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THE INFLUENCE OF THE HARVEST PERIOD ON MORPHOLOGICAL AND PRODUCTIVITY TRAITS AT ASPARAGUS

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ABSTRACT

The asparagus (Asparagus officinalis L.) is a perennial vegetable species, cultivated worldwide under a variety of climatic conditions for its edible shoots. This study aimed to evaluate the morphological and productivity traits of two asparagus genotypes, grown for the production of green shoots, within the soil and climatic conditions of southwestern Romania. Throughout the growing season, measurements were taken for each genotype regarding the average number of shoots, their length and diameter, their average weight, and the yield per hectare considering both a four-week and an extended six-week harvesting period. It was found that the total shoot yield was higher during the first harvesting period. The total average yield, combined for both periods, ranged from 5.6 to 6.6 kg ha^{-1}, with the highest value observed for the 'Mary Washington' genotype. This genotype demonstrated good adaptability to the climatic conditions of southwestern Romania across both harvesting periods.

INTRODUCTION

Asparagus is a perennial, monocotyledonous, dioecious vegetable species, with distinct male and female plants, belonging to the *Liliaceae* family. Male plants exhibit higher productivity than female plants; consequently, exclusively male varieties are more frequently cultivated. Conversely, the spears of female plants have a greater weight than those of male plants (Motoki et al., 2022). Asparagus productivity varies significantly, influenced by the climatic conditions of each region and by production techniques (Drost, 2023). It is widely cultivated in temperate climate zones across Europe, Asia, and South America. In 2024, the total global cultivation area for this vegetable spans 1,569,410 hectares, with a total global harvest of approximately 8,909,741 tonnes (FAOSTAT, 2026).

China has become the world's largest producer and exporter of asparagus, with an area of nearly 90,000 hectares in 2020 (Drost, 2023).

In the European Union, as of 2024, the main asparagus-producing countries are Germany, Spain, and Italy, in terms of both harvested area and production

volume. Consequently, the area and volume of asparagus production in the EU amounted to 58,910 hectares and 305,870 tonnes, respectively (FAOSTAT, 2026).

In Romania, the areas cultivated with asparagus and the production volume are much smaller, covering approximately 10 hectares and yielding 10 tonnes in 2024 (FAOSTAT, 2026). Although Romania has numerous advantages in terms of soil, climate, and growing conditions, asparagus cultivation is practiced sporadically, and producers lack the adequate expertise to cultivate and popularize it.

The edible part of asparagus consists of green, violet, or white (etiolated) spears, which allows for a diverse range of products on the market to suit consumer preferences. Often referred to as the "king of vegetables" due to its rich composition, this species is widely consumed across the globe and is rapidly becoming one of the trendiest vegetables (Slatnar et al., 2018). It is considered a healthy food due to its low calorie and high fiber content, as well as the presence of various phytochemicals. Asparagus spears are rich in vitamins, minerals, carbohydrates, organic acids, and bioactive compounds, such as polyphenols, anthocyanins, and saponins (Slatnar et al., 2018; Redondo-Cuenca et al., 2023; Rolbiecki et al., 2024). Certain pharmacological properties have demonstrated potential antioxidant, anticancer, or diuretic effects on the human body (Guo et al., 2020). Based on studies regarding its health-promoting properties, asparagus has been included on the list of nutraceutical foods (Iqbal et al., 2017). Due to the presence of the antioxidant glutathione in the spears, consuming this vegetable is beneficial in the treatment of cataracts; it also supports heart function, blood pressure regulation, and nervous system activity, while contributing to the reduction of cholesterol and blood sugar levels (Conversa et al., 2019; Rolbiecki et al., 2024). By-products derived from the processing of the spears and roots can be used to stimulate the growth of commensal or probiotic strains of *Lactobacillus* and *Bifidobacterium* (Redondo-Cuenca et al., 2023).

Asparagus spears can be used as a raw material for processing—such as in the production of canned goods or as an alternative raw material for making crunchy snacks. In culinary preparations, they can be served in salads, soups, or as a gratin.

Asparagus crops can be cultivated for 8–12 years. Establishing the crop entails high costs, and production levels must be sufficient to ensure profitability. From a production point of view, the marketable yield of green asparagus is obtained by the number of shoots combined with their diameter and quality, gathered in bunches for the market or canning industry (Amato et al., 2022). Obtaining high-quality asparagus spears depends on the cultivar, the timing of harvest, and the agricultural practices applied during the growing season.

