

COMPARATIVE RESEARCH OF CERTAIN TRAITS OF THE LIVING  
ABILITY OF GENTIAN SEED GROWN AND WILD FROM SEVERAL  
LOCATIONS

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**Abstract:** Results of the laboratory study of the quality of gentian seed are analyzed in this paper. Seed originated from wild and grown plants from Zlatibor Mountain (approx. 1000 m above sea level) collected in the third decade of August 2006 and from wild and grown gentian plants around Ivanjica (approx. 1030 m above sea level) collected also in the third decade of August 2006, as well as from grown plants in the Tara Mountain (approx. 1000 m above sea level) collected during the same period.

The effects of cooling (90 days at 4<sup>0</sup>C) and moistening and cooling (90 days at 4<sup>0</sup>C) on germination energy (GE) and total germination of seed (TG) were observed.

The origin of the seed (if it comes from grown or wild plant) had influence on both investigated traits, and grown seed had slightly better germination energy and higher total germination compared to seed of wild plants. On the location in Tara we had no seed from wild plants so no comparison was possible.

The location also demonstrated significant effect on traits of ability for living, so wild seed from Zlatibor was of higher quality than the one collected in the vicinity of Ivanjica. In regard to seed from grown gentian the highest quality was determined in seed grown in Zlatibor Mountain, than Tara, and the poorest germination traits were exhibited by seed grown around Ivanjica.

The variant with moistening and cooling of seed regardless of the location and origin possessed better germination energy and total germination compared to seed that has only been cooled, and especially in regard to the control (no cooling).

**Key words:** gentian, wild plants, grown plants, moistening, cooling, GE, TG.

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## Introduction

Gentian (*Gentiana lutea* L.) is characterized by strong stem of 1-1.5 m height and strong meaty, fleshy root. It is perennial, herbaceous plant from the family *Gentianaceae*. Its five-year old root is of the highest quality. Its medicinal traits were known to ancient peoples. Illyrian ruler Gentians was the first to indicate the medicinal traits of this plant 200 b.c. And the plant was named after him.

Wild plants grow on mountain meadows and pastures, rarely in forests and rocky terrains (Kohlein, F., 1991). Most often it can be found at sea level of 800-1500 m, but also to the altitude of 2500 m. The occurrence of wild gentian was also recorded at 600 m above sea level in South Kučaj. In Serbia, gentian is present in almost all mountains (Tucakov, J., 1958; Tucakov, J., Kilibarda, R., 1960; Mihajlov, M. i Tucakov, J., 1972; Mihajlov, M., 1988; 1992; 1994) but the best quality gentian comes from Zlatibor Mountain, in Serbia and in the world (Tucakov, J., 1996).

Its root is rich in active substances (Šavikin-Fodulović, K., et al., 2000; Lalić, Ž. et al., 2000; Menković, N. 1997) which are applied in pharmacological industry and industry of bitter alcoholic beverages.

By its uncontrolled exploitation gentian was brought to total extermination (Panjković, B., Novčić, R., 2001). Now it is on the list of protected plants and its exploitation is prohibited. In order to satisfy the needs, requirements for gentian root and to protect natural resources gentian is increasingly grown (Stepanović, B., et al., 2003; Radanović, D., et al., 2006). Problem in growing gentian is the seed which has extremely low germination; therefore this research contributes to overcoming this problem.

The aim of the paper was to point out possibilities for improvement of germination traits of gentian seed.

## Material and Methods

Seed of grown gentian collected in the mountains Zlatibor and Tara and in the vicinity of Ivanjica, as well as seed of wild plants collected in the mountain Zlatibor and in the vicinity of Ivanjica was used for our research.

Seed was additionally dried and processed in the Medicinal Plants Research Institute "Dr Josif Pančić" - Belgrade, in the seed laboratory in Pančevo, where the study was performed.

From all locations (Zlatibor, Tara and vicinity of Ivanjica) and both variants (grown and wild) samples were taken and divided each into three parts, one was left in natural conditions (control), the second was cooled for 90 days at 4°C, and the third moistened and cooled for 90 days at 4°C.

After 90 days, of each part and variant, seeds were counted in four repetitions (100 seeds for each repetition) and placed for germination.

Investigation of germination was carried out in a germination place, in Petri dishes at filter paper and at constant temperature of 20°C.

Counting of germinated seeds to determine germination energy and total germination was done according to ISTA Standards (1999).

The obtained experimental data were processed using statistical procedure. Testing of significance of differences between calculated mean values of investigated factors (location and growing variants, and different seed treatments) was done using the model of variance analysis for factorial trials. All evaluations of significance were made based on F-test and LSD-test for threshold of 5% and 1% significance (Maletić, R., 2005).

### Results and Discussion

Germination ability of gentian seed (GE and TG) treated differently, and depending on the location and growing variant (grown and wild gentian) is presented in table 1.

