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RESULTS REGARDING *PRIMULA OFFICINALIS* HILL. TECHNOLOGY AND POSIBILITY FOR INTRODUCTION INTO CULTURE

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Abstract

The oldest form of treatment, over time, was phytotherapy, which was probably born with human being. Popular medicine has developed on an empirical basis in the context of a magical world where analogy and coincidence have played an important role in choosing remedy plants. Regarding the multiple biological effects of Primula officinalis Hill., the scientific literature highlighted anti-asthmatic, anti-inflammatory and strong antiviral properties. Glycosides contained in this plant have a role in the treatment of kidney and biliary disorders, bronchitis and some gastrointestinal diseases. Primrose is an endangered plant in many Western European countries. In Romania, the plant is found in hills, pastures and alpine meadows up to about 2300-2400 m altitude. Research regarding introduction to culture are ongoing at National Institute of Research and Development for Potato and Sugar Beet Braşov. This paper presents the results obtained regarding the cultivation technology and the establishment of the possibility for introduction into culture. To establish these experiences, the plants were harvested from the spontaneous flora in 2016 and then acclimated to the greenhouses in the Technology Department, Laboratory of medicinal and aromatic plants. In the second experimental year, during the vegetation, observations and measurements were made in dynamics on each experimental variant to highlight the phenological stages regarding the formation of vegetative and generative organs in Primula officinalis (the emergence, the development of the foliar apparatus, the initiation of the floral buttons, the appearance of flowering stems, flowering, capsule and seed formation).

Key words**:** *Primula officinalis, biology, technology, phytotherapy, culture*

INTRODUCTION

Primula officinalis Hill. (synonym with *Primula veris* L.) has been frequently misidentified or mistaken with similar species of *Primula* genus. This species was mentioned by Pliniu the Elder in his writings, for early blossoming [18]. *Primula officinalis* (in popular language, St. Peter's plant, Petrella or the cuckoo) it is a known medicinal plant, which grows spontaneously in our country, being a species endangered by the irrational harvesting. The plant grows in warm, sunny, dry habitats, most commonly on meadows and pastures, but also in hardwoods [3, 15]. Some of its natural sites are endangered as a result of massive deforestation, by taking land cultivation or grazing intensively.
This specie is under partial legal protection in Poland. The plant can be harvested from areas where the species is widespread in low hill areas and in lower mountain parts [18, 16, 8].
In countries such as Austria and Switzerland, *Primula officinalis* is protected by law [6]. Loki Schmidt Foundation based in Hamburg, Germany has appointed primrose (*Primula veris* L.) the flower of 2016 year. The flower is on the red list of species endangered in most German states [7, 17]. Ecology and biodiversity conservation in the *Primula* species were studied over time by many researchers [16, 4].
Pharmacological studies have shown that extracts of *Primula officinalis* have powerful asthmatic, inflammatory and antiviral proprieties [6]. In the literature results have been reported on the isolation and identification of 10 lipophilic flavonoids from *Primula* leaves *in vivo* and *in vitro* culture [9].

Primula officinalis is a herbaceous species which belongs to the *Primulaceae* family, one of the 400 species of the genus *Primula*. Is widespread in most of Europe, with the exception of the northern Caucasus, some northern areas of Europe, including northwest Scotland. Recently, her appearance was reported again in the northern Scottish provinces Sutherland, Orkney and in Scandinavia [14].

Primula officinalis is a small plant, which is usually found in limestone pastures, poor in nutrients, grassland or coastal dunes. It can be also found along forest edges and open forests of mixed oak and beech [1].

Primula officinalis is a perennial plant, with bush appearance and a height of 15-30 cm. The underground part consists of a cylindrical rhizome of up to 10 cm long and 0.5 cm thick, with many roots, up to 15 cm long, thin, white-yellowish. The aerial stem is cylindrical, 15-30 cm high, erect, hairy, leafless, ending with inflorescence. The leaves are arranged in a basal rosette, ovate, crenate or crimped edge, up to 15 cm long and 5 cm width, with prominent veins on the undersid, green on the upper face and gray on the underside due to the bristles, the petiole is long and winged. The flowers are type 5, in a number of 6-18, with persistent calyx and golden yellow corolla [5]. The fruit is a ellipsoidal capsule, 6 -10 mm long, with persistent calyx. Blooms in April-May, