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Research regarding the influence of the preparing methods on seed germination on *Gleditsia triacanthos* L

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Abstract

Gleditsia triacanthos is a leafy tree that originates in the S-E of North America. Because of its use in landscaping and protective curtains or fences, we need a large amount of seedlings in a short period. The research focused on the production of seedlings from seeds using 4 experimental plots in 4 repetitions: a_1 – scarified seeds; a_2 – stratified seeds; a_3 – seeds soaked in hot water (20 minutes in boiled water at 100°C, then 24 hours at 18°C); a_4 – seeds soaked in cold water for 24 hours. Germination capacity assessment was conducted over a period of 45 days depending on the experimental variant with an interval of five days between measurements. The experimental results obtained reveal the existence of differences between experimental studied variants. Also, processing the results allowed us to determine "optimum technological" in terms of preparation methods influence upon germination capacity.

Keywords: *germination, Gleditsia, scarified seeds, stratified seeds*

1. Introduction

The aim of the study was to determine the impact of the preparation methods on the germination of *Gleditsia*.

Gleditsia triacanthos can also be cultivated in polluted regions on compact soils poorly drained and it tolerates draught (M. Ertekin, E. Kirdar [1]).

It brings fruits at an early age (8-10 years), annually and hardy. The fruits are big beans 30-40 cm long and 3-4 cm wide, reddish-brown coloured, shiny, flattened, twisted and indehiscent. The seeds are of a reddish brown colour, shiny and have a tegument as hard as rock with a soft and sweet kernel that attracts wild animals (Vines, 1960 [2]).

In 2006, they tried to obtain seedlings from seeds, with five different treatment applied to the seeds in order to stimulate their germination (M. Beckler [3]).

In this respect, different chemical and mechanical treatments have been applied in order to reduce the waterproof coating of the seed (M. P. Roleston [4]; M. B. Asl et al. [5]).

The chemical treatment is done by using concentrated sulphuric acid (C. E. Heit [6]) and, for the dried seeds, the scarificator (R. Usberti and L. Martins [7]).

2. Materials and methods

The fruits of *Gleditsia triacanthos* have been harvested in November 2013 from a single tree from the Didactic Station of the B.U.A.S.V.M "King Michael I of Romania' from Timisoara.

The beans have been dried in the Arboriculture and landscaping Laboratory, at 20°-22°C; we then extracted the seeds manually.

Before sowing and stratification, the seeds were soaked in water so that the dried out ones, inchoate and attacked by pests could be removed.

Following the soaking of the seeds, each experimental plot was established at 200 seeds for each variant (50 seeds per repetition). The observations and measurements were done on 4 experimental variants with 4 repetitions.

The preparation of seeds was done in four variants:

a_1 – scarified seeds;
a_2 – stratified seeds;
a_3 – seeds soaked for 5 minutes in boiling water at 100°C, then for 24 hours at 18°C;
a_4 – seeds soaked in cold water for 24 hours.

The stratification of seeds was done in sand on November 10, 2013 by keeping the sand permanently moist at a temperature of 3-4°C.

The sowing was done at the February 11, 2014 for all the experimental variants in a mixture of 50% decomposed manure and 50% sand.

Following the preparation of the seeds, the germination percentage of the four variants was a_1 – 98%; a_2 – 70%; a_3 – 75% and a_4 – 85%.

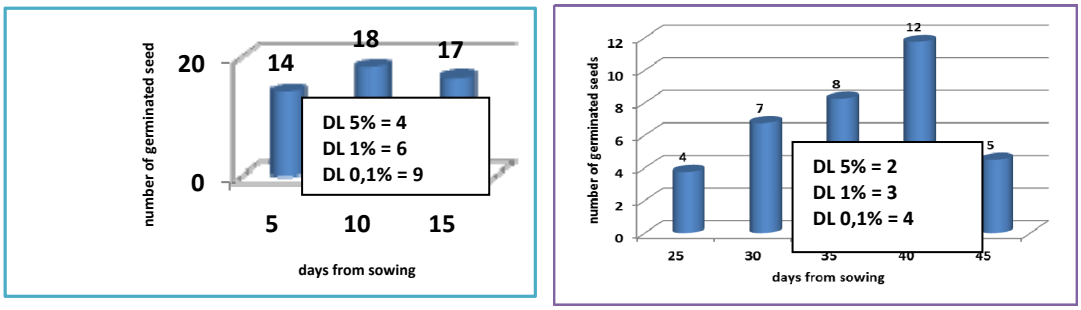
The observation on the seedlings growth was done each 5 days.

Due to the preparation methods, the seedlings emerged as follows: a_1 – February 25; a_2 – March 22; a_3 – March 17 and a_4 – March 12.

