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# PROPAGATION OF TRANSYLVANIAN ENDEMIC AND ENDANGERED PLANT SPECIES

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***Abstract***
*Climate change has already caused irreversible stock changes in species distributions in many parts of the world. Species are lost and disrupted because they are highly dependent on changes in temperature. The aim of the experiment is to develop cultivation techniques for wild perennial plants of ornamental value that are rare, protected or highly endangered, thus helping to maintain these plant populations while increasing the number of ornamental plants grown. As plant material we have collected the seeds of Achillea ptarmica, Achillea impatiens, Achillea x girgioensis, Allium obliquum, Silene zawadskii, Dianthus petraeus ssp. orbelicus, and Centaurea triumfettii in two different years. The collected seeds were sown in spring and autumn, alongside these the germination was determined also in Petri dishes. From our results could be determined that at the Caryophyllaceae family both genus seeds germinated reasonably good, in the case of the plants belonging to the Asteraceae family the seeds obtained different results, furthermore at the A. obliquum the germination was low. The present experiment offers the possibilities to multiply these endangered plant species, and to improve the impoverished genetic stock.*

*Keywords: propagation, Transylvania, wild plant species.*

## 1. INTRODUCTION

Climate change has already caused irreversible stock changes in species distributions in many parts of the world. Species are lost and disrupted because they are highly dependent on temperature changes. According to Hurdu et al., 2022; Radomir et al., 2023 Romania has a relatively high diversity of plant species spontaneous plant taxa include 3829 vascular and 979 non-vascular. It retains one of the most significant resources of wild flora lowland grassland in Europe (Akeroyd and Page, 2011; Craioveanu et al., 2021). Plants are essential components of all life on earth (Sharrock et al., 2014), of biodiversity, and are an important part of ecosystems' ecological stability (Urziceanu et al., 2021). Unfortunately, plant species are exposed to extinction risk due to climate change, habitat loss, fragmentation, or even competition with invasive species (Corlett, 2016; Zambrano et al., 2019). Moreover, endemic plant species are generally more vulnerable to natural changes and anthropogenic threats because of this they hold a higher risk of extinction (Coelho et al., 2020). Endemic plant species are growing naturally in specific geographical areas (Işik, 2011). Many of these wild-growing plant species are important because of their ornamental, medicinal, and aromatic properties (Radomir et al., 2023). There are two prevailing approaches to preserving plant



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genetic resources: in situ conservation, which involves maintaining the plants within their natural habitat, and ex situ conservation, which entails preserving plant species outside of their natural habitat, typically in gene banks or botanical gardens. (O'Donnell and Sharrock, 2018; Halmagyi et al., 2020). Conservation of the plant species and fauna, could have an important great impact on other species, regardless of their biological importance (Sămărghiţan et al., 2017).
The experiment aimed to develop cultivation techniques for wild perennial plants of ornamental value that are rare, protected, or highly endangered, thus helping to maintain these plant populations while increasing the number of ornamental plants grown.

## 2. MATERIALS AND METHODS

The experiment was conducted at the Sapientia Hungarian University of Transylvania, Târgu Mureș (46°31′17″ N 24°35′54″ E). Seven Transylvanian endemic and endangered plant species seeds were collected from different locations in Romania as follows: Cheile Turzii, Cheile Runcului, Depresunea Gheorgheni, and Hăşmaşul Mare (Figure 1). The selected plant species were: *Achillea ptarmica* L. (Figure 2a), *Achillea impatiens* L. (Figure 2b), *Achillea* x *girgioensis* Nyár. (Figure 2c), *Allium obliquum* L. (Figure 2d), *Silene zawadskii* Fenzl. (Figure 3a), *Dianthus petraeus* Waldst. & Kit. ssp. *orbelicus* (Figure 3b), and *Centaurea triumfettii* All. (Figure 3c) in two different years. The collected seeds were sown in spring and autumn, alongside these the germination was determined also in Petri dishes.