Selecting the right cultivar for a specific growing area is essential for maximizing crop yields (Jakše and Maršić, 2005). Asparagus breeders continue to make genetic improvements, focusing on adapting varieties to diverse growing environments (González and del Pozo, 2002).

For asparagus growers, maximizing productivity and maintaining the quality of the spears are essential for ensuring profitability (López-Moreno et al., 2025). The profitability of the crop stems from the commercialization of high-quality, well-developed spears.

Reduced production is a complex issue with multiple potential causes. Low soil and air temperatures often slow down the emergence and growth of spears; furthermore, the cultivation system employed and an excessively long harvesting period within each season can lead to a progressive decline in plant vigor and, consequently, in yield (Hanagasaki and Nakasone, 2023; Hanh et al., 2024; Murariu

et al., 2025). High summer temperatures, as well as fluctuations in precipitation, can also influence the timing of harvest, assimilation rates, and total yield (Hanh et al., 2024; López-Moreno et al., 2025).

Following a comparative analysis of asparagus cultivation methods, it was found that the conventional system yielded the highest output, due to a greater number of shoots per plant, whereas organic management resulted in improved shoot quality (Murariu et al. 2025). Nevertheless, Siomos (2018) noted that, beyond the cultivation system, the quality of the spears can be influenced by genetic, environmental, and agronomic factors, as well as the timing of harvest. Harvesting over an excessively long period each season can progressively reduce the vigor of the asparagus plants, leading to a decline in long-term production (Paschold et al., 2002). Performance of asparagus cultivars depends not only on their genetic potential but also on ability for adaptation to environmental conditions (Kałużewicz et al., 2010; Kameswara and Mohammed, 2011). The objective of this study was to evaluate the morphological and productivity traits of two asparagus genotypes cultivated for the production of green spears in relation to the time of harvest, under the pedoclimatic conditions of southwestern Romania.

MATERIAL AND METHODS

The experiment was established at the teaching and research field of the Faculty of Horticulture, University of Craiova (44°18'29" N, 23°51'43" E), Romania, on a reddish-brown preluvosol. The planting scheme involved a spacing of 1.5 m between rows and 0.5 m between plants within the rows (13,000 plants/ha). The biological material consisted of two asparagus genotypes: G1-'Argenteuil' and G2 - 'Mary Washington'. Standard asparagus cultivation practices were followed throughout the growing season. The asparagus plantation was established 10 years ago. During the evaluation period for morphological and productivity traits (2023–2024), climatic conditions were favorable for asparagus cultivation (Table 1). The harvest period spanned from May 15 to June 30 for the second harvest phase in each year. Throughout the growing season, measurements were taken for each genotype, evaluating the average number of spears, their length and diameter, their average weight, and the spear yield per hectare, for both a four-week and a six-week harvesting period. For these measurements, spears from each variety were cut with a knife below the soil surface, and representative samples were collected. The values for each analyzed trait represent the average over the years 2023–2024.

For statistical analysis, Microsoft Excel and Data Analysis was used. All data were expressed as means. Differences between means were first analyzed by Anova Two-Factor Without Replication test and then by Least Significant Difference (LSD).

Table 1.

The climatic conditions of the area of South-west Romania, 2023- 2024*

Month	Temperature (^{0}C)						The relative humidity of the air (%)		Rainfall (mm)	
	Minimum		maximum		medium					
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
May	6.9	7.9	+26.7	+26.8	+15.7	16.7	72	66	53	24
June	11.2	13.5	+32.9	+36.3	+20.3	+25.4	75	53	116	47
July	11.5	14	+36.5	+39.6	+25.1	+27.4	62	48	57	18

https://rp5.ru/Weather_in_Craiova_(airport)

RESULTS AND DISCUSSIONS

Studies in the specialized literature have reported significant differences among asparagus varieties regarding morphological characteristics. In asparagus cultivation, high-quality spears are defined by their weight, diameter, and uniformity (López-Moreno et al., 2025). The values obtained from the evaluation of morphological characteristics in the studied asparagus cultivars are presented in Figures 1–5. Over the four-week harvest period, the average number of spears per plant ranged from 9 to 10.6 for G1, and from 5.2 to 7 for G2. Regarding the harvest duration, lower values were recorded for the six-week period compared to the four-week period, with the decrease being more pronounced for G1. In the interaction between the factors of genotype and harvest duration, significantly positive differences were observed for G1 between the two durations, while significantly negative differences were noted for G2 (Figure 1). Other authors (Rolbiecki et al. 2024) have reported an increase in the number of spears reaching 10.78 per plant as a result of drip irrigation.

