing the losses | There is no demand of buyers                | 32     | 64.00             | ---        | 11     | 78.57             | ---   |
|  | Unaware of the practices                    | 14     | 28.00             | ---        | ---    | ---               | ---   |
|  | Absence of facilities                       | 11     | 22.00             | ---        | 5      | 35.71             | ---   |
|  | High packaging costs                        | 2      | 4.00              | ---        | ---    | ---               | ---   |
|  | Lack of good quality product to be packaged | 1      | 2.00              | ---        | ---    | ---               | ---   |
| Total  | 50  | ---    | ---               | 14         | ---    | ---               |       |

reflections over whether they sold their products at the best prices and conditions, more than one in every two farmers (58.70%) replied that they could not sell their products at good prices and conditions. According to these farmers, if they sold their products at best prices they could get an average of 47.63% higher income. On the other hand, farmers thinking that they sell their products at a fair price were also common (41.30%). These producers were happy of the fact that, the buyers come to selling area in their village. In addition, they thought that taking the product to far away markets and trying to sell it there is a waste of

time and resources, and such a practice also hinders their many activities especially tomato harvest.

A great majority of the producers thought that they could not sell fresh bean at good price and conditions. Their estimate of income loss due to insufficient price and selling conditions were 31.74%. Fresh bean produced in the region is generally sold at selling area established in villages. Buyers come to these areas. However, the producer has to accept the conditions of the buyer. Most of the time, the payment is made later. There are some problems of trusting and

producers feel that they are risking their product by selling it on trust. When the middlemen, agents acting between farmers and consumers, come to the villages to buy agricultural products, they can select the product they want to buy among many. Farmers feeling obliged to sell the product at once are vulnerable against such middlemen.

Producers were asked whether they needed any information regarding agricultural production and marketing, and if so, in what topics do they need the information most. Among the topics that the producers wanted to have information were crop protection (51.06%), marketing (36.17%) and

crop management (25.53%). More information was made available to farmers about marketing, its conditions and needs, different market types, prices, consumer preferences, product harvest and preservation techniques and packaging could help farmers sell their products at better price and conditions.

However, 63.83% of the producers did not have any demand for information. A majority of the farmers do not search for other possibilities when the buyers come to village marketing area. The leading source of information for agricultural marketing was state agricultural extension personnel (29.79%) followed by middlemen, traders and other persons in vegetable market hall (26.60%). Other information sources were fellow farmers (19.15%), experienced people in the village (17.02%), and in smaller rates TV, radio and other mass media (3.19%) and cooperatives (1.06%). About 15.00% of the producers reported that they had no source of information for marketing.

### **Relationship between some characteristics of the producers and harvest and post-harvest practices**

Based on total points given to producers according to their performance at harvest operations, 83.70% of tomato producers and 77.50% of fresh bean producers fell in the high point group. Evaluations based on Chi-square analyses to reveal the effect of farmers' experience, annual income and educational level on various harvest operations, storage and selling the product at good prices and conditions are given in Table 5. According to the results, there were no correlations between farming experience of tomato and fresh bean producers and their use of storage and size grading techniques and selling their product at better prices and conditions. Lack of correlation between farming experience and the aforementioned marketing practices is quite interesting, which might indicate the lack of interest by farmers in self-development in terms of marketing.

Chi-square analysis showed that, annual income was related to tomato harvest operations and product storage criteria. Farmers with higher annual incomes made the harvest operations better and used storage more than other farmers. On the other hand, annual income was not related to the criteria of product size-grading and selling the product at good price and conditions. When it comes to fresh bean, annual income did not have relationships with harvest operations and selling at good price and conditions in fresh bean. Chi-square analysis showed that, education level of farmers was a factor which did not have any significant effect on any criteria studied.