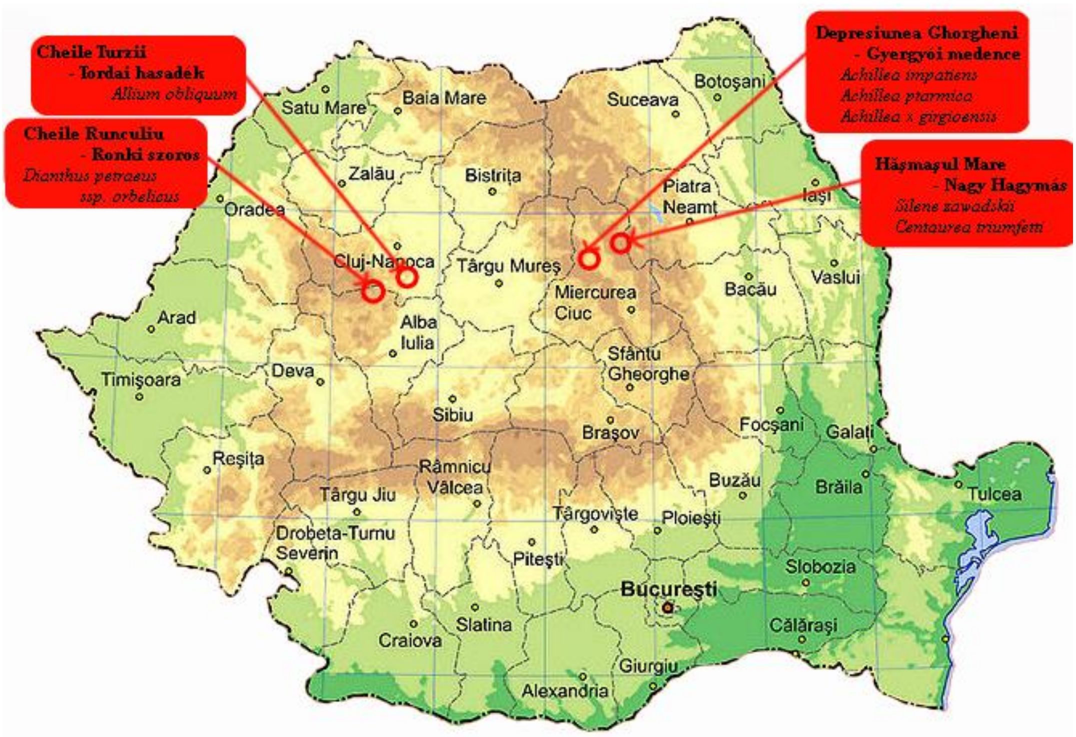


***Figure 1. Areas where the seeds were collected: Cheile Turzii, Cheile Runcului, Depresiunea Gheorgheni, and Hăşmaşul Mare***


