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Effect of low temperatures at the beginning of the vegetation growth period on beech yield in Belgrade

Abstract

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This paper points out the effect of temperatures at the beginning of the vegetation period on beech yield in Belgrade. The reconnaissance in the field study and the comparative analysis were performed during years 2001, 2002 and 2003. The reasons of the reduced yield are related to the variability of temperatures during the study period, but also with the conditions of cultivation outside the ecological optimum.

Introduction

The beech forests in Serbia are characterized by ecological and taxonomic diversity, which distinguishes them from beech forests of Europe. However, general devastation and intensive felling decreased the area of the best stands and deteriorated the ecological conditions of their development. Still, in Serbia, Moesian beech is the most widely distributed species on 25% of the territory covered with forests, and it is the national wealth (Mišić 1997; Janković & Nikolić 1998; Jovanović 2000).

In addition to Moesian beech significance for forestry practice, there is its great significance (and also of European beech) in urban coenoses (Vukićević 1996). Their cultivation in parks enriches the diversity of dendroflora, and simultaneously represents a specific experiment in adaptation to ecological circumstances in Belgrade (Ocokoljić & Anastasijević 2004).

The seed yield and quality of Moesian beech and European beech in the green spaces in Belgrade were studied aiming at the investigation of the effect of low temperatures at the beginning of the vegetation period on fructification. The study is based on the fact that the selection in using beech trees as seed sources enables the provision of good quality seed and planting material for the needs of green spaces in settlements, as well as for the regeneration of beech forests.

Material and methods

Altogether 20 trees were selected in Belgrade green spaces, 10 trees of each species. All the analysed trees are in the central part of Belgrade, which is, from the thermal aspect, the transition between the climate of the Adriatic Littoral to continental climate. This position of Belgrade makes it possible to assess the reactions of Moesian beech and European beech to the effect of low and extremely low temperatures at the beginning of the vegetation period.

For this reason, Table 1 presents the relevant data of the Republican Hydro-Meteorological Institute in Belgrade on air temperatures in April, which are especially significant, because it is the period when beech flowers most frequently (Popović 1953; Ocokoljić & Ninić-Todorović 2003). In all three study years 2001, 2002 and 2003 the flowering phenophases occurred in mid April.

The effect of low temperatures on the yield of Moesian beech and European beech during three successive years was studied, taking into account that there was no yield in 2002. Closed fruits picked in the fall from trees recently felled in logging operations, at the same time when a completely brown fruit indicates seed maturity. After the fruits were stripped from the branches, they were spread to dry in a thin layer until they open and the nuts were shacked out. The seeds were categorized based on the morphometric analysis and the analysis of germination percentage (Tab. 2, 3). Seed fullness was measured by the method of cross cutting on the sample of 100 seeds in four repetitions. Seed germination percentage was assessed on the same number of samples and repetitions by standard methods of germination tests according to Suszka (1975). The prescribed testing method for bout beeches was to germinate stratified seeds on the top of moist blotters at 3 to 5ºC. Test duration ruined up to 24 weeks, which includes 140 days of stratification at the same 3 to 5ºC. Because of the lengthy tests, viability estimation by tetrazolium staining is recommended as an alternate method (ISTA 1993). In this study tetrazolium staining do not included. The Excel statistically processed the data, with the computation of the basic statistical parameters.

Results

The study data on seed characteristics show the effect of low temperatures at the beginning of the vegetation period on seed quality of both Moesian and European beech. The low temperatures caused the lower quality of seeds in all trees. Namely, although 2001 was a year with the maximum yield of all 20 beech trees, in both species the percentages of full seed and germination percentages were lower in 2001 than in 2003 (Tab. 2, 3).

Table 1. The temperature in April 2001 and 2003.

Temperature (ºC)	2001	2003
Mean	11.9	12.0
Mean absolute	5.7	7.9
Absolute minimum	- 0.9 (day 14)	1.1 (day 8)

Table 2. The biometric parameters and germination percentage of seeds collected from 10 Moesian beech trees in 2001 and 2003.

2001

Tree	Length (cm)	Width (cm)	100 seeds (g)	Full seed (%)	Germination (%)
1	1.98	1.13	12.0	25.6	15
2	1.90	1.10	17.1	21.5	10
3	2.00	1.00	22.1	18.4	14
4	1.65	0.99	16.6	12.3	12
5	1.74	0.90	14.5	18.2	11
6	1.68	0.92	10.1	15.4	14
7	2.01	0.97	24.2	19.5	18
8	1.12	0.93	11.5	19.2	11
9	1.54	0.98	16.2	21.4	12
10	1.69	0.99	24.5	18.3	17
Mean value	1.73	0.99	16.9	19.0	13

2003

Tree	Length (cm)	Width (cm)	100 seeds (g)	Full seed (%)	Germination (%)
1	2.28	1.24	34.0	82.2	62
2	2.18	1.14	36.1	72.3	43
3	2.11	1.15	41.4	65.4	50
4	1.56	0.90	30.0	75.2	36
5	1.50	0.92	32.3	78.3	49
6	1.56	0.97	29.2	66.3	35
7	1.63	0.94	33.0	71.3	49
8	1.47	0.92	30.2	71.1	47
9	1.35	0.94	25.0	92.5	54
10	1.47	0.95	24.4	81.2	36
Mean value	1.71	1.01	31.6	75.6	46

Conclusions

The analysis of several morpho-physiological characteristics of the seeds of 10 trees Moesian beech and 10 trees European beech in Belgrade, shows the adverse effects of low temperatures at the beginning of the vegetation growth period on seed quality, percentage of full seed and germination percentage. This fact should be taken into account in the plans of cultivation of these two beech species for the requirements of practice.

Table 3. Biometric parameters and germination percentage of seeds collected of 10 European beech trees in 2001 and 2003.

2001

Tree	Length (cm)	Width (cm)	100 seeds (g)	Full seed (%)	Germination (%)
1	1.56	0.45	15.0	22.7	12
2	1.64	0.51	16.4	20.4	15
3	2.10	0.62	19.1	17.1	18
4	1.57	0.74	17.6	12.0	20
5	1.87	0.87	18.9	14.2	21
6	1.54	0.92	15.5	16.4	17
7	1.87	0.94	21.3	20.8	18
8	1.54	0.95	17.5	15.4	15
9	1.54	0.54	18.6	22.7	17
10	1.57	0.87	19.7	17.0	17
Mean values	1.68	0.74	18.0	17.9	17

2003

Tree	Length (cm)	Width (cm)	100 seeds (g)	Full seed (%)	Germination (%)
1	1.28	0.57	36.5	65.2	58
2	1.54	0.58	31.4	78.4	49
3	1.78	1.00	39.4	68.6	55
4	1.95	0.94	38.2	76.4	44
5	1.99	0.57	35.7	82.3	47
6	1.88	0.59	31.2	65.8	54
7	1.74	0.85	30.0	73.4	68
8	1.58	0.54	30.7	72.5	57
9	1.54	0.78	28.9	89.6	52
10	1.62	0.88	26.8	80.1	44
Mean values	1.69	0.73	32.9	75.2	53

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