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SADRŽAJ:

The impact of location and planting time on the morphological characteristics of the domestic ecotype of garlic (*Allium sativum* L.)

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Abstract

Garlic is one of the oldest cultivated species, with a characteristic smell and taste. This paper aimed to prove the impact of the production location and planting time on morphological traits of the bulbs of the domestic ecotype of garlic from Berkovići. Before setting up the experiment, the morphological characteristics of the bulb planting material originating from Berkovići were determined. That planting material was planted at two locations (Bijelo Polje and Hodbina) in two planting terms: autumn and spring planting terms. According to the results of this research, we can conclude that the traits of the bulbs of the domestic ecotype of garlic were influenced by cultivating location and planting term. Average values for all tested parameters were higher at the Bijelo Polje location and in the spring planting time, but these differences were not all statistically significant

Key words: garlic, ecotype, location, planting time, morphological characteristics.

Introduction

Garlic (*Allium sativum* L.) is a traditional species inour country and its surrounding area with a large amount of local populations, produced in almost every garden, and is one of the most popular species from the *Allium* genus. It is produced on 16.8 million hectares in the world with an average yield of 17 t/ha (FAOSTAT, 2023). It is used in nutrition, as a condiment, and as raw material for phytoformation. Despite the economic and culinary value of garlic, its cultivation is accompanied by certain problems, primarily the selection of planting material. Due to the inability to flower and reproduce by seed, garlic

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is propagated exclusively vegetatively. Most cultivars in our country and around the world were obtained through clonal selection of local ecotypes. Ecotypes have relatively poor adaptability (Lešić et al., 2004). Progress in garlic cultivation requires the evaluation and selection of superior clones adapted to different agroecological conditions (Azimi et al., 2025).

The most cultivated populations in our area are domestic spring and winter kinds of garlic. Garlic is very responsive to the changes in ecological conditions. It belongs to species with moderate requirements to agroecological environmental conditions. It is sensitive to drought, and maximizing garlic bulb yield depends largely on water availability (Habuš Jerčić et al., 2023).

Planting time is one of the most important agronomic measures in garlic production technology. Planting date affects morphological characteristics such as plant height, leaf length, number of leaves per plant, and yield attributes such as bulb diameter, number of cloves per bulb, and bulb yield (Sultana et all., 2022). The same authors point out that growth, yield attributes and yield of garlic decreased gradually with delayed planting. Planting date is a critical factor determining the yield and quality parameters of garlic bulbs (Kacjan Maršić et all., 2020). It is very important to plant garlic on time in spring. Delays in planting spring garlic can have several negative consequences. With rising temperatures spring garlic forms a weak root system (optimal temperature is 5-10 °C) which cannot nurture the above-ground part of the plant (Gvozdenović-Varga et al., 2009). Delayed planting not only reduces bulb size but also decreases the mass and number of cloves, negatively affecting the quality of the planting material (Gvozdenović-Varga et al., 2009). Gvozdanović-Varga, (2005) states that there is a significant impact of weather conditions during vegetation on yields' basic components such as the cloves' mass, size, and compactness of the bulb. Tomić (2007) states that morphological features of bulbs are characteristic of each genotype, but they also depend on planting term.

This research aimed to determine in which way the population of domestic ecotype of garlic from the area of Berkovići would behave in other locations, and what would be the quality of bulbs in the new locations, as well as which planting term would give better results.

Materials and methods

In this research domestic ecotype of garlic from Berkovići was used. It belongs to the spring type of garlic. The experiment was set at two locations: Bijelo Polje (north of Mostar, about 200 m altitude, coordinates 43°27′N17°53′E), and Hodbina (south of Mostar, about 47 m altitude, coordinates 43°14′N17°51′E). Planting material was planted at both of these locations in two terms: autumn planting term (last decade of October 2016.) and spring planting term (first decade of March 2017). The experiment was set to the block schedule in three replications. The size of the main parcel was 1 m^2. Before setting the experiment, bulb mass was determined, as well as its width and height, the number of cloves, and cloves width and height of planting material. Before planting, basic soil preparation was