## **DISCUSSION**

Results showed that, there were significant losses at

every stage from the harvest to the consumer, in both tomato and fresh bean. There are many studies reporting quality and quantity losses during and after harvest (Turan, 2008; Murthy et al., 2007; Troger, 2007; Ozcan, 2007; Karabulut et al., 2005; Tatlidil et al., 2005; Kumar et al., 2004; Lawande, 2004; Reddy, 2004; Singh et al., 2004; Tatlidil et al., 2003; Klein and Lurie, 1991; Ozcan and Baklaya, 1995; Ozcan et al., 1997; Dokuzoguz, 1997; Gunduz, 1997; Kaynas et al., 1988). Ozcan (2007) mentioned that, the losses occurred during harvest, preparation for market, transportation and consumption of fruits and vegetables vary from 15.00 to 50.00%. It was found that, the losses during the harvest period in tomato varied from 5.15 to 9.83%, in studies conducted in Ayaş and Nallihan districts of Ankara (Tatlidil et al., 2003; Tatlidil et al., 2005) varying from 6.70 to 33.50% in India (Singh et al., 2004). Singh et al. (2004) reported post-harvest losses of about 7.5% for fresh bean. Murty et al. (2007) reported losses of 28.84% in whole-sale channels and 18.31% in cooperative-mediated sale channels in banana, in harvest and post-harvest periods.

According to the estimates in literature, about 50% of produced fruits and vegetables are lost after being harvested (Tröger et al., 2007). It was determined that losses due to early and late harvests in tomato were 5.00 and 12.97%, respectively (Table 1). Product losses in fresh bean due to late harvest was 18.44. The losses due to the problems about harvest method, olacing in cases, transportation, standardization, storage and packaging were mentioned as income losses by producers. Producers thought that the highest income loss was due to the lack of packaging (26.91% in tomato and 25.00% in fresh bean). Other studies mention the post-harvest losses due to erroneous practices. Özcan (2007) listed the reasons for the marketing losses as follows:

- 1) Early or late harvests,
- 2) Harvest using unsuitable method for specific product,
- 3) Use of improper tools and machines in the harvest,
- 4) Lack of training and experience for workers,
- 5) Use of packaging of improper size and nature
- 6) Unsuitable transportation necessitated by the special requirements of the crop,
- 7) Length of the time from picking to placing in storage,
- 8) Lack of specific conditions during the storage,
- 9) Problems about taking the product to the market,
- 10) Excess supply of product,
- 11) Standardization problems and
- 12) Allowing the customer to selectively buy the product in the market.

Another study mentioned that improper harvest and post-harvest practices result in losses, risk the marketability of the product, lower the prices and shorten the duration in which the product can be stored (Turan, 2008). It was found that producers lacked enough knowledge about standardization, storage and packaging. Farmers in the



**Table 5.** Relationship between some characteristics of the producers and harvest and post-harvest practices in tomato and fresh bean.

