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Production of *Acer saccharinum* L. seedlings using different substrates

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Abstract
The experiment was carried out in the greenhouse of the Arboriculture discipline, at the Didactic and Research Base of the "King Mihai I" University of Life Sciences from Timisoara. The seeds of *Acer saccharinum* L. represented the biological propagation material. The method used to stimulate germination process was hydrothermal wetting 24 h. The purpose of this study was to identify the best substrate for the germination of *Acer saccharinum* L seeds. The substrates used were: TS 3 Medium Basic peat (Standard), TS 4 Plus medium peat with perlite and clay, TS4 Brut plus Greenfibre peat, Baltic peat, TS 4 medium peat + Clay + Greenfibre. Following the analysed data, it can be concluded that the TS 4 Plus peat substrate medium with perlite and clay, was the most efficient in the growth of seedlings, having the highest values and significant positive differences for most of the analysed criteria. The analysed features were: seedling height, crown diameter, number of roots, root length, number of leaves and leaf area.

Keywords: seeds, hydrothermal wetting, germination

Introduction

Acer saccharinum L. - silver maple is native from the eastern and central United States and central Canada [15]. Species is a relatively fast-growing deciduous tree and is widely planted in green spaces both in its native area and in Europe. Silver maple produces a sweet sap, but it is generally not used by commercial sugar producers due to its lower sugar content compared to the other maple species, e.g. *Acer saccharum* (sugar maple) [5]. The germination process is the critical phase in the development of the seedlings, playing a major role in the continuation of the existence and evolution of the species for the following generations [7]. Germination is an important stage in the life cycle of a plant, serving as an essential starting point for the establishment of a new generation [12]. Several factors have been highlighted experimentally to be influential during the stratification and wetting processes of *Acer saccharum* seeds [14]. In order to enhance germination, the seeds of *Acer platanoides* and *Acer campestre* species were subjected to different stratification methods, in other studies on *Aceraceae* [3]. The seeds of silver maple (*Acer saccharinum* L.), can germinate immediately after the harvesting because they are not dormant. If they are not sown under proper germination conditions, they lose their germination capacity due to seed dehydration. This is due to the outer membrane damage [10].

Recent studies suggest that selenium might be beneficial to the biological functions of the plants due to its antioxidant action [2, 4, 6]. It has been scientifically demonstrated that a crude ethanolic extract obtained from the leaves of silver maple (*Acer saccharinum* L.) can be used to destroy three phytopathogenic bacteria. In this sense it can be said that this extract can be considered for the potential control of the bacterial diseases in the horticultural crops [1].

Other studies were investigated the germination capacity of *Acer saccharinum* L. seedlings in the conditions of their stimulation with sodium selenite (10 mg/L) or soaking in water for 6 h [10,11]. Thus, stimulation of seed germination in hard-shelled ornamental woody species as e.g. *Gleditsia triacanthos* L., or *Koelreuteria paniculata* LAXM can be done using several methods [8, 9].

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The aim of the present research was the identification of a proper substrate for the production of seedlings of silver maple for practical purposes.

Material and Method

The biological material considered in the present research and subjected to analysis was represented by the seeds of *Acer saccharinum* L. The seeds of silver maple were harvested on May 15, 2024, from trees growing in the Park of the University of Life Sciences "King Mihai I" from Timisoara. After harvesting, the seeds were prepared in the laboratory of the Arboriculture discipline at the Didactic and Research Base of the University where they were conditioned by removing the wings and placed in a container with warm water, at temperatures of 50 °C for 24 hours, in order to stimulate the germination process. After soaking, the seeds were selected and dried slightly. There were placed 30 seeds per variant in sowing cells, in three replicates, in the greenhouse of Arboriculture discipline. There were used different nutritive substrates: V_1 - TS 3 Medium Basic peat (Standard) (Control), V_2 - TS 4 Plus medium peat with perlite and clay, V_3 - TS4 Brut plus Greenfibre peat, V_4 - Baltic peat, V_5 - TS 4 medium peat + Clay + Greenfibre.

After 45 days from the emerging of the seedlings, respectively on June 25, 2024, biometric measurements were made on 25 plants, considering the following features: seedling height, diameter at the crown, number of roots, root length, number of leaves and leaf area per seedling. The measurements were aimed the identification of the best type of substrate that can be recommended to be used for the germination and growth of *Acer saccharinum* L. seedlings.

Results and Discussion

The descriptive statistics of the analysed biometrical features of the silver maple seedling after 45 days after germination are presented in Table 1.