performed by plowing to a depth of 25 cm, followed by pre-planting soil preparation through tilling and leveling the surface layer of the soil. The soil of the experimental plot in Bijelo Polje belongs to the soil type of redeposited (allochthonous) red soil, with an alkaline pH reaction (pH in water 7.56). The soil in Hodbina belongs to the type of brown colluvial soil with a slightly heavier texture, neutral pH reaction (pH in water 6.92). Planting was done in rows, with a spacing of 30 cm between rows and 10 cm within rows. During the vegetation period, the usual crop maintenance measures were carried out destroying ragweed and hoeing. During the experiment, the onset of emergence, growth dynamics, and the beginning of ripening were monitored. After ripening and harvesting the bulbs, the following measurements were taken: bulb mass, bulb width and height, number of cloves, clove mass, clove width, and clove height. The obtained results were processed using analysis of variance, and the differences between individual average values were tested using the LSD test, using Excel software.

Results and discussion

The *bulb mass* varied from 22.45 to 36.93 g (table 1). According to the variance analysis results it can be seen that research factors did not have a statistically significant impact on this feature, while the interaction of researched factors showed statistical significance. The bulb mass was larger at the location of Bijelo Polje (30.65 g) compared to the other location, and that the bulb mass was larger in the spring planting term compared to the autumn period (29.69 g). However, the LSD test has shown that these differences are not statistically significant.

Table 1. *The impact of the location and planting term on the bulb mass (g)*

Location		Planting term		Average
		Spring	Autumn	
Bijelo Polje		36.93	24.37	**30.65^{A}**
Hodbina		22.45	34.47	**28.46^{A}**
Average		**29.69^{A}**	**29.42^{A}**	
LSD	0.05		Term	Location
	0.01		4.41	4.41
			5.95	5.95

Bulb width and height - variance analysis results show that location and planting term had a significant impact on the height of the bulb, while their interaction did not have a statistically significant impact (table 2). Regarding the location, bulb height was greater at the location of Bijelo Polje (3.80 cm), which is statistically significant according to the LSD test. Regarding the planting term and according to the LSD test, the garlic from the spring planting term had statistically bigger bulb height (3.69 cm).

Table 2. *The impact of location and planting term on bulb height (cm)*

Location		Planting term		Average
		Spring	Autumn	
Bijelo Polje		4.03	3.58	**3.80^{A}**
Hodbina		3.37	2.75	**3.06^{B}**
Average		**3.69^{A}**	**3.16^{B}**	
LSD	0.05		Term	Location
	0.01		0.27	0.27
			0.36	0.36

The factors research, as well as their interaction, had a statistically significant effect on the width of the garlic bulb (table 3). The width of the garlic bulb, depending on the location of cultivation and the planting term, ranged from 3.16 to 4.62 cm. The LSD test showed that the value of this parameter was statistically significantly higher at the location of Bijelo Polje. Regarding planting terms, a higher value of this parameter was recorded in the spring planting term, but this difference was not statistically significant.

Table 3. *The impact of location and planting term on bulb width (cm)*

Location		Panting term		Average
		Spring	Autumn	
Bijelo Polje		4.62	4.16	**4.16^{A}**
Hodbina		3.34	3.16	**3.25^{B}**
Average		**3.97^{A}**	**3.66^{A}**	
LSD	0.05		Term	Location
	0.01		0.41	0.41
			0.55	0.55

The *number of cloves* per bulb varied from 9.90 to 12.60. Variance analysis showed that research factors did not have a statistically significant impact on the number of cloves in a garlic bulb, while their interaction had that effect. Although the LSD test indicated that differences in the number of cloves between location and planting terms were not statistically significant, the results in Table 4 show that number of cloves was higher at the location of Bijelo Polje (11.85) and in the spring planting term (11.80).

Table 4. *The impact of location on cloves number in a bulb*

Location		Planting term		Average
		Spring	Autumn	
Bijelo Polje		11.10	12.60	**11.85^{A}**
Hodbina		12.50	9.90	**11.20^{A}**
Average		**11.80^{A}**	**11.25^{A}**	
LSD	0.05		Term	Location
	0.01		1.97	1.97
			2.66	2.66

Mass of cloves - although variance analysis indicated that research factors had a statistically significant impact on this feature, the LSD test showed that the values of clove mass did not differ significantly between locations and planting terms, which is seen in the results presented in Table 5.