|   | Tomato   |       |      |  |         |  |                  |
|---|--|-------|------|--|---------|--|------------------|
|   | Farming experience (years)                                     |       |      | Annual Income (US \$)**  |         | Level of education   |                  |
|   | ≤ 10 yıl   | 11-25 | ≥ 26 | ≤11500   | ≥ 11501 | Primary school   | Secondary school |
| <b>Harvest practices</b>                      |  |       |      |  |         |  |                  |
| 6 – 10 points                                 | 2  | 4     | 9    | 8  | 7       | 9  | 6                |
| 12 – 16 points                                | 11   | 18    | 48   | 23   | 54      | 52   | 25               |
| Total   | 13   | 21    | 57   | 31   | 61      | 61   | 31               |
|   |  | *     |      | X <sup>2</sup> : 3.094 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 0.319 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |                  |
| <b>Grading</b>                                |  |       |      |  |         |  |                  |
| Yes   | 9  | 16    | 29   | 20   | 34      | 36   | 18               |
| No  | 4  | 6     | 28   | 11   | 27      | 25   | 13               |
| Total   | 13   | 22    | 57   | 31   | 61      | 61   | 31               |
|   | X <sup>2</sup> : 3.819 X <sup>2</sup> <sub>0.1;2</sub> : 4.605 |       |      | X <sup>2</sup> : 0.653 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 0.008 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |                  |
| <b>Storing</b>                                |  |       |      |  |         |  |                  |
| Yes   | 4  | 9     | 15   | 4  | 24      | 21   | 7                |
| No  | 9  | 13    | 42   | 27   | 37      | 40   | 24               |
| Total   | 13   | 22    | 57   | 31   | 61      | 61   | 31               |
|   | X <sup>2</sup> : 1.597 X <sup>2</sup> <sub>0.1;2</sub> : 4.605 |       |      | X <sup>2</sup> : 7.508 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 1.362 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |                  |
| <b>Selling at proper price and conditions</b> |  |       |      |  |         |  |                  |
| Yes   | 5  | 8     | 25   | 17   | 21      | 27   | 11               |
| No  | 8  | 14    | 32   | 14   | 40      | 34   | 20               |
| Total   | 13   | 22    | 57   | 31   | 61      | 61   | 31               |
|   | X <sup>2</sup> : 2.868 X <sup>2</sup> <sub>0.1;2</sub> : 4.605 |       |      | X <sup>2</sup> : 1.216 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 1.259 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |                  |
| <b>Fresh bean</b>                             |  |       |      |  |         |  |                  |
|   | Farming experience (years)                                     |       |      | Annual Income (US \$)  |         | Level of education   |                  |
|   | ≤ 10   | 11-25 | ≥ 26 | ≤11500   | ≥ 11501 | Primary school   | Secondary school |
| <b>Harvest practices</b>                      |  |       |      |  |         |  |                  |
| 6 – 10 points                                 | 1  | 2     | 6    | 4  | 5       | 5  | 4                |
| 12 – 16 points                                | 4  | 13    | 14   | 9  | 22      | 19   | 12               |
| Total   | 5  | 15    | 20   | 13   | 27      | 24   | 16               |
|   |  | *     |      | X <sup>2</sup> : 0.755 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 0.96 X <sup>2</sup> <sub>0.1;1</sub> : 2.706  |                  |
| <b>Selling at proper price and conditions</b> |  |       |      |  |         |  |                  |
| Yes   | 1  | 6     | 6    | 4  | 9       | 7  | 6                |
| No  | 4  | 9     | 14   | 9  | 18      | 17   | 10               |
| Total   | 5  | 15    | 20   | 13   | 27      | 24   | 16               |
|   |  | *     |      | X <sup>2</sup> : 0.026 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |         | X <sup>2</sup> : 0.304 X <sup>2</sup> <sub>0.1;1</sub> : 2.706 |                  |

\*Chi-square value was not evaluated since more than one expected value are less than five. \*\* 1 US \$ equals to 1.2979 Turkish Lira in 2008 (SPO, 2010).

region sell without making any size-grading. They think that size-grading is not necessary for fresh bean. About 70.00% of the producers did not consider storing the tomato. About 50.00% of the producers storing the tomato in primitive storage conditions thought that, they did not have any income loss due to lack of better

storage conditions. All of the farmers producing fresh bean did not store product and think that storage is unsuitable for fresh bean.

None of the producers packaged fresh bean and a few part of them tomato. It could be said that almost all of reasons of not packing were related to lack of information

and organization. Previous studies also reported the significance of standardization, storage and packaging and mentioned significant losses especially in fresh fruit and vegetables in the absence of these practices (Yulafci and Cinemre, 2007; Ozcan, 2007; Ozcan, 1999; Ozcan and Akbulut, 1999; Ozcan et al., 1997). According to research findings, a great majority of the producers who sell their products to the buyers come to the selling area in their village. According to a study conducted over fresh bean in Turkey, the most common marketing chain is producer-wholesaler-retailer-consumer. Local markets and groceries have significant roles in marketing of fresh bean (Ercal et al., 1989). Acting collectively through farmers unions make farmers stronger against third parties or groups. Although, 63.83% of the producers were members of at least a cooperative, these cooperatives were not active in marketing of tomato and fresh bean.

