

## Results regarding the preservation of asparagus (*Asparagus officinalis* L.) after harvesting

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**Abstract** The experiment was performed on a crop of asparagus, Precocious D'Argenteuil variety, in the 4th year of production. The shoots were harvested by cutting as they appeared on the surface of the soil and presented the optimal dimensions for recovery. They were sorted into 5 size categories, in diameter: V1 - 2.8 cm, V2 - 2.3 cm, V3 - 2.0 cm, V4 - 1.5 cm, V5 - 1.0 cm. The shoots were weighed and then stored at a temperature of 18°C for 5 days. The shoots were weighed at intervals of 3 and 5 days, respectively, and we noticed greater weight loss in shoots with a diameter of less than 2.0 cm. Weight loss was 4.134% at V1-2.8 cm and 16.109% at V5 - 1.0 cm. The hardness of the shoots indicates the degree of freshness. The fresher a shoot, the lower its resistance. As the shoots are kept longer, they lose weight but also lignify starting from the base. We found that at harvest the shoots showed a lower hardness compared to the values recorded after 3 days and 5 days, respectively.

### Key words

*Asparagus officinalis* L., shoots, size, storage losses

The genus *Asparagus* L. belongs to the family *Asparagaceae*, which includes about 300 species. *Asparagus officinalis* is native to North America, but has been successfully acclimatized to Europe, North Africa, and West Asia, and is widely grown as a vegetable plant [5; 4; 6].

Some authors mention that the family includes around 150 species of the family *Asparagaceae*, widespread in tropical and subtropical regions up to an altitude of 1500 m predominantly in the regions of Europe, America, Australia and Asia [15].

*Asparagus* was also called the "food of kings". It is a vegetable that is grown for consumption by its shoots, etiolated or green, which have a high nutritional value. The shoots appear in early spring, from March-April-May, being consumed as special dishes (fine and expensive) or are used by the food industry for canning [19; 18]. Their nutritional value is special, as they are growing shoots, based on the reserved substances in the rhizome.

The specific taste is given by the content of asparagine, vanillin, acids, methyl mercaptan and a volatile oil containing sulphur.

*Asparagus* is a vegetable that also has a medicinal effect for the treatment of serious diseases. The high content of amino acids and minerals is very high, especially in fresh shoots. Takuya Sakurai et al., (2014), emphasize the importance of asparagus consumption in treating Alzheimer.

Mohammad et al., (2020) isolated nine steroids from asparagus roots, demonstrating their cytotoxic activity.

József Deli et al., (2000) identified in asparagus shoots *capsanthin*, *capsorubin*, *capsanthin 5,6-epoxide*, *anteraxanthin*, *violaxanthin*, *neoxanthin*, *mutatoxanthin epimers*, *zeaxanthin*, *lutein*,  $\beta$ -*cryptoxanthin*,  $\beta$ -*carotene* and other isomers of cis form.

Peru is one of the largest exporters of asparagus in the world, with better market shares compared to China (Schwarz and Mathijs (2017) mentioned by Qingbin et al. (2020).

Increased interest in cultivated asparagus varieties has been noted since the 16th century in Germany, France, England and the Netherlands.

In Romania, asparagus is grown in very small areas compared to other states. In 2019, the first asparagus crop was inaugurated in Romania, established in Băneasa from Giurgiu district on an area of 170 ha of which approximately 35 ha with white asparagus and 135 ha with green asparagus.

*Asparagus* is not included in the Official Catalogue of Cultivated Plants, so far only the imported varieties have been used [21].

*Asparagus* is a vegetable species that are resistant to low temperatures, and the cold during the resting period positively influences the vigour of the plant, the rhizome and the lifespan [1]. *Asparagus* also withstands high summer temperatures, which are associated with a lack of water in the soil.

Vinătoru et al., (2019), recommend a minimum temperature of 8-10°C for seed germination and temperatures of 16-24°C for the normal growth of aerial shoots.

Temperature is the main factor affecting not only vegetative growth but also harvest time [19; 16].

Technology aspects of the most favourable soil type for plant growth are moderately drained sandy clay has been mentioned by numerous authors Findlay and Ryan, (1974) as well as Franklin et al., (1980) also on soil fertility by Bussell and Prasad, (1988), Bussell, (1996) or Bussell (1996).

An important aspect is the quality of the planting material (Matei et al., 2019) as well as the quality of substrate crops [13].