Table 5. *The impact of location on garlic clove mass (g)*

Location		Planting term		Average
		Spring	Autumn	
Bijelo Polje		4.69	2.82	**3.75^{A}**
Hodbina		2.85	4.61	**3.72^{A}**
Average		**3.76^{A}**	**3.71^{A}**	
LSD	0.05		Term	Location
	0.01		0.84	0.84
			1.13	1.13

Clove width and height - research factors, as well as their interaction, had a statistically highly significant impact on the height of garlic cloves. When we look at the results in Table 6, we can see that the cloves' height was bigger at the location of Bijelo Polje (2.94 cm) compared to the location of Hodbine, as well as in the spring planting period (3.04 cm) compared to the autumn planting period, but these differences were not statistically significant according to the LSD test.

As in the case of clove height, the research factors, as well as their interaction, had a statistically highly significant impact on the width of garlic cloves. LSD test showed that the clove width differed statistically significantly between locations and planting terms. From the results shown in Table 7 we can see that the clove width at the location of Bijelo Polje (1.77 cm) was statistically highly bigger in

comparison to the location of Hodbine, as well as in the spring planting term (1.75 cm) compared to the winter planting term.

Table 6. *The impact of location and planting term on clove height (cm)*

Location	Planting term		Average
	Spring	Autumn	
Bijelo Polje	3.19	2.71	**2.94^{A}**
Hodbina	2.90	2.41	**2.65^{A}**
Average	**3.04^{A}**	**2.55^{A}**	
LSD	0.05	Term	Location
	0.01	0.57	0.55
		0.77	0.77

Table 7. *The impact of location and planting term on clove width*

Location	Planting term		Average
	Spring	Autumn	
Bijelo Polje	1.93	1.63	**1.77^{A}**
Hodbina	1.57	0.98	**1.27^{B}**
Average	**1.75^{A}**	**1.31^{B}**	
LSD	0.05	Term	Location
	0.01	0.19	0.19
		0.25	0.25

Characteristics of garlic planting material

Table 8 presents the results of morphometric measurements of garlic planting material produced in Berkovići.

Table 8. *Values of Examined Morphometric Parameters of Garlic Planting Material*

Parameters examined	Bulb mass (g)	Bulb height (cm)	Bulb width (cm)	Number of cloves	Clove mass (g)	Clove height (cm)	Clove width (cm)
The Value	44.59	3.53	4.25	11.9	4.42	2.01	0.96

Based on the measured parameters of the planting material produced in Berkovići, and comparing them with the values of the parameters of garlic produced in the experiment, it can be stated that the values of most of the examined parameters of the planting material produced in Berkovići were significantly higher compared to the garlic produced in the experiment (table 8).

The planting material, compared to the garlic produced in the experiment, had significantly higher values for the following parameters: bulb mass, bulb width, and clove weight. The number of cloves per bulb was also higher in the planting material in comparison to the obtained garlic, but this difference was negligible. The bulb height of the planting material (3.53 cm) was bigger than the garlic produced in the experiment at the location of Hodbine and in the autumn planting term, while it was lower than the bulb height of the garlic from the experiment at the location of Bijelo Polje and in the spring planting term.

Only the height and width of the cloves were greater in the produced garlic compared to the planting material.

Discussion

Research factors location and time of planting influenced the following characteristics of the garlic bulb: bulb height, bulb width, cloves height and cloves width, while bulb weight, number of cloves in the bulb and cloves weight were not influenced. The interaction of the research factors showed a significant influence in all tested parameters except for the bulb height parameter.

When analyzing the average values of the tested parameters according to the treatments of the experiment, we can state that all the average values of all the tested parameters were higher at the Bijelo Polje location and in the spring planting time. However, not all of these differences were statistically significant.

Thus, we can distinguish that the height of the bulb, the width of the bulb and the width of the cloves were statistically significantly higher in the Bijelo Polje location compared to the Hodbina location, and the height of the bulb and the width of the cloves were statistically significantly higher in the spring planting time compared to the autumn planting time.