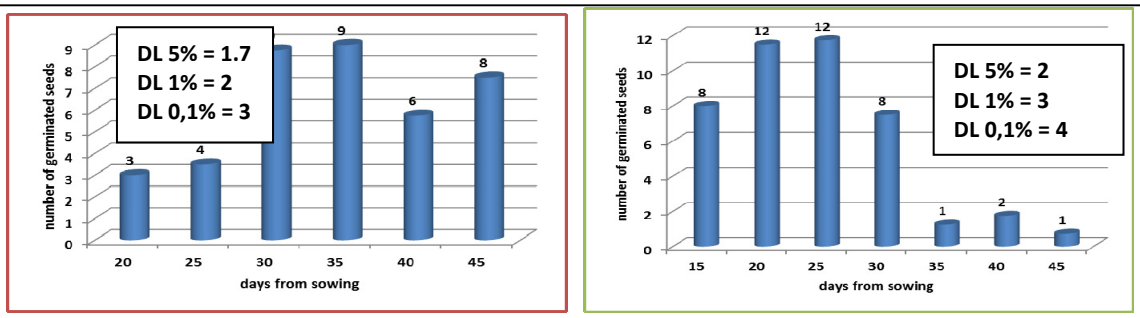
According to ISTA (International Seed Testing Association), the seedlings that were harmed, deformed and attacked by pests and diseases have been considered abnormally germinated (V. Enescu [8]). Results were statistically processed using the ANOVA test and the regression equation.

3. Results and discussion

Regarding seed germination in *Gleditsia triacanthos*, it has been noticed that the treatment of seeds before sowing has influenced the germination of seeds within 15-45 days (Figure 1).



(a) **(b)**



(c) **(d)**

Figure 1. Average values of germinated seeds at each moment of data determinations (a) – scarified seeds; (b) – stratified seeds; (c) – seeds soaked in hot water; (d) – seeds soaked in cold water

M. Ertekin and E. Kirdar [9], citing Saatçioglu (1971) and Bonner et al. (1974) [9] confirm the variation of the germination capacity in a research that was aimed to establish the effect of seed tegument coloration on the germination capacity of *Gleditsia triachanthos*. The data revealed that the seeds treated through scarification germinated within 15 days from sowing while the other three experimental variants needed 45 days to germinate. In some cases (black locust, *Robinia pseudoacacia*) the germination of seeds can represent a restrictive parameter on the growing and development of the tree. The treatment of seeds can represent a parameter that can improve the germination capacity and exceed abeyance (M. Mirzaei et al. [10]).

Table 1. The significance of germination increase % to the control

Variant	Germination capacity %	Difference %	Significance
a_1 – scarified seeds	98	**control**	
a_2 – stratified seeds	70	-28	00
a_3 – seeds soaked in hot water	75	-23	0
a_4 – seeds soaked in cold water	85	-13	

DL 5% = 18.3%, DL 1% = 26.3, DL 0.1% = 38.7

Regarding the germination capacity increase, comparing the tested variants to the control (scarified seeds) we determined that stratified seeds shown a decrease of 28%. The seeds soaked in hot water have also shown a decrease (Table 1). A possible explanation could be that the structure of the seed tegument limits soaking. This proves that the mechanical scarification allows water to enter the seeds and activate the enzymes involved in the germination process. Z. Zoghi et al. [11] testing the influence of different treatments on the germination capacity of *Gleditsia caspica,* point that the best results were given by the chemical scarification with sulphuric acid for 1.5 hours. Another important fact in improving the germination capacity of pulses (*Spartium junceum*, *Bauhinia* spp., *Colutea* spp., *Cytisus* spp., *Gleditsia triacanthos, Robinia* spp., *Sophora japonica, Spartium junceum, Ulex europaeus* and *Wisteria sinensis*) is represented by choosing the sowing time. The best results in this respect have been revealed when the sowing was done early (C. Yücedağ, H. C. Gültekin [12]). B. Dehgan et al.[13] discover that another fact in improving the germination capacity of the seeds is connected to the scarification method, pointing out the effect of chemical scarification as compared to the other methods.

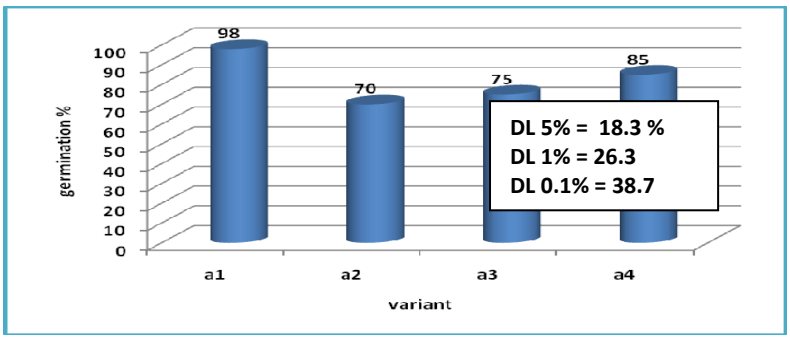


Figure 2. The variation of the germination capacity (%) of the four experimental variants taken into research: a_1 – scarified seeds; a_2 – stratified seeds; a_3 – seeds soaked in hot water; a_4 – seeds soaked in cold water