Gentian seed collected on the location of Zlatibor Mountain had the best germination energy. Considerably lower germination energy was determined in seed from other locations (Tara and vicinity of Ivanjica), tab. 1. Therefore, statistically highly significant difference in germination energy of seed obtained from the location of Zlatibor and seed from the location in Tara and vicinity of Ivanjica were established ( $p < 0.01$ ), whereas germination energy of seed from these two locations showed no statistically significant differences ( $p > 0.05$ ).

Seed of grown gentian exhibited somewhat better germination energy compared to the seed from wild gentian. On the location of Zlatibor, germination energy of seed from grown gentian, was on average, 52.42%, and of seed from wild plant 51.83%, whereas on the location around the town of Ivanjica in seed from grown plant value of germination energy established was 41.58%, and from wild plants 39.33%. Note: on the location in Tara Mountain no wild gentian was found. The obtained differences in content of germination energy of seed from grown and wild gentian plants showed no statistical significance on any of the locations ( $p > 0.05$ ).

The value of germination energy of seed from grown gentian on the location of Zlatibor and other locations was statistically significantly different ( $p < 0.01$ ), whereas the difference in germination energy of seeds from locations of Tara and vicinity of Ivanjica showed no statistical significance ( $p > 0.05$ ). Also, germination energy of seed from grown gentian shows statistically significant differences between all observed seed treatments (cooled for 90 days at 4°C, moistened and cooled for 90 days at 4°C and control),  $p < 0.01$ .

Germination energy of seed from wild gentian from the location in Zlatibor and vicinity of Ivanjica differs statistically significantly between locations, and all seed treatments ( $p < 0.01$ ).

T a b. 1. - Quality indicators of gentian seed of different treatments, locations and growing variants

Seed quality	Location	Growing variant	Seed treatments			Statistical indic.	
			Cooled for 90 days on 4°C	Moistened and cooled for 90 days on 4°C	Control	Average	Cv (%)
Germination energy	Zlatibor Mt.	wild	45.75	66.00	43.75	51.83	20.64
		grown	46.75	66.25	44.25	52.42	20.02
		$\bar{x}$	46.25	66.12	44.00		
		Cv (%)	4.87	3.04	5.15		
	Vicinity of Ivanjica	wild	3.75	56.00	26.25	39.33	34.29
		grown	36.50	57.25	31.00	41.58	28.85
		$\bar{x}$	36.12	56.62	28.62		
		Cv (%)	4.77	5.50	16.90		
	Tara Mt.	grown	37.00	58.25	29.25	41.50	32.26
	Average		40.35	60.75	34.90		
Cv (%)		13.07	8.49	25.03			
Total germination	Zlatibor Mt.	wild	48.25	70.00	46.25	54.83	20.92
		grown	49.50	70.50	47.00	55.67	20.20
		$\bar{x}$	48.88	70.25	46.62		
		Cv (%)	5.52	3.38	4.58		
	Vicinity of Ivanjica	wild	38.25	59.25	31.25	42.92	29.78
		grown	39.50	60.25	33.00	44.25	27.78
		$\bar{x}$	38.88	59.75	32.12		
		Cv (%)	5.58	5.78	6.95		
	Tara Mt.	grown	40.25	61.25	34.50	45.33	26.88
	Average		43.15	64.25	29.00		
Cv (%)		12.27	8.95	18.94			
Test	Germination energy			Total germination			
	Location	Growing variant	Seed treatment	Location	Growing variant	Seed treatment	
	$F_{exp}$	195.35**	2.88 <sup>NS</sup>	337.89**	228.35**	1.97 <sup>NS</sup>	418.73**
	p-level	0.000000	0.098295	0.000000	0.000000	0.16913	0.000000
	LSD	0.05	1.6361	1.3358	1.6361	1.5132	1.2355
	0.01	2.1536	1.7584	2.1536	1.9919	1.6264	1.9919

Different treatments of gentian seed resulted in explicit and statistically significant values of germination energy of seed from all locations and both growing variants (wild or grown plant),  $p < 0.01$ .

Moistened and cooled seed for 90 days at 4°C showed best germination energy. On the location of Zlatibor the value of seed germination energy was over 66% (seed of wild gentian 66% and grown gentian 66.25%), on the location in the vicinity of Ivanjica slightly below 60% (seed of wild gentian 56% and 57.25% for seed of grown gentian), and on the location in Tara Mountain 58.25%.

Seed treated only by cooling for 90 days at 4°C also had favourable germination energy, but less compared to previous form of seed treatment. Therefore, seed of gentian from the location in Zlatibor, has on average germination energy of approx. 46.25% (wild gentian 45.75%, and grown gentian 46.75%), on the location in the vicinity of Ivanjica 36.12%, and Tara 37%.