Table 1. Descriptive statistics of some biometrical features of silver maple seedling after 45 days after germination (seedling height, diameter at the crown, number of roots, root length, number of leaves and leaf area per seedling)

Feature	Variant	Valid	Mean	Std. Deviation	Coefficient of variation	Shapiro-Wilk	P-value of Shapiro-Wilk
plant height (cm)	V1	25	3.808	0.674	0.177	0.940	0.147
plant height (cm)	V2	25	6.244	0.687	0.110	0.946	0.206
plant height (cm)	V3	25	4.388	0.573	0.131	0.972	0.695
plant height (cm)	V4	25	4.252	0.680	0.160	0.930	0.087
plant height (cm)	V5	26	5.777	0.628	0.109	0.908	0.024
crown diameter (mm)	V1	25	0.110	0.044	0.398	0.915	0.040
crown diameter (mm)	V2	25	0.353	0.065	0.183	0.980	0.884
crown diameter (mm)	V3	25	0.184	0.046	0.248	0.949	0.236
crown diameter (mm)	V4	25	0.166	0.058	0.350	0.963	0.476
crown diameter (mm)	V5	26	0.306	0.049	0.162	0.900	0.016
no. of roots	V1	25	1.920	0.572	0.298	0.742	< 0.001
no. of roots	V2	25	3.000	0.645	0.215	0.789	< 0.001
no. of roots	V3	25	2.240	0.436	0.195	0.533	< 0.001
no. of roots	V4	25	2.040	0.455	0.223	0.624	< 0.001
no. of roots	V5	26	2.731	0.604	0.221	0.759	< 0.001
root length (cm)	V1	25	0.428	0.121	0.282	0.883	0.008
root length (cm)	V2	25	1.608	0.406	0.253	0.967	0.567
root length (cm)	V3	25	0.692	0.189	0.273	0.938	0.134
root length (cm)	V4	25	0.624	0.207	0.331	0.948	0.224
root length (cm)	V5	26	1.100	0.255	0.231	0.924	0.054
leaves no.	V1	25	1.960	0.611	0.312	0.770	< .0001
leaves no.	V2	25	2.720	0.458	0.168	0.565	< 0.001
leaves no.	V3	25	2.040	0.200	0.098	0.203	< 0.001
leaves no.	V4	25	1.840	0.473	0.257	0.636	< 0.001
leaves no.	V5	26	2.577	0.504	0.196	0.630	< 0.001
foliar surface	V1	25	0.426	0.145	0.340	0.962	0.448
foliar surface	V2	25	0.910	0.336	0.369	0.909	0.029
foliar surface	V3	25	0.648	0.259	0.399	0.846	0.001
foliar surface	V4	25	0.616	0.286	0.463	0.886	0.009

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Feature	Variant	Valid	Mean	Std. Deviation	Coefficient of variation	Shapiro-Wilk	P-value of Shapiro-Wilk
foliar surface	V5	26	0.900	0.391	0.435	0.925	0.058

In the following are presented the boxplot graphs for the features plant height, diameter at the crown, and root length in conditions of the experimental variants, respectively the used substrates. On these graphs is displayed Standard Deviation (SD). There were not presented the graphs for the number of roots and the number of leaves because their distribution deviates from normal according with P-value of Shapiro-Wilk which is less than < 0.05 (P-value of Shapiro-Wilk < 0.001) (Table 1).

In Figure 1 is presented the graph of the reaction the plant height to the substrate variants. There is obvious that V_2 was the most efficient from the point of view of this feature.

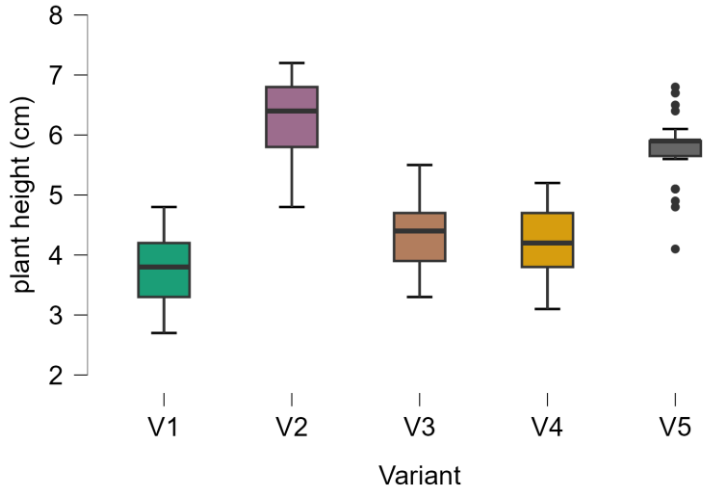

Figure 1. Boxplots representing plant height (cm) for silver maple seedlings at 45 days after germination (SD and outliers displayed)

The results referring to the diameter of the crown of the silver maple seedlings at 45 days after germination are presented in Table 2. Also, V_2 manifested the best on this plant feature.