These differences between localities could be related to different growing conditions, given that localities have different altitudes and different types of soil. Differences in altitude cause differences in the average air temperature, which affected the growth and development of plants during critical phases.

This could have resulted in a location with higher altitude having more moderate air temperatures, which potentially mitigated heat stress that could negatively affect vegetative growth and root system formation, especially in spring planting time.

Proper planting time, first of all, ensures favorable temperatures for individual growth phases. Mensah and Valenti 2025. state that early autumn planting produces large bulbs, and Plodma et al., 2005. point out that autumn planting outperforms spring planting.

Light, alluvial and well-structured soils are more suitable for growing garlic. When we compare the types of soil in the localities of cultivation, we can say that allochthonous pre-deposited red soils have an advantage for growing garlic, compared to brown colluvial soil.

The difference in average bulb weight values between treatments is not statistically significant. However, when analyzing the interaction effect, it can be seen that the highest bulb mass was recorded in the combination Bijelo Polje/spring planting date (36.93 g), and the next highest value was recorded in the combination Hodbina/winter planting date (34.47 g). The significant interaction effect of planting date and location on bulb mass and width (diameter) indicates that both planting time and location-specific environmental conditions play a key role in determining these traits (Mensah i Valenti, 2025).

The obtained values of the examined parameters in the experiment are similar to the results of other authors. According to Gvozdenović – Varga et.al. (1994), the bulb mass of different clones of spring garlic ranged from 16.47 to 21.81 g. The number of cloves is a varietal characteristic, and in this study, it ranged from 9.8 to 16.8. The higher the number of cloves in the head, the lower their weight is. The values of certain bulb features of domestic and introduced garlic ecotypes in the study by Dumičić et al., (2013), ranged as follows: bulb mass ranged from 39.6 to 58.0 g, number of cloves from 10.5 to 11.9, bulb height from 2.2 to 3.9 cm, bulb width from 4.1 to 5.0 cm, and clove mass from 3.2 to 5.2 g.

Many authors have established a significant influence of the time of planting on plant growth and development, as well as yield and yield (Bhuiya et. al., 2003; Sultana et al., 2022; Shuvra et al., 2017).

From the previously presented results related to the comparison of planting material and experimental results, we can state that the average experimental results for most parameters were lower. We can single out that the height and width of the cloves in cultivated garlic were higher compared to the planting material, as well as the height of the bulb in the Bijelo Polje location and in the spring planting time. However, when we single out the result of the best treatment combination Bijelo Polje/spring planting date (4.62 cm) for the bulb width property, we can see that the obtained value significantly exceeds the planting material. This shows that the most effective combination of treatments was able to produce larger bulbs than the original material.

Dumičić et al., 2013, investigated the influence of domestic ecotypes (Ljubitovački šarac and Ljubitovački garlic) and introduced cultivars (Domestic winter red onion and Domestic winter garlic) of garlic on yield components under traditional cultivation conditions in the karst field area of Ljubitovica. Both ecotypes from Ljubitovica achieved a significantly higher percentage of dry matter

and higher morphological parameters of the bulbs compared to the two introduced cultivars. Azimi et al. 2025. investigated the adaptability of selected garlic clones in comparison with local populations in three localities. All selected clones outperformed their parental populations, and two clones showed superior performance at all three breeding locations, which suggests the high adaptability of these two clones and they are recommended for mass production at all three studied locations (regions).

Conclusion

The examined features of the bulb of domestic ecotype of garlic were influenced by the following research factors – location of cultivation and planting terms. The values of all examined parameters of the bulb were higher at the location of Bijelo Polje and in the spring planting term. The average values of most of the investigated parameters of the produced garlic in the experiment are significantly lower compared to the values of the parameters of the planting material originating from the area of Berković. Although the average values of most experimental results are lower than the starting material, it should be noted that the bulb diameter obtained at the Bijelo Polje location and in the spring planting time is significantly larger than the bulb diameter of the planting material, which means that the most effective combination of treatments managed to produce larger bulbs than the original material.

This experiment should be repeated and expanded to determine whether a longer period of adaptation is needed.