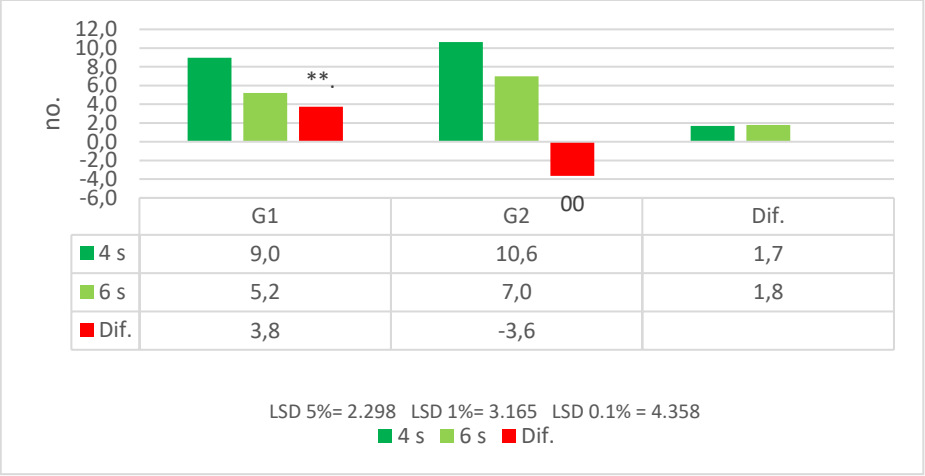


Figure 1. The interaction between genotype and harvest period on the number of spears

The length and diameter of the spear are criteria taken into account to determine whether or not it is marketable. It has been reported that asparagus spears with a length of 180–250 mm (Anido and Cointry 2008; Lee et al. 2014) and a diameter of at least 8 mm (Korkmaz et al., 2020) can be considered marketable.

In the present research, the average length of the spears at harvest ranged from 18.4 cm (G1) to 21.2 cm (G2) over a four-week harvest period, and from 16 cm (G1) to 18 cm (G2) over a six-week harvest period. It can be observed that spear length was greater during the first harvest period compared to the second; furthermore, regarding the interaction between the two factors, G2 showed significantly positive differences (Figure 2). The spears of both varieties can be considered marketable, as they largely fall into the superior quality class (exceeding 18 cm in length). In a two-year study on asparagus cultivation, Rolbiecki et al. (2024) reported spear heights under drip irrigation conditions ranging from 21.09 cm to 27.12 cm, depending on the variety.