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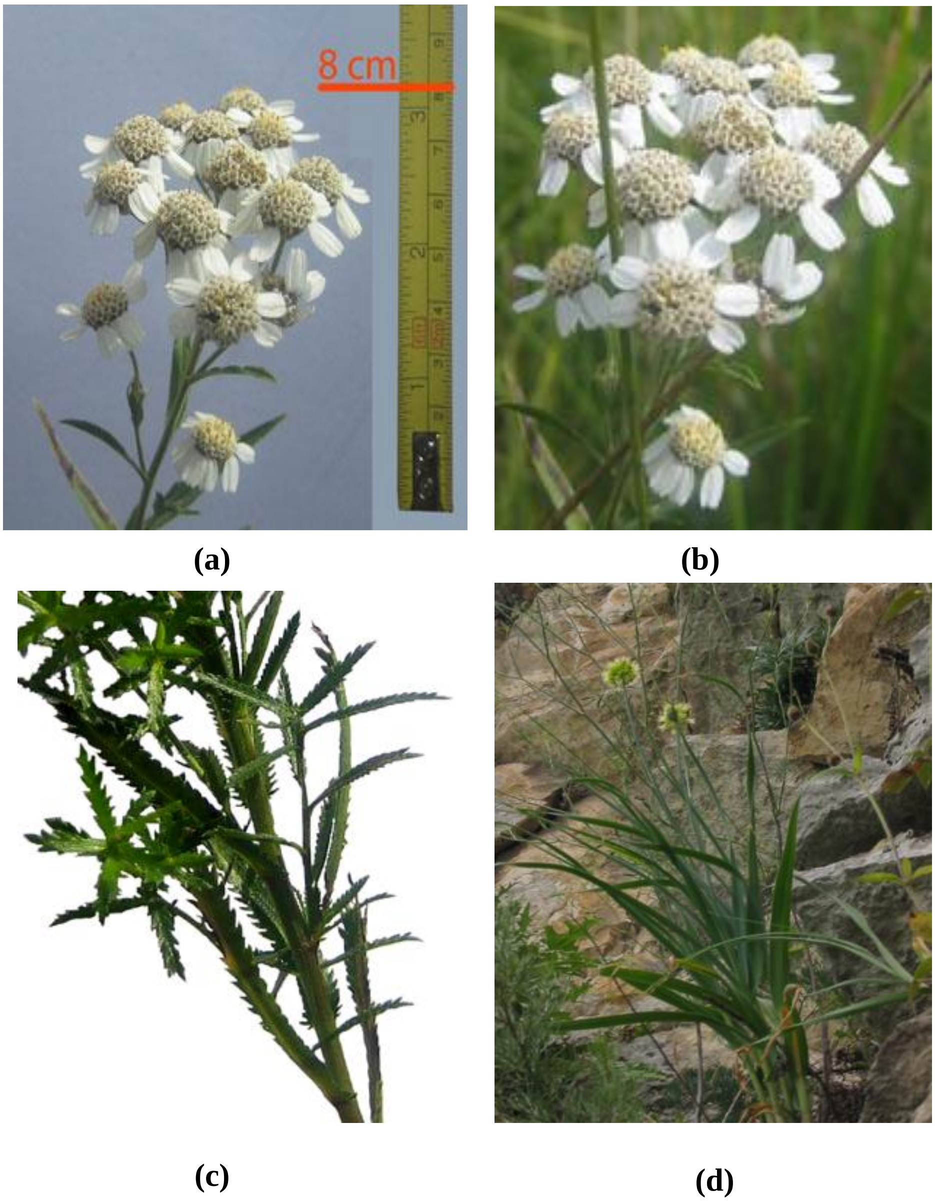


***Figure 2. The selected Transylvanian endemic and endangered plant species: (a)–Achillea ptarmica; (b)–Achillea impatiens; (c)– Achillea x girgioensis; and (d)– Allium obliquum***

The experiment started in spring, during which the areas were explored, on two occasions: during flowering and fruiting time. On second occasion the necessary propagation material was collected, being careful not to damage the natural population of protected plants. For each specie were collected 180 seeds. The germination was tested with three different methods (autumn sowing, spring sowing, and laboratory tests), for each method I performed three repetitions, with 20–20–20 seeds.

The seeds were stored in a plastic bag in a refrigerator at a temperature of 0–4 °C. This was necessary so that the seeds retained their natural moisture, and not dry out, and retained their ability to germinate. The same method was used in the second year.


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**(a)**

**(b)**

**(c)**

***Figure 3. The selected Transylvanian endemic and endangered plant species: (a)– Silene zawadskii; (b)– Dianthus petraeus ssp. orbelicus; and (c)– Centaurea triumfettii***

During the propagation, germination was tested in laboratory conditions and sowing in cell trays. We selected two dates for sowing in the cell tray: autumn and spring sowing. These methods were used to examine the germination rate. The propagation medium was a mixture of 60–35–5% garden soil, peat, and perlite, and the propagation trays were placed in the greenhouse with an automatic humidifier controller to provide the necessary humidity for germination at 90–95%. Humidity and temperature were measured using a Testo 175H1; the average temperature was between 22–28 °C. The laboratory test was carried out in a germination chamber, the temperature was 25 °C, and were observed for 28 days. In the first year the seeds sown in the autumn germination period in November, and in the spring germination period in April. In the second year, the sowing period was