References

Azimi, M., Alemkhoumaram, M. H., Damankeshan, B., Bayat, F. (2025). Adaptability of parentalpopulations and selected garlic (Allium sativum L.) clones for introducing promising clones in Iran. *Scientific Reports, 15,* 34950. https://doi.org/10.1038/s41598-025-18841-x

Bhuiya, M. A. K., Rahim, M. A., Chowdhury, M. N. A. (2003). Effect of Planting time, Mulch and Irrigation on the Growth and Yield of Garlic. *Asian Journal of Plant Sciences 2(8), 639-643.*

Dumičić, G., Čagalj, M., Urlić, B., Runjić, M., Ban, G. (2013). Komponente prinosa češnjaka (*Allium sativum* L.). Zbornik radova *48. Hrvatski i 8. međunarodni Simpozij agronoma*, Dubrovnik – Hrvatska, 349-352.

F. A. O. S. T. A. T. (2023). https://www.fao.org/faostat/en/#home

Gvozdanović-Varga, J., Takač, A., Vasić, M. (1994). Povezanost komponenti prinosa jesenjeg belog luka. *Zbornik radova VI Simpozijum sa medjunarodnim učešćem* „Povrće i krompir", 117–120.

Gvozdanović-Varga, J., Vasić, M., Červenski, J. (2005). Quality diferences among garlic ecotypes. *Contemporary Agriculture, 54, 3–4,* 171–176.

Gvozdanović-Varga, J., Vasić, M., Takač, A., Bugarski, D., Jovićević, D., Červenski, J., Stojšin, V. (2009). Proizvodnja belog luka sa aspekta sadnog materijala. *Zbornik radova Instituta za ratarstvo i povrtarstvo, 46(1),* 99-109.

Habuš Jerčić, I., Bošnjak Mihovilović, A., Matković Stanković, Lazarević, B., Goreta Ban, S., Ban, D., Major, N., Tomaz, I., Banjavčić, Z., Kereša, S. (2023). Garlic Ecotypes Utilise Different Morphological, Physiological and Biochemical Mechanisms to Cope with Drought Stress. *Plants, 12,* 1824. https://doi.org/10.3390/plants12091824

Kacjan Maršić, N., Košmelj, K., Slatnar, A. (2020). The impact of planting date and cultivar on yield and morphological traits of garlic (*Allium sativum* L.) bulbs: data from a small-scale experiment. *55th Croatian & 15th International Symposium on Agriculture*, Vodice, Croatia, 208-2012.

Lešić, R., Borošić, J., Butorac, I., Herak-Čustić, M., Poljak, M., Romić, D. (2004). *Povrćarstvo.* Čakovec: Zrinjski.

Mensah, S., Valenti, H. H. (2025). Evaluating the Effect of Cultivar and Planting Dates on Garlic Growth and Yield in North Dakota Stephen Mensah and Harlene Hatterman Valenti. *Archives of Agriculture Research and Technology, 6(1)*, 1-18. DOI: 10.54026/AART/1077

Põldma, P., Merivee, A., Pae, A., Justus, K. (2005). Influence of planting time on the development, yield and quality of garlic (Allium sativum L.) in Estonia. *Acta Horticulturae*, 688(688), 333-338. https://doi.org/10.17660/ActaHortic.2005.688.49

Shuvra, J., Hosain, M., Rahman, M., Shaha, U., (2017). Effect of Planting Time on Growth, Development and Yield Performance of Ten Garlic Genotypes. *European academic research, 5(7),* 3156-3176.

Sultana, A., Debsharma, S.K., Mondal, S., Maniruzzaman, S., Al Fakhrul Islam, M. M., Rahim, R., Haque, A. (2022). Effect of Planting Time on Growth and Yield of Garlic (Allium sativum L.) Genotypes. *Asian Journal of Research in Crop Science, 7(2),* 1-12. https://doi.org/10.9734/ajrcs/2022/v7i230133.

Tomić, M. (2007). Uzgoj češnjaka. Savjetodavna služba, Zagreb. http://www.savjetodavna.hr/savjeti/17/152/uzgoj-cesnjaka/ (pristupljeno: 1.12.2025).

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