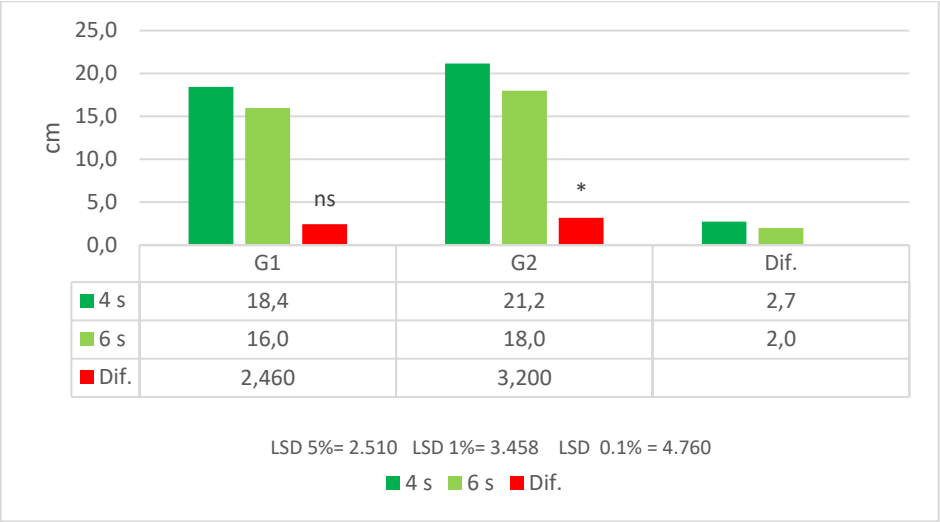


Figure 2. interaction between genotype and harvest period on spear length

An average spear diameter of at least 8 mm indicates the formation of well-developed, uniform spears with commercial potential (Korkmaz et al., 2020). In the present study, the recorded average values, ranging from 1 cm to 1.7 cm, were higher than those reported by the aforementioned authors. Differences in average spear diameter between genotypes were not significant; however, regarding the harvest period, "distinctly positive" differences were observed for G1, and "positive" differences for G2. It is noted that spear diameter was influenced less by the cultivar and more by the harvest period (Figure 3). A varied response among asparagus cultivars regarding this characteristic has also been documented by other authors, who reported average values ranging from 9.10 mm to 12.75 mm (Rolbiecki et al., 2024).

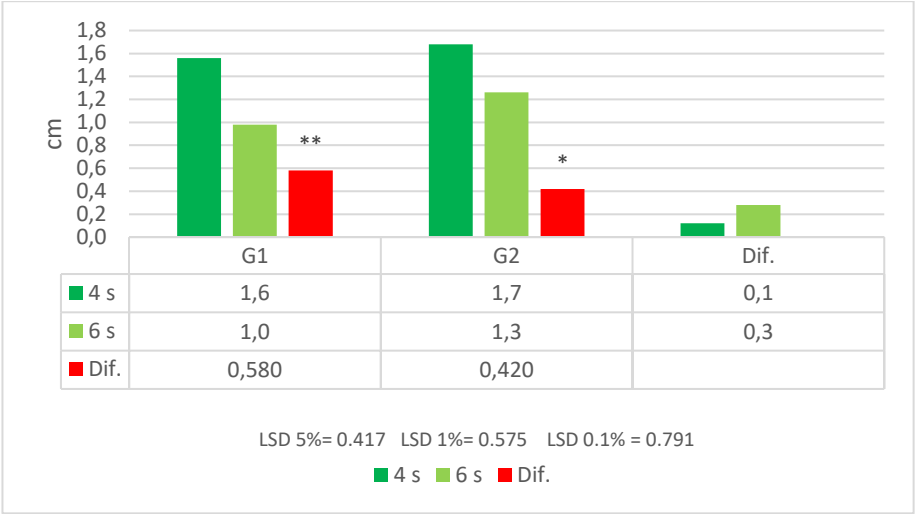


Figure 3. Interaction between genotype and harvest period regarding spear diameter

In this study, the average weight of green asparagus shoots (g) varied according to genotype and harvest period. The highest yields of spears were obtained during a four-week harvest period for both cultivars, considering the interaction between the two factors, with the differences being significantly positive (Figure 4). Lee et al. (2014) reported a wider range for the fresh weight of edible shoots, between 17.3 and 24.1 g, while Alan (2016) reported higher mean values, ranging from 23.5 to 51 g; meanwhile, Kałużewicz et al. (2010) in Poland reported a variation in shoot weight of 16 - 45 g. This variability in spear weight is influenced by the genotype, the growing year, the timing of harvest, and the climatic conditions of the cultivation area.