Germination energy of seed treated as control (no pre-treatment) was considerably lower than in both variants of treated seed. Therefore, statistically significant difference in germination energy between both seed treatments and standard material was calculated ( $p < 0.01$ ).

Total germination of gentian seed was also observed. Seed collected or grown in Zlatibor had higher total germination than seed collected from other locations. Average total germination of seed of wild gentian from Zlatibor location was 54.83%, and total germination of seed of grown plant 55.67%. In the vicinity of Ivanjica the same trait was 42.92% (wild) and 44.25% (grown gentian), whereas in Tara location total germination of grown gentian seed was 45.33%. Established differences in germination of gentian seed from the location of Zlatibor and other investigated locations were statistically very significant ( $p < 0.01$ ). No statistically significant difference in total germination of grown seed on the locations of Tara and Ivanjica were established ( $p > 0.05$ ).

Germination of collected seed of wild gentian on the locations of Zlatibor and Ivanjica was statistically significantly different ( $F_{uz} = 97.22^{**}$ ).

Seed of grown gentian had slightly better germination compared to the seed of wild gentian on both locations (Zlatibor and vicinity of Ivanjica) and both seed treatments. However, established differences weren't statistically significant ( $F_{uz} = 1.9689^{NS}$ ,  $p = 0.169$ ).

Moistening and cooling of seed for 90 days at 4°C had the most favourable effect on seed germination from all experimental locations and both growing variants (wild and grown gentian). So, in Zlatibor, the value of germination in this treatment of seed was, on average, 70.25%, in the vicinity of Ivanjica 59.75% and in Tara 61.25%. Statistically considerably lower germination was registered for the treatment of seed only by cooling for 90 days at 4°C, for seed collected on the location of Zlatibor 48.88%, location of Ivanjica 38.88%, and location of Tara 40.25%. Seed which was untreated, used as control, had the lowest germination:

in Zlatibor 46.62%, on the location of Ivanjica 32.12% and in Tara 34.50%. Measured total germination of control seed on all locations was statistically considerably lower compared to germination of treated seed ( $p < 0.01$ ).

The obtained results are in accordance with previous researches (Jevdjović, R., 2004; Jevdjović, R., et al., 2006).

### Conclusion

Based on research and analysis of obtained results, the following can be concluded:

Seed of grown gentian had better results in regard to germination compared to wild plants, but differences weren't statistically significant.

The best results were established for seed from Zlatibor Mt., and this should be taken into consideration when choosing the location for seed production.

Moistening and cooling of seed for 90 days at 4°C had the best results in germination energy and total germination compared to the seed which was only cooled, and especially compared to control material, so recommendation is that this method should primarily be used for improving germination traits of gentian seed.

Gentian seed without and pre-treatment should not be used for sowing.

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## UPOREDO ISPITIVANJE POJEDINIH OSOBINA ŽIVOTNE SPOSOBNOSTI SEMENA GAJENE I SAMONIKLE LINCURE SA VIŠE LOKALITETA

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### Re z i m e

U radu su analizirani rezultati laboratorijskog ispitivanja kvaliteta semena lincure. Seme je bilo poreklom od samoniklih i gajenih biljaka sa Zlatibora (oko 1000 m nadmorske visine) sakupljeno u trećoj dekadi avgusta 2006. godine, od samoniklih i gajenih biljaka lincure iz okoline Ivanjice (oko 1030 m nadmorske visine) sakupljeno takodje u trećoj dekadi avgusta 2006. godine, kao i od gajenih biljaka sa planine Tare (oko 1000 m nadmorske visine) sakupljeno u istom periodu.

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Posmatran je uticaj hladjenja (90 dana na 4<sup>0</sup>C) i kvašenja i hladjenja (90 dana na 4<sup>0</sup>C) na energiju klijanja (EK) i ukupno klijanje (UK) semena.

Poreklo semena (gajeno ili samoniklo) imalo je uticaja na obe ispitivane osobine pa je gajeno seme imalo nešto bolju energiju klijanja i veću ukupnu klijavost od semena samoniklih biljaka. Sa Tare nismo imali seme samoniklih biljaka pa ovde poredjenje nije pravljeno.

Lokalitet je ispoljio značajan uticaj na osobine životne sposobnosti tako da je samoniklo seme sa Zlatibora bilo kvalitetnije od onog iz okoline Ivanjice. Kod semena gajene lincure najkvalitetnije je bilo seme gajeno na Zlatiboru, zatim na Tari, a najlošije osobine klijavosti ispoljilo je seme gajeno u okolini Ivanjice.

Varijanta sa kvašenjem i hladjenjem semena bez obzira na lokalitet i poreklo, imala je bolju energiju klijanja i ukupno klijanje od semena koje je samo hladjeno, a naročito u odnosu na kontrolu (nehladjeno).

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