Asparagus is grown in the field, but also under forced and protected conditions. The duration of the harvest, starting from the third year, is shorter, at 20 days, and in the following years, it can even reach 35-40 days. The harvesting technique depends on the type of asparagus, so the varieties for bleached shoots, the harvest is done every morning, manually. In the case of varieties for green shoots, harvesting is done when they are 18-25 cm long (depending on the variety) before the covering scales of the shoots unfold. Mechanized harvesting can also be done on these types of varieties. For better positioning of the product on the market, it is necessary that the shoots are green in at least 80% of their length, to be grown, well-formed and healthy. Forcing plants leads to an increase in production [10].

In the spring, asparagus shoots appear from the soil. Depending on the vigor of the plants, shoots appear on the surface of the soil, in stages, they have different sizes. After harvesting, they must be sorted, stored and then capitalized. The aim of the study was to determine the weight loss, and the firmness of the shoots, after 5 days from harvesting and storage in storage conditions at ambient conditions of 18°C and atmospheric humidity between 58% and 60%.

## Material and Method

The research was conducted at the University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, in the period 2019.

The biological material was the Precocious D'Argenteuil variety, grown in field conditions and chemically fertilized, with complex fertilizer, NPK 20:20:20. Asparagus shoots were harvested from the crop, sorted by size, sorted by size category, by measuring the diameter of the shoot at the base, and after weighing them, they were stored at a temperature of 18°C for 5 days. Atmospheric humidity was between 58% and 60%.

In order to appreciate the differences in the weight loss, the shoots were weighed on the following size variants in their diameter, as follows: V1 - 2.8 cm; V2 - 2.3 cm; V3 - 2.0 cm; V4 - 1.5 cm and V5 - 1.0 cm. The diameter of the shoots was made with a calliper measured at the base of the shoot. The shoots were weighed before the experiment, for each variant, after 3 days and 5 days, respectively, thus recording all values. The hardness of the shoot using a penetrometer was determined, and an analysis was made in the laboratory. The determination was made in 3 points: at the base, in the middle and at the top of the shoot. The mass losses of the shoots were determined by calculating the percentage.

## Results and Discussions

Asparagus shoots stored in environmental conditions lose weight. We found mass differences between the experimental variants. In the case of V1 - shoots with a diameter of 2.8 cm, at harvest, they showed average masses of 39.233 g, after 3 days of 38.140 g and after 5 days 37.611 g. In the case of V2 at harvest, the shoots had an average mass of 32.156 g, after 3 days 31.090 g and after 5 days from storage 30.876 g. In the case of V3 - shoots with a diameter of 2.0 cm at harvest their mass was 22.211 g, after 3 days it decreased to 21.030 g and after 5 days to 20.953 g. At V4 - shoots with a diameter of 1.5 cm, the mass of shoots at harvest was 21.133 g, after 3 days it decreased to 19.100 g and after 5 days to 18.332 g. smaller were those from V5 with a diameter of 1.0 cm and a harvesting mass of only 15.308 g. In this variant, after 3 days, shoots weighed 13.110 g and after 5 days 12.842 g (figure 1).

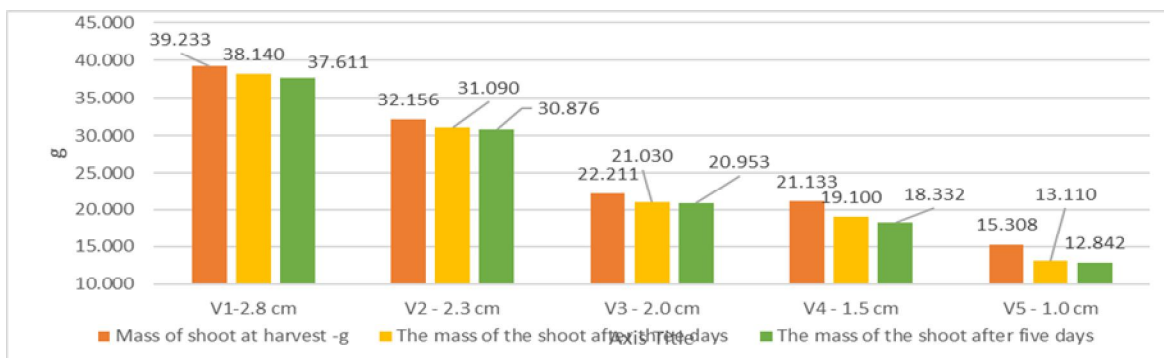


Figure 1. Mass of asparagus shoots after harvest, three days and 5 days after harvest