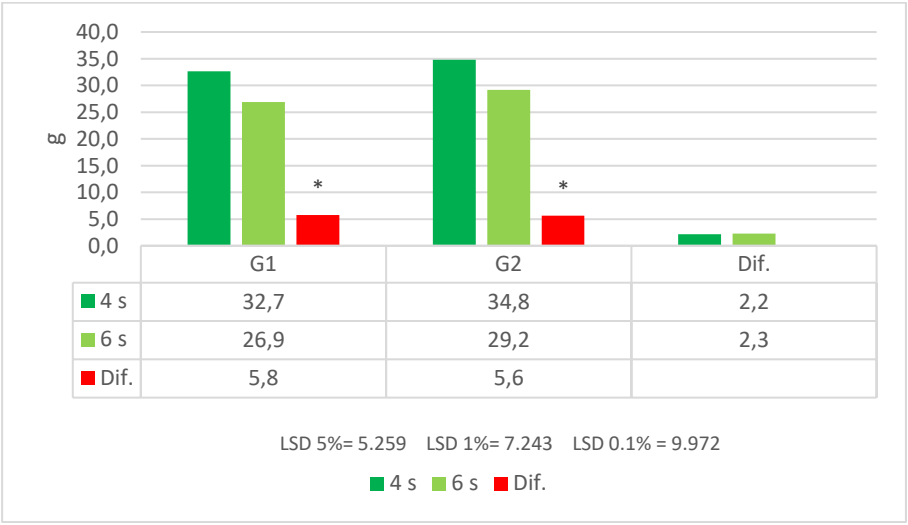


Figure 4. The interaction between genotype and harvest period on spear weight

During the six-week harvest period, the weight and consequently the yield of the asparagus decreased compared to the four-week harvest period. The reduction in spear weight also affected overall spear yield; it was observed that as the harvest duration is extended, the spears exhibit lower weights, a result of the progressive depletion of nutrient reserves within the rhizome during the warm season. Regarding the interaction between genotype and harvest period, highly significant positive differences were noted for Genotype 1, and significant positive differences for Genotype 2 (Figure 4).

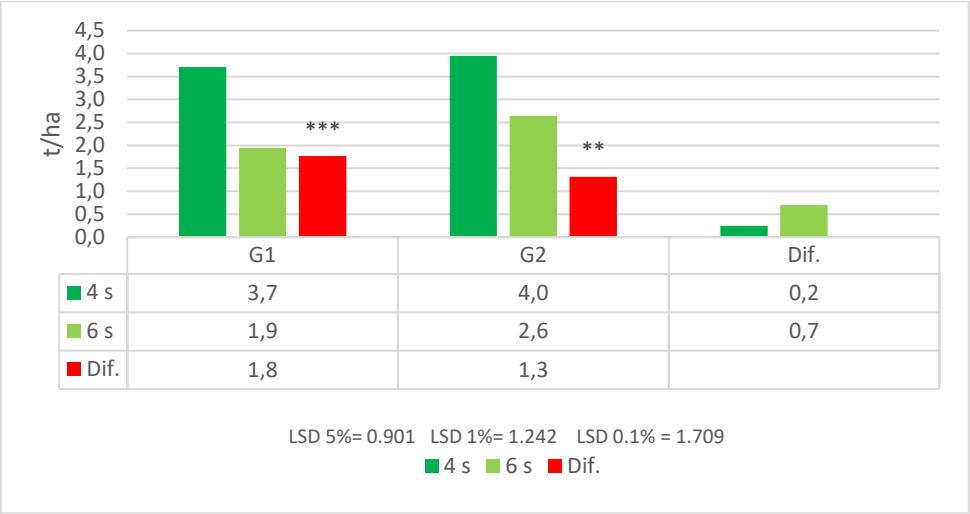


Figure 4. The interaction between genotype and harvest period on shoot production

The productivity and quality of asparagus spears can be influenced by various factors, such as genetic traits, climatic conditions in the production area, production practices, and harvest frequency (Paschold et al. 2002; Molina et al. 2012; Drost, 2023). Average yields in Asia (5,344 kg ha^{-1}), Europe (5,010 kg ha^{-1}), North America (4,146 kg ha^{-1}), and Australasia (4,247 kg ha^{-1}) represent approximately half the yield of high-production regions, such as Peru (11,670 kg ha^{-1}) and Mexico (9,430 kg ha^{-1}) (Drost, 2023).

The asparagus yield recorded for the genotypes under study, aggregated across the two periods, ranged from 5.6 to 6.6 kg ha^{-1}, with the highest yield observed for G2. The yield results obtained for the two periods were highly significantly positive for G1 and significantly positive for G2 (Figure 4). It can be stated that asparagus yield is significantly influenced by the harvest period, the genotype, and ecological conditions. According to research conducted by numerous investigators, extending the harvest period leads to a gradual deterioration of biometric parameters, caused by the depletion of carbohydrate reserves in the rhizome (Paschold et al., 2002; Siomos, 2018; Nguyen et al., 2024).

CONCLUSIONS

The total spears yield, combined across both periods, was highest for G2 – 'Mary Washington'. This genotype demonstrated good adaptability to the climatic conditions of southwestern Romania. The highest spears yields for both genotypes were obtained with a four-week harvest duration, whereas yields decreased under the six-week harvest regime. Extending the harvest period to six weeks or longer leads to a decline in both spears quality and yield, due to the progressive depletion of nutrient reserves within the rhizome and the high temperatures experienced during the summer. By using varieties with good adaptation to the soil and climatic conditions of the growing region and shortening the harvest period in the season, higher yields and better spear quality can be obtained.

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