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similar to the first year, moreover, the seeds in the laboratory were placed for germination at the same time.
The statistical software Past 4 (Oslo, Norway) was utilized to analyze the data. To determine the significance of the differences between the treatments, an ANOVA test was conducted at a confidence level of 95%. In cases where the null hypothesis of the ANOVA was rejected, Tukey's post hoc test was performed to identify statistically significant differences at a significance level of $p < 0.05$.

## 3. RESULTS AND DISCUSSIONS

The obtained data was similar in both experimental years, we not find statistically significant differences, and because of this, we present the results only from the second year.
Considering the germination percentage of the *Achillea impatiens*, it could be determined that significant increases were observed in the seeds sown in the spring period, and in the Petri dishes, compared to the autumn sowing (Figure 4). The spring sowing period recorded the highest germination percentage of 23.33%, followed by the Petri dishes with 23%, and the autumn sowing season with only 16.66%.

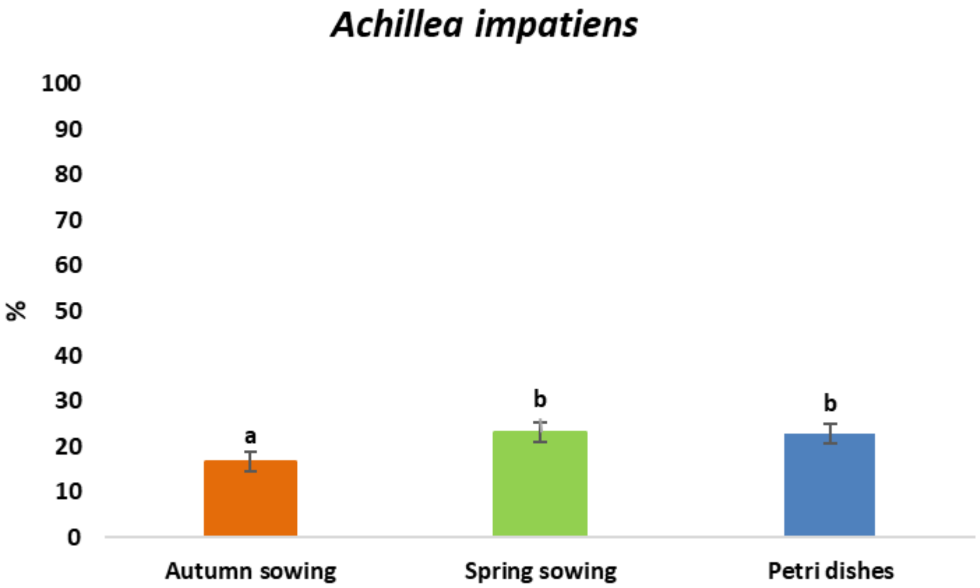


***Figure 4. Germination percentage of Achillea impatiens under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test (p < 0.05).***

From the results of the *Achillea ptarmica*, could be concluded that highly significant increases were observed at the seeds germinated in the Petri dishes, furthermore also at the autumn sowing compared to the spring swing period (Figure 5). The laboratory germination method reached the highest germination percentage of 67%, which was followed by the autumn with ~ 38% and the spring with only ~ 27%.
Regarding the *Allium obliquum* only at the autumn sowing was recorded germination and this too was barely 3.33% (Figure 6). At the other two methods (spring sowing and Petri dishes) 0% was observed, and no seeds have been germinated. The same issues were determined at the *Silene zawadskii* (Figure 7), in this case the autumn germination recorded a higher percentage of


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germination almost ~ 72%, however the other at the other two methods non of the seeds germinated, furthermore at *Centaurea triumfetti* (Figure 8) here again germination was only recorded at the autumn sowing where approximatively ~ 27% of the seeds emerged. Of course no seed germination was determined at the other two propagation methods.