Within the tested variants, the results varied within a range of 13%. The best results were given by the scarified seeds (98%) (this was also control variant). The lowest germination index (70%) was pointed out by variant a_2 –stratified seeds (Figure 2). In 2011, E. Pipinis et al. [14] pointed out a method that combines the chemical scarification with stratification on improving the germination capacity of *Cercis siliquastrum* seeds. They mention that the best results were given by the chemical scarification followed by 3 months of stratification, mentioning that stratifying the seeds for more than 4 months has a negative impact on the germination capacity. D. S. Poşta et al., 2012 [15] recommend scarifying the seeds before sowing as it has a positive effect on the seedlings of *Cercis siliquastrum* growth.

Combining the two methods is also confirmed in a research on *Arbutus unedo,* whose seeds have been treated with GA3 followed by stratifying seeds for 5-15 weeks (D. Demirsoy [16]).

Regarding the interrelation between the number of days from sowing and germination, it can be noticed that the results are quite uniform as compared to the control (a_4). For the first three variants we noticed a low germination percentage in the first days of determinations (5-10 days from sowing for a_1, 20-30 days from sowing for a_2, 20-30 days from sowing for a_3). A different situation was noticed in the control, which had a high percentage of germinated seeds 15 days from sowing, followed by a decrease.

Table 3 Correlation between the number of days from sowing (25: 30: 35: 40: 45) and germination (no of seeds)

VARIANT	EQUATION of the quadratic regression $y = a_0 + a_1*x + a_2*x^2$ (n = 5 obs)			
	Regression equation	Correlation equation (R)	Theoretical maximum	
			Energy period (days)	Maximum germination (%)
a_1 – scarified seeds	Germination = $-0.1x^2 + 2.3x + 5$	0.99**	11	18
a_2 – stratified seeds	Germination = $-0.0486x^2 + 3.54x - 54.771$	0.81*	36	9.5
a_3 – seeds soaked in hot water	Germination = $-0.0193x^2 + 1.4307x - 18.221$	0.82*	37	8.5
a_4 – seeds soaked in cold water	Germination = $-0.0131x^2 + 0.4079x + 7.1024$	0.86	15	10.5

The equation of quadratic regression is of great practical interest as it helps determine the optimal correlation between the two variables (germination percentage and the number of days from sowing). Deriving the regression equation leads to the technical optimal (correlation between the number of days and germination together with the optimal values are revealed in Table 2). It can be observed that the greatest results on the germination capacity have been noticed 11-37 days from sowing. The highest percentage of germinated seeds has been noticed on variant a_1 (11 days from sowing) as compared to the control whose higher germination percentage was 10.5%, 15 days from sowing.

Table 4. The significance of germination (number of seed) as compared to the control (45 days from sowing)

AxB		Germination (number of seed)	Difference to the control	Significance
a_2 – stratified seeds	b_1 – 25 days	3.75	-0.75	
	b_2 – 30 days	6.75	2.25	**
	b_3 – 35 days	8.25	3.75	***
	b_4 – 40 days	11.75	7.25	***
	b_5 – 45 days	4.5	**control**	
a_3 – seeds soaked in hot water	b_1 – 25 days	3.5	-4	000
	b_2 – 30 days	8.75	1.25	
	b_3 – 35 days	9	1.5	
	b_4 – 40 days	5.75	-1.75	0
	b_5 – 45 days	7.5	**control**	
a_4 – seeds soaked in cold water	b_1 – 25 days	11.75	11	***
	b_2 – 30 days	7.5	6.75	***
	b_3 – 35 days	1.25	0.5	
	b_4 – 40 days	1.75	1	
	b_5 – 45 days	0.75	**control**	

DL 5% = 1.7%, DL 1% = 2.1, DL 0.1% = 2.8

Comparing the experimental variants (Table 3) in which germination lasted longer (25-45 days: a_2, a_3, a_4) we observed that in variant a_2 maximum germination increase occurred 40 days after sowing (11.75%), the difference to the control being 7.25%. As a reference, the value of the last determination after 45 days was chosen. Variant a_3 revealed a positive increase to the control 35 days from sowing (1.5%), while 25 days from sowing and 45 days from sowing the increase was negative (-4% and -1,75%, respectively). In variant a_4, the increase was positive pointing out the 11% increase 25 days from sowing.

4. Conclusions

Regarding the influence of seed treatments before sowing in order to improve the germination capacity we conclude that the best results are achieved after the seeds are scarified. A 70 % were when the seeds were stratified. The numbers of days after sowing required for achieving the peak percentage of new germinated seeds was: 11 (scarifified seeds), 36 (stratified seeds), 37 (seeds soaked in hot water) and 15 (seeds soaked in cold water).

The optimal germination efficiency was influenced by the treatment applied, recording a germination percentage of 18% in 11 days from sowing, as to variant a_1 (scarified seeds).

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