In a study conducted in India, it was found that acting collectively in marketing improved marketing efficiency both in terms of procedures and prices, and decreased marketing losses. In the study, reported losses of 28.84% in whole-sale channels and 18.31% in cooperative-mediated sale channels in banana in harvest and post-harvest period (Murty et al., 2007). The producers in the region investigated lacked significant information about harvest and post-harvest operations. It is interesting that farmers saw traders and middlemen, who have opposite interests to farmers', as the source of information in their marketing operations. Some studies dealt with the lack of information about harvest and post-harvest operations in Turkey and significance of improvements in this area (Candemir and Boz, 2007; Ozcan, 2007; Yulafci and Cinemre, 2007; Tatlidil et al., 2003; Tatlidil et al., 2005). Kumar et al. (2004) rated among the main limitations about marketing of tomato in India, poor communication about market conditions, erroneous measuring and pricing policy, lack of information and organization in the marketplace and lack of projection about sale volume.

Findings showed that, factors such as experience in farming and educational level did not have any influence on harvest and storage practices in tomato and fresh bean. Annual income level did not have also an effect on harvest and storage practices in fresh bean. On the other hand, annual income level had an effect on harvest and storage in tomato. The producers with higher incomes made better harvest and transportation. They also stored their product after the harvest. The experience of farmers did not move them towards searching and using better marketing practices. The farmers with higher incomes were more sensitive about harvest and transportation practices and used storage facilities in tomato. However, they did not make any effort to size-grade, package, sell at better prices and conditions in tomato and fresh bean compared to other farmers.

In a study, Okoedo-Okojie and Onemolease (2009) examined the factors affecting the adoption of modern yam storage technologies by farmers. They came to the

conclusion that, age and farming experience had significant influence on farmers' adoption of improved yam storage technology. Major constraints limiting the farmers' adoption of these technologies were ignorance of technology existence, non-availability and high cost of the some of the storage technologies.

## Conclusion

Generally, it can be expected that such critical factors as experience, annual income and education should also be significant in harvest and marketing operations. It is logical for farmers with more experience and higher education levels to be in a better situation for harvest and marketing decisions. Nevertheless, data showed that farmers behaved similarly no matter what their education and experience levels were.

What was meant by educational level was formal school education. Farmers did not get special training about agricultural production in their formal education.

However, it could be thought that middle school or over graduates would be more involved in reading and finding solutions about their problems compared to primary school graduates or unschooled farmers. Nevertheless, farmers with higher educational levels preferred to act similar to others and used similar marketing preferences. Against such a negative aspect, which means the education obtained is not used, solutions should be developed which can allow those people to use their education better in agricultural production. The education they receive should be improved in such a way to drive them to be more productive in their activities. For this aim, special farmer training programs should be implemented in rural areas and farmers should be made more conscious about the advantages of having training.

According to the results, advanced techniques and alternatives in tomato and fresh bean harvest and marketing were not known by the farmers in the area. The farmers were not aware of to what degree a difference could be made using the currently used and alternative techniques. Even if they were in need of making changes in marketing, they were not informed and equipped about how they could do it. Here, development of special projects including training programs for especially harvest and post harvest operations will be beneficial. Multifaceted and comprehensive training programs about harvest and post-harvest operations could be made. At the same time, practical applications could be made together with producers in pilot areas selected. Producers could be made aware of different and efficient marketing systems. Meetings with producers from different areas could be organized and exchange their experiences could be facilitated.

It is important for farmers to be aware of cooperative-based organization, which could be very efficient in marketing. Producers should be made conscious about the fact that, they can gain power and advantages as

being cooperative members. The reasons that make farmers' unions and cooperatives inefficient in Turkey but efficient in developed countries should be revealed and solutions should be devised. Another important issue for marketing is the use of information technologies. Marketing is an area in which information technologies could be used very efficiently. Making the farmers aware of what could be done using these technologies could lead to many significant developments.