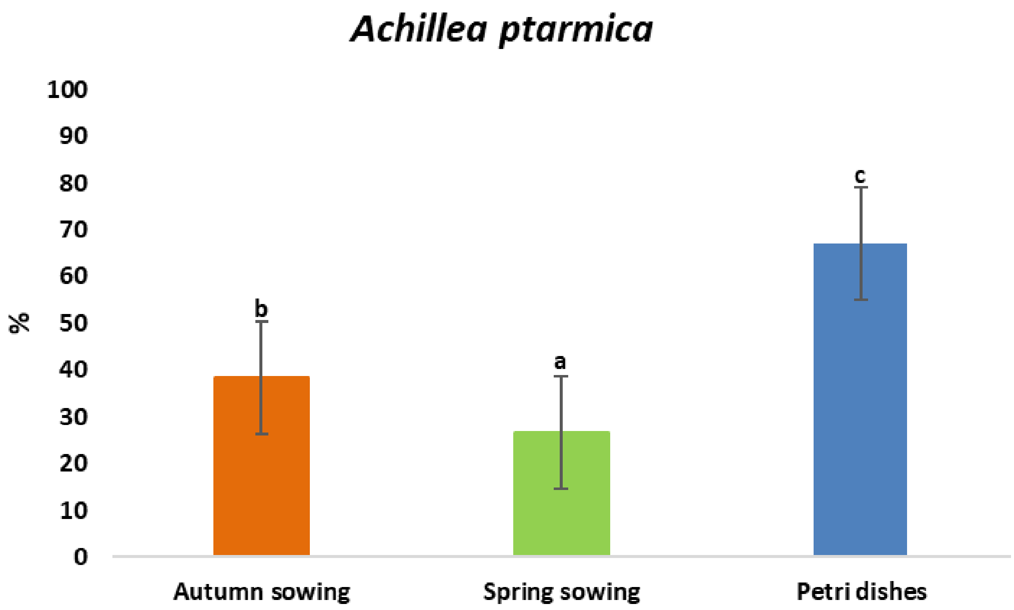


***Figure 5. Germination percentage of Achillea ptarmica under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test ($p < 0.05$)***

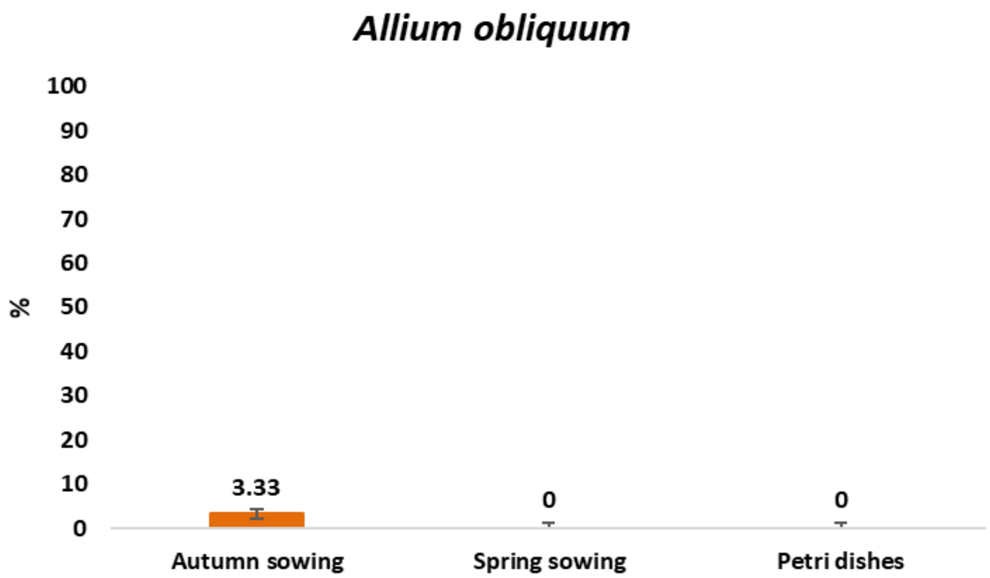


***Figure 6. Germination percentage of Allium obliquum under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test ($p < 0.05$).***