It was found that after 3 days of storage, the weight loss was 1.093 g in the case of large shoots, with a diameter of 2.8 cm and 1.622 g after 5 days. In the case of V2 - shoots of 2.3 cm in diameter, the losses after 3 days, were 1,066 g and after 5 days 1,280 g. In variant 3 - shoots of 2.0 cm in diameter, the losses were 1.81 g after 3 days and 1.258 g after 5 days.

The largest weight loss was found in shoots with a size of 1.5 cm and 1.0 cm in diameter, respectively. At V4, after 3 days, the shoots lost 2,033 g and after 5 days 2,801 g. In the case of V5 - diameter shoots 1.0 cm the weight loss was 2,198 g after 3 days and 2,466 g after 5 days (figure 2).

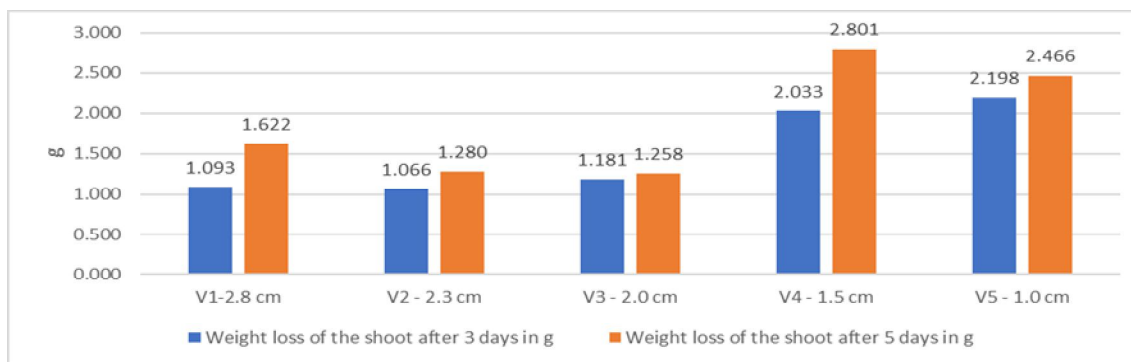


Figure 2. Weight loss of asparagus shoots

Analyzing the percentage of weight loss in asparagus shoots, it was observed that the largest losses were recorded in V5 - shoots of 1.0 cm in diameter and weighing 15,308 g, these being 14.359% after 3 days

respectively 16.109% after 5 days. Smaller losses were recorded in V1 - shoots with a diameter of 2.8 cm. In this variant, the losses were only 2.786% g after 3 days and 4.134% after 5 days.

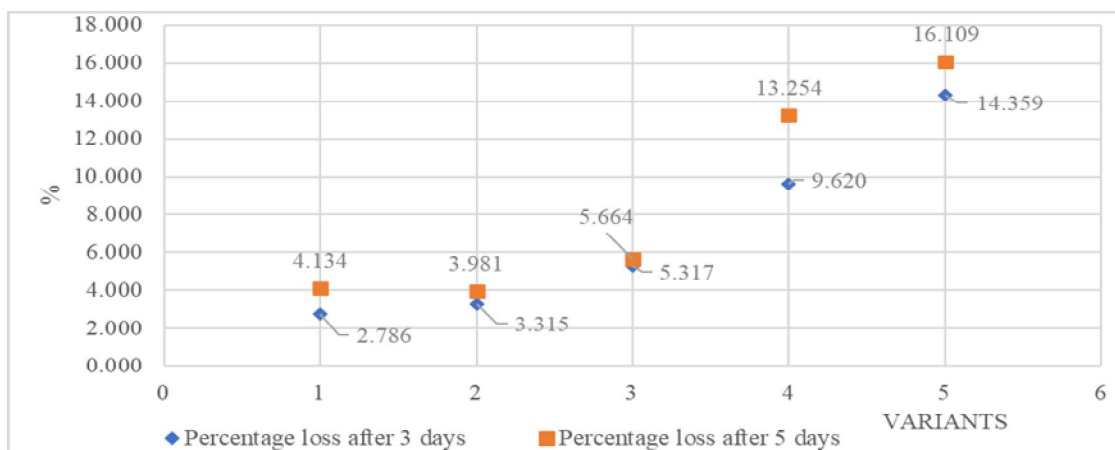


Figure 3. Weight loss of shoots after 3 and 5 days, respectively, from storage - expression as a percentage



Figure 4. The aspects of asparagus shoots have been used to determine storage capacity and hardness.



