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The assessment of the Bulb Size Impact in Onions Characteristics and Losses during Storage with Natural Ventilation

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Abstract

The effect of bulb size on storage behavior of onions was investigated in an experiment carried out in Korça region. This study was focused on evaluation of certain bulb characteristics during storage under natural ventilation conditions. The autochthonous cultivar of Miras was involved in the study and three bulb sizes were observed: small, medium and large, with diameters ≤ 3cm, 3-5cm and ≥5cm respectively. The sealed and dries bulbs were placed for storage in the building with natural ventilation. During the storage period, the weight loss, the damaged bulbs and the percentage of sprouted bulbs were estimated. The first two indicators were evaluated for the periods 30, 60, 90 and 120 days of the storage, while the last indicator after 60, 90 and 120 days.The results showed that during storage period, humidity gradually decreases. There were differences of bulb moisture content at different time periods after harvesting depending on their size and storage periods. After 120 days of storage, weight loss of large bulbs was about 23.827%, about 23.604% and 20.263% for small and medium bulbs size respectively. Results indicated that these losses are slightly affected by the size of the bulbs, while the storage period had the greatest impact, whereby the losses increase with the extension of the storage period.The findings raise the need of storage conditions improvement to reduce onions post harvest losses.

Keywords: Onions, storage, bulb size, postharvest losses.

1. Introduction

Onion is widely cultivated in our country in an area of about 5753 ha with a production around 102296 tones [13]. The Miras onion, part of the "sweet" onion group, is predominantly spread in the Korça area and is considered as one of the main cultivars of this area, mainly due to its high yield and good organoleptic characteristics during use. But this autochthonous variety is not well preserved after harvesting because with the existing traditional technology the storage period is short, bulbs sprout rapidly, losses are relatively large. The proper management of all production and storage technologies is of great importance. The supply of quality continuously to the market requires the application of some simple technologies and without much cost to maintain good bulbs, with minimal losses [4].

Postharvest losses of onions are classified as quantitative, i.e. reduction of the bulb weight as a result of water content losses, reduction of the dry matter content through the respiration process and qualitative related to the change of various ingredients content that affect the nutritional values and the taste of bulbs. For good preservation, researchers report that bulbs should be stored at the temperature 0°C and 65 to 70% relative humidity which are considered as standard conditions for a storage period of 1-8 months depending on cultivar [5].

Losses after harvesting of onion bulbs can be reduced by improving their production techniques such as irrigation, fertilization, harvesting and treatments immediately after harvesting [3]. Better quality for the extension of the storage period can be achieved through the proper use of nitrogen fertilization of plants in the pre-harvest period [12]. After-harvest field drying is always necessary to extend the shelf life of bulbs and improve the color. The good and long storage of bulbs is related to the varietal characteristics [2]. In addition, other indicators such as bulb size, weight and diameter are associated with storage losses. The overall percentage

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of bulb losses results in positive dependence on the bulb diameter [9].

The bulb itself is in the positive correlation with the bulb weight and the thickness of the neck. Bulbs of medium diameter and weight result in less storage losses. A negative correlation between bulb weight and marketable value after storage has been determined [1]. The indicators related to production and growth features were analyzed, as well as other features associated with losses during conservation of field cultivated onions in ambient conditions. The thin neck feature is very important for selecting the cultivars with the greatest potential for extending the life during storage. The total loss percentage is correlated positively to bulb's neck thickness, bulb diameter, physiological weight loss, sprouting and decay [10]. Cultivars with medium neck thickness and bulb weight showed good quality and showed low loss percentage in storage. During the storage period, the fructose content increases as a result of hydrolysis of reserve sugars, while the content of vitamin C decreases [11].

Better storage behavior has been observed on cultivars with longer cultural cycle, high content of ash, potash and soluble matter, dry matter, considerable chilliness, low protein value, and poor peroxidation activity, a high ratio of non-reducing/reducing sugars [11].

Recent studies showed that the amount of fructose in the bulb at harvest time has a positive impact on the extension of storage life. Also, the content of alkaline invertases measured a few months after the bulb storage placement can provide a good orientation for the extension of the storage period. The development of the yellow-cream colored buds found in the center of the bulb base (defined at the moment of harvest) seems to be in inverse correlation with the storage time. The main factors causing the quality deterioration of bulbs during storage are decay, dehydration and sprouting [7], [8], [14].

The purpose of this study is to evaluate the influence of bulb size on some quantitative and qualitative indicators at different time periods during storage with natural ventilation.

2. Material and Methods

The experiment was carried in Korça region for the autochthonous cultivar of Miras and three bulb sizes were observed: small, medium and large, with diameters ≤ 3cm, 3-5cm and ≥5cm respectively. Bulbs of these sizes were placed for storage duration of 30, 60, 90 and 120 days.

The experiment was developed according to the block randomized scheme with three replicates, where the bulb sizes are considered as the main variants, while the storage time varies as sub-variants. The onions were selected to be dry and were placed in crates, which were arranged in wooden shelves. The environment where storage onions were placed had good natural air ventilation, where windows were open except rainy days and fog. The storage environment was in the absence of direct sunlight, as it affects the acceleration of bulbs germination. The experiment started late August and lasted four months. During the storage period, several quantitative and qualitative parameters were evaluated, such as percentage of bulb weight loss, percentage of damaged bulbs and percentage of sprouted bulbs. These data were recorded every 30 days, starting from the first day storage time and after 30, 60, 90 and 120 days of storage. Data regarding the percentage of sprouted bulbs were taken after 60, 90 and 120 days of storage according to the defined method.