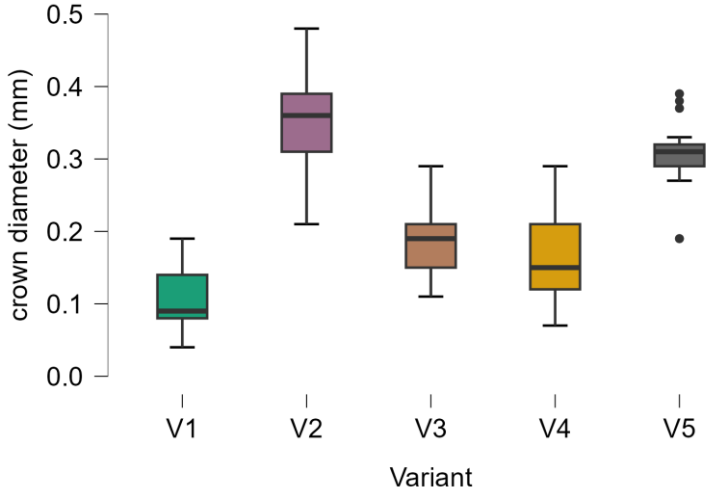

Figure 2. Boxplots representing crown diameter (mm) for silver maple seedlings at 45 days after germination (SD and outliers displayed)

In Table 3 is presented the reaction of root length of the silver maple seedlings, the response being similar as in the case of the previously analysed features, respectively V_2 offered the best results.

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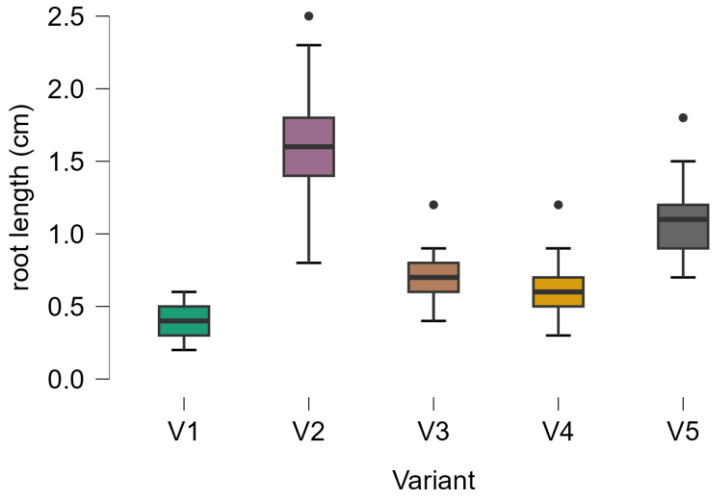

Figure 3. Boxplots representing root length (cm) for silver maple seedlings at 45 days after germination (SD and outliers displayed)

Foliar surface presented a different reaction to the substrates, respectively V_5 has the best response, but it was followed very closely by V_2 (Table 4).

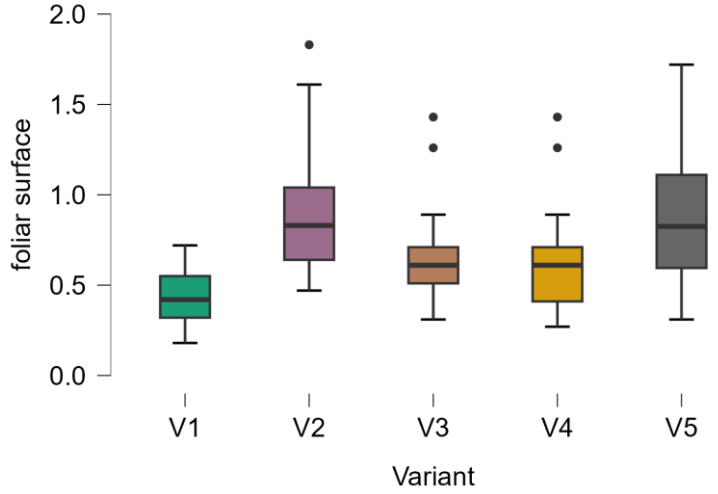

Figure 4. Boxplots representing foliar surface (cm^2) for silver maple seedlings at 45 days after germination (SD and outliers displayed)

The results from some researches from the literature suggest that the germination of the exotic ornamental tree species can be influenced by the application of a growth regulator [13].

Conclusions

The general conclusion is that the V_2 (TS 4 Plus peat substrate medium with perlite and clay) has the best results for the growth of silver maple seedlings, showing the best values for most of the considered biometric features, respectively plant height, crown diameter and root length. In the case of foliar surface, the best result was obtained in the case of substrate V_5 (TS 4 medium peat + Clay + Greenfibre), but it was followed very closely by V_2.

The distribution of the number of roots and number of leaves wasn't normal, that is why wasn't considered to be relevant for the statistical analysis at this phenophase.

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