Figure 5. Laboratory hardness test

The hardness of the shoots indicates the degree of freshness. The fresher a shoot, the lower its resistance. As the shoots are kept longer, they decrease in weight but also lignify from the base.

We found that at harvest the shoots showed a lower hardness compared to the values recorded after 3 days and 5 days, respectively. We can thus emphasize that as the shoots are consumed later, the fibres from the base of the shoot to the top are lignified, thus leading to its rigidity.

We found that towards the base, the shoots showed higher hardness, due to the lignification of the free-wood vessels. Thus, for V1 - shoots 2.8 cm thick, the hardness at the base of the shoot was 10.02 kg / cm<sup>2</sup>, after 3 days of 10.31 kg / cm<sup>2</sup> and after 5 days of 10.74 kg / cm<sup>2</sup>. In the middle part of the shoots, a

decrease in hardness was found, this being 4.76 kg / cm<sup>2</sup> at the beginning, 4.93 kg / cm<sup>2</sup> after 3 days and 5.07 kg / cm<sup>2</sup> after 5 days. In the top part of the shoot, the hardness at harvest was 3 kg / cm<sup>2</sup>, after 3 days of 3.09 kg / cm<sup>2</sup> and after 5 days of 3.32 kg / cm<sup>2</sup>.

In the case of very small shoots in diameter, V5 shoots with a diameter of 1 cm, the hardness of the shoots at the base were 6.89 kg / cm<sup>2</sup> and after 3 days respectively after 5 days of 7.1 kg / cm<sup>2</sup> respectively 7.33 kg / cm<sup>2</sup>. In the middle, it increased from 2.78 kg / cm<sup>2</sup> to 2.85 kg / cm<sup>2</sup> after 3 days and to 3.01 kg / cm<sup>2</sup> after 5 days. At the top of the shoot, the recorded hardness was 2.49 kg / cm<sup>2</sup> at the beginning, then after 3 days it increased to 2.54 kg / cm<sup>2</sup> and after 5 days to 2.89. (Table 1).

Table 1. Hardness of shoots at harvest, after 3 days and 5 days respectively

Variants	Hardness of shoots - at the base			The hardness of the shoot in the middle			Hardness of the shoot at the tip of the shoot		
	(kg/cm <sup>2</sup> )	After three days (kg/cm <sup>2</sup> )	After five days (kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	After three days (kg/cm <sup>2</sup> )	After five days (kg/cm <sup>2</sup> )	(kg/cm <sup>2</sup> )	After three days (kg/cm <sup>2</sup> )	After five days (kg/cm <sup>2</sup> )
V1 - 2.8 cm	10,02	10,31	10,74	4,76	4,93	5,07	3	3,09	3,32
V2 - 2.3 cm	7,11	7,37	7,51	4,11	4,25	4,37	3	3,1	3,4
V3 - 2.0 cm	6,12	6,38	6,98	3,66	3,77	3,98	4,62	4,66	4,83
V4 - 1.5 cm	6,65	6,88	7,03	3,41	3,49	3,66	3,59	3,61	3,88
V5 - 1.0 cm	6,89	7,1	7,33	2,78	2,85	3,01	2,49	2,54	2,89

## Conclusions

Based on the data obtained in this experiment we could see that the shoots that had a higher average mass (39.233 g) lost less weight, reaching 37.611 g / shoot after 5 days when storing them at a temperature of 18°C and humidity of 58% and 60%.

Asparagus shoots, with an average weight of 15,308 g, decreased to a weight of 12,842 g (V5) after 3 days.

Depending on the size, the shoots lost an average of 5.22 g at V1 and 2.801 g at V4 after 5 days of harvest.

The percentage of weight loss was between 4.134% in V1 and 16,109 in V5.

Thinner asparagus shoots, with a diameter of less than 2 cm, are more fragile and their hardness is lower compared to larger shoots, with a diameter of more than 2 cm.

We recommend that very small shoots be harvested and then delivered to the canning industry.

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