## REFERENCES

- Batu A (1999). Effects of Temperature and Ripening Stage on the Respiration Rate of Tomatoes, *Turkish J. Agric. Forestr.*, 23: 473-481.
- Candemir S, Boz I (2007). Extension Agents' Maras of View of Agricultural, Institutional Problems in Kahramanmaraş and Their Possible Solutions. *KSU J. Sci. Eng.*, 10(1): 97-105.
- Cakiroglu O (2009). Turkey Tomatoes and Products Annual, Fresh Tomatoes, USDA Foreign Agricultural Service, Global Agricultural Information Network Report, Gain Report Number: p. TU9022.
- Demirci F, Erdoğlan C, Tatlıdil FF (2005). Plant Protection Practices in Tomato Plantations in Ayaş and Nallıhan Provinces of Ankara, *J. Agric. Sci.*, 11(4) 422-427, (in Turkish).
- Dokuzoguz M (1997). Developments on Storage of Horticultural Products in Turkey. First Symposium of Storage and Marketing in Horticultural Products, 21-24 October, Yalova, p. 9, (in Turkish).
- Erkal S, Osmanoglu E, Safak A, Ergun ME, Yucel A, Turkes T (1989). A Research on Fresh Beans Production, Marketing and Consumption in Marmara Region, <http://www.arastirma-yalova.gov.tr/ar444/eko/eko80-90.htm>, (Accessed: 12.03.2008), (in Turkish).
- FAO (2009). Statistical Database. <http://faostat.fao.org/site>
- Gunduz M (1997). Market Structure, Storage, Marketing Systems and Foreign Trade Relations in Horticulture Products. First Symposium of Storage and Marketing in Horticultural Products, 21-24 October, Yalova, (in Turkish), pp. 9-14.
- Gunduz O, Esengun K (2007). Socio-economic Analysis of Tomatoes Farms According to Risk Attitude in the Central District of Tokat Province, *J. Gaziosmanpasa Uni. Facul. Agric.*, 24(1): 51-62, (in Turkish).
- Karabulut ÖA, Kuruoglu G, İlhan K, Arslan U (2005). Using of Heat Treatments Against Postharvest Diseases, *J. Ondokuz Mayıs Univ. Facul. Agric.*, 20(1): 94-101, (in Turkish).
- Karagol S (2007). <http://www.agaclar.net/forum/showthread.php?t=3985>, (Accessed :28.04.2008).
- Kaynas K, Celikel FG, Türkes N, Sürmeli N (1988). Studies on Maturity Physiology of Storage Facilities and of Some Tomato Varieties Grown in Yalova and Iznik Regions. Vegetable Breeding in Open Research Project Report, Atatürk Horticulture Research Institute, (in Turkish). pp. 415-423.
- Kaynas K, Ozelkok S, Sürmeli N (1997). Effect of Pre-Cooling and High CO<sub>2</sub> Applications in Tomato Storage. First Symposium of Storage and Marketing in Horticultural Products. 21 – 24 October, pp. 153-162, Yalova, (in Turkish).
- Klein JD, Lurie S (1991). Postharvest Heat Treatment and Fruit Quality. *Postharvest News Inf.*, 2:15-19.
- Kumar S, Pal S, Joshi PK (2004). Vegetable Sector in India: An Overview, Impact of Vegetable Research in India, National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi, pp. 9-33.
- Kuruc K (2005). [http://www.referansgazetesi.com/haber.aspx?HBR\\_KOD=23852&KTG\\_KOD=323](http://www.referansgazetesi.com/haber.aspx?HBR_KOD=23852&KTG_KOD=323) 30.09.2005 erişim: 16.05.2008).
- Lawande KE (2004). "Status of Onion and Garlic Research in India, Impact of Vegetable Research in India, National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi, pp. 59-64.
- MARA (2006). The Master Plan of Tokat Province, Tokat. MARA (2009). Statistical Data of Tokat Province, Tokat.
- Murty SD, Gajanana TM, Sudha M, Dakshinamoorthy V (2007). Marketing Losses and Their Impact on Marketing Margins: A Case Study of Banana in Karnataka, *Agricultural Econ. Res. Rev.*, 20(1): 47-60.
- Okoedo-Okojie DU, Onemolease EA (2009). Factors Affecting the Adoption of Yam Storage Technologies in the Northern Ecological Zone of Edo State, Nigeria, *J. Hum. Ecol.*, 27(2): 155-160.