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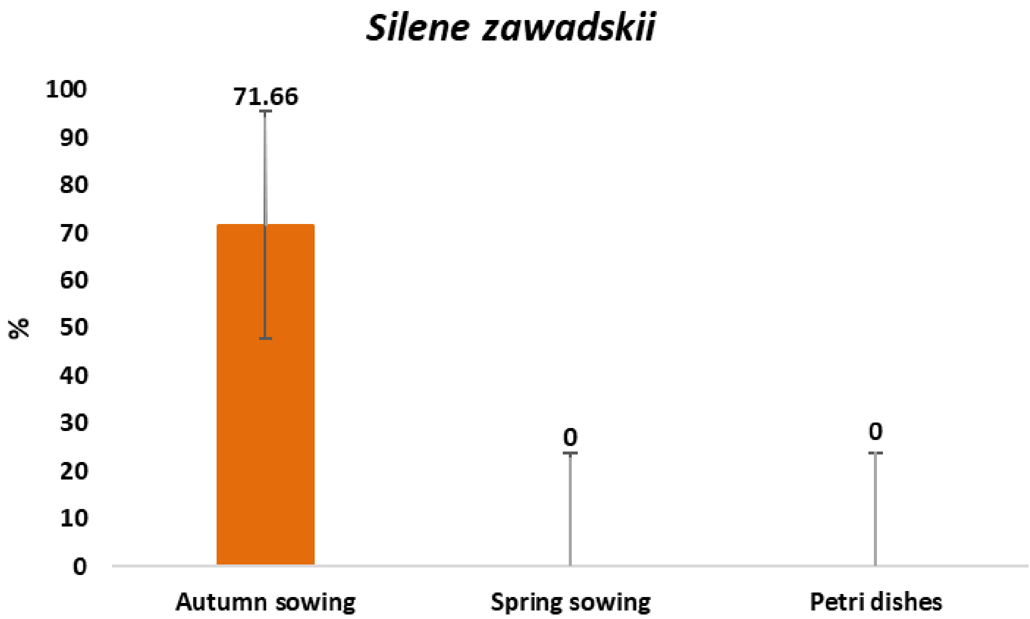


***Figure 7. Germination percentage of Silene zawadskii under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test ($p < 0.05$).***