Determination of bulbs weight losses was carried out according to the following method: the bulbs were divided into four groups with three replicates and each of them was weighed before storage. The first data was taken after 30 days, while the second, third, and fourth were taken respectively after 60, 90 and 120 days of storage. Losses of weight bulbs were then calculated in percentage.

Determination of the number of damaged bulbs expressed as a percentage is calculated as follows: the bulbs are divided into four groups and each group is identified by the number of damaged bulbs started to count after 30 days of storage in the first group, and the number of bulbs spoiled in the second, third and fourth groups was accounted for after 60, 90 and 120 days of storage. Based on these data, the number of defective bulbs expressed in percentage was determined.

Determination of the number of sprouted bulbs expressed as a percentage was made by dividing the bulbs into four groups in which the number of sprouted bulbs was detected was determined after 60 days of storage in the first group whereas the number of bulbs in the group second and third counts were calculated after 90 and 120 days of storage. Based on these data, the percentage of sparkling bulbs was

determined.The data of the recorded parameters were subjected to statistical analysis of variance.

3. Results and Discussion

Bulb weight loss during storage

Data referring to the percentage of bulbs weight loss during the storage period are shown in Table 1. The data show that the size of bulbs affects the percentage of weight loss of the bulbs after their storage under natural air ventilatin conditions environment.

Weght losses of large size bulbs (23.827%) were more pronounced than two other sizes. They are followed by bullets of small and medium size. The weight loss of small and medium size bulbs was 23.604% and 20.263% respectively. The lowest percentage of weight loss is recorded in mid-sized bulbs (Table 1).

Table 1. Weight loss of different bulbs sizes during storage time.

Diameter (cm)	Storage time (days)			
	30	**60**	**90**	**120**
Small (≤ 3)	4.61	22.31	28.24	39.26
Medium (3-5)	4.01	16.10	24.77	36.17
Large (≥5)	3.26	20.73	29.22	42.11
Mean	3.96	19.71	27.41	39.18
SD of bulb size = 2.018 SD of weight loss =1.474				

Comparing the different storage period, the lowest percentage of 3.26% weight loss was evidenced in the 30-day storage period. The highest losses in bulb weight 42.11% were recorded during the 120 day storage period. Larger bulbs have the disadvantage of faster losses, compared to medium and small bulbs. These results are also confirmed in astudy of storage variability among onion cultivars and its relationships with disease incidence and bulbs characteristics [6]. The largest absolute water losses in large bulbs can be explained by the faster dehydration of these bulbs during storage.

Damaged bulbs during storage

Data referring to the percentage of damaged bulbs during storage are shown in (Table 2). The results showed that the percentage of bulb loss is mainly related to the size of bulbs. Among bulbs with different sizes, the largest percentage loss (11.69%) was recorded in bulb with larger diameter, followed by bulbs with small diameter (10.89%). While the smallest losses were evidenced in bulbs with average diameter, in which the percentage of damaged bulbs was about 10.59%.

Taking into account the different storage periods, the minimum bulb losses in number (0.7) were determined in the 30-day storage period, in the medium size bulb variant. The biggest losses (23.19) have been recorded in large bulbs, in the period of 120 days after storage placement. After 120 days of storage the losses range from 16.80% to 21.60% and 23.19% respectively for small, medium and large diameter bulbs.

Table 2. Percentage of damaged bulbs during storage

Diameter (cm)	Storage time (days)			
	30	**60**	**90**	**120**
Small (≤ 3)	1.59	10.80	14.40	16.80
Medium (3-5)	0.70	6.00	14.78	21.60
Large (≥5)	0.80	7.20	15.60	23.19
Mean	0.80	8.00	14.93	20.53
SD of bulb size = 2.750 SD of defected bulbs = 2.009				

Sprouted bulbs during storage

The data concerning the percentage of sprouted bulbs during different storage periods are given in table 3. The results showed that the size of the bulbs during the study period significantly affects the sprouting percentage. The phenomenon is greatly influenced not only by their size, but especially by the time of storage.

The highest percentage of bulb sprouting was detected in larger bulbs (17.96%), followed by bulbs with smaller and medium diameter with 2.93% and 5.86% respectively after 120 days of storage (Table 3).

Based on storage time, the lowest percentage of sprouting was recorded during the 60-day storage period followed by those with 90 and 120 days of storage, respectively, 0.24%, 2.93% and 8.922% respectively.

Table 3. Percentage of sprouted bulbs during storage

Diameter (cm)	**Storage time (days)**		
	60	**90**	**120**
Small (≤ 3)	0.00	0.24	2.93
Medium (3-5)	0.00	2.93	5.86
Large (≥5)	0.73	8.92	17.96
Mean	0.24	4,03	8.92
SD = 6.469			

Selecting the right bulb size is always necessary to extend the onion storage life. One of the simplest and most effective ways to reduce damages during storage is the standardization of bulbs according to their size, prior of storage.

4. Conclusions

The bulb's weight loss percentage is influenced by the size of the bulbs. The greatest weight losses are recorded in large size bulbs followed by small and medium size.

Losses depend on the storage period of bulbs after harvest, where the lowest percentage of weight loss result in bulbs stored for 30 days. While the highest losses are recorded after 120 days period of storage.

Bulb defects are influenced slightly by the bulb size. Between different sizes the losses are larger in larger bulbs, followed by bulbs with smaller diameter.

Storage longivity affect the bulbs loss, where losses increase with the extension of the storage period.

The highest percentage of sprouted bulbs results in bulbs of large size.

Storage time affect the percentage of sprouted bulbs, which increases with the duration of the storage period.

Medium sized bulbs appear to be more convenient for storage, as they showed better storage behavior than big size bulbs.

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