- Özcan M, Balkaya A (1995). Causes of Harvest and Post-Harvest Losses on Fruits and Vegetables Product Grown in Amasya Province. *J. Ondokuz Mayıs Univ. Facul. Agric.*, 10(1) : 51-61, (in Turkish).
- Özcan M, Balkaya A, Ceyhan V (1997). Analysis of Vegetable Marketing Activities in the Black Sea Region. First Symposium of Storage and Marketing in Horticultural Products, 21-24 October, Yalova. pp. 229-234s, (in Turkish).
- Özcan M (1999). The Importance of Standardization and Packaging in Marketing of Fruit - Vegetable. *Agricultural Production and Marketing Symposium in Black Sea Region*. October 15-16. 1999. Samsun. pp. 102-107.
- Özcan M, Akbulut M (1999). The Importance of Storage on Fruit and Vegetable Marketing in The Black Sea Region. *Agricultural Production and Marketing Symposium in Black Sea Region*. October 15-16. Samsun. pp. 223-226s.
- Özcan M (2007). Affects on Quality and Durability of Harvest and Post-Harvest Practices in Horticultural Products, [http://www.carsambaziraatodasi.com/ab1\\_1.asp](http://www.carsambaziraatodasi.com/ab1_1.asp), (Accessed: May 2009), (in Turkish).
- Reddy PP (2004). "Vegetable Research in India-An IIHR Perspective, Impact of Vegetable Research in India, National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi, pp. 45-58.
- Sabir A, Sabir KF, Tangolar S, Ađar T (2009). Effects on Conservation Duration and Quality of Ethanol and Sulfurdioxide Practices on Some Grape Varieties, 4<sup>th</sup> Symposium of Storage and Marketing in Horticultural Products, 8-11 October 2008, Antalya, pp. 441-448, (in Turkish).
- Sarisacılı İE (2009). Tomato Paste and Tomato Products, Export Promotion Centre of Turkey, Ankara, p. 6.
- Singh B, Banerjee MK, Singh KP, Pandey PK, Sudhakar P, Rai M (2004). AICRP on Vegetables in India: Evolution and Achievements, Impact of Vegetable Research in India, National Centre for Agricultural Economics and Policy Research, ICAR, New Delhi, pp. 65-79.
- SPO (2007). 9<sup>th</sup> Development Plan Plant Production Specialty Commission Report, Publication No: DPT.; Ö.K, 2713: 666, Ankara, (in Turkish).
- SPO (2010). Basic Economic Indicators, <http://ekutup.dpt.gov.tr/teg/2009/12/tv.25.xls> (Accessed 23.12.2010).
- Sahin G, Erkan M (2009). Effects on Fruit Quality and Conservation of Ultraviolet-C and 1-Methylcyclopropene Practices of in Different Maturity Stages bunched tomatoes, 4<sup>th</sup> Symposium of Storage and Marketing in Horticultural Products, 8-11 October 2008, Antalya, pp. 415-423, (in Turkish).
- Tatlıdil F, Kiral T, Gunes A, Demir K, Erdemir G, Fidan H, Demirci F, Erdogan C, Akturk D (2003). Economic Analysis of Crop losses during Pre-Harvest and Harvest Periods in Tomato Production in the Ayaş and Nallıhan Districts of Ankara Province, TÜBİTAK-TARP 2387: 86. Ankara, (in Turkish).
- Troger K, Hensel O, Burkert A (2007). Conservation of Onion and Tomato in Niger - Assessment of Post-Harvest Losses and Drying Methods. Conference on International Agricultural Research for Development, University of Kassel-Witzenhausen and University of Gottingen, October 9-11.
- Turan (2008). Post-harvest Practices on Fruits, 12: 3, July-August, (in Turkish).
- UPMFD (2006). <http://www.dtm.gov.tr> 2006.doc, Undersecretariat of the Prime Ministry for Foreign Trade (Accessed 23.05.2008).
- Yamane T (2001). Basic Sampling Methods. Translated by A. Esin, M. A. Bakir, C. Aydin and E. Gurbuzsel, Literature Publishing, Istanbul, p. 118.
- Yulafci A, Cinemre HA (2007). Fresh fruit and Vegetable Marketing in Carsamba Plain, Its Problems and Some Solution Alternatives. *J. Facul. Agric., Omu.*, 22(3): 260-268.