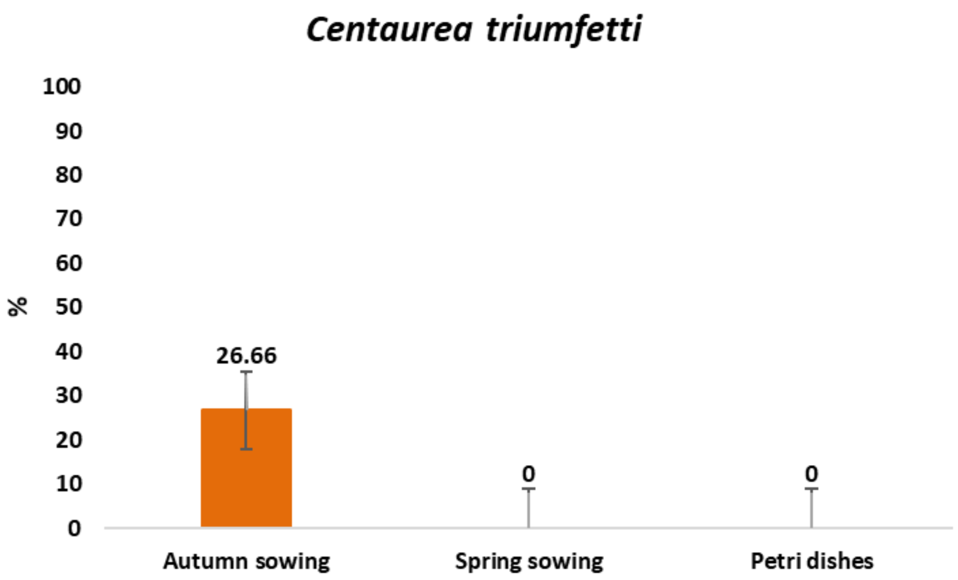


***Figure 8. Germination percentage of Centaurea triumfetti under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test ($p < 0.05$).***

Under our experimental at *Dianthus petraeus* ssp. *Orbelicus* significant differences in germination percentage were observed when comparing the three propagation methods (Figure 9). Considering the autumn sowing the germination percentage was significantly increased compared to the other two methods. When comparing the spring sowing and Petri dishes methods, it could be concluded that the spring sowing reached a significantly higher germination percentage than the Petri dishes.


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The highest germination percentage was recorded at the autumn sowing method (65%), followed by the spring (55%), and the Petri dishes, with 43.33%.

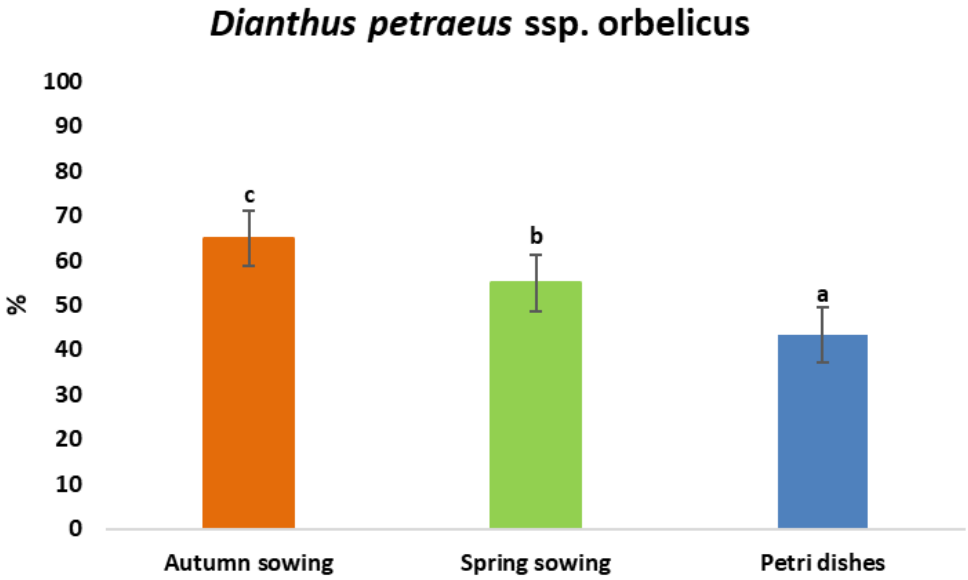


***Figure 9. Germination percentage of Dianthus petraeus ssp. orbelicus under the effect of three different methods. Bars represent the means ± SE (n = 60). Different lowercase letters above the bars indicate significant differences between the germination methods, according to Tukey's test (p < 0.05).***

## 4. CONCLUSIONS

The present experiment offers the possibilities to multiply these endangered plant species, and to improve the impoverished genetic stock. From our data could be concluded that some types of endangered plant species could not be propagated artificially. Furthermore, at the *Allium obliquum*, *Silene zawadskii*, and *Centaurea triumfetti* could be clearly observed that the autumn propagation period is more favourable. From our results could be determined that at the *Caryophyllaceae* family both genus seeds germinated reasonably good, in the case of the plants belonging to the *Asteraceae* family the seeds obtained different results, furthermore at the *Allium obliquum* the germination was low. Unfortunately, the *Achillea x girgioensis* seeds did not germinate in the Petri dishes nor in the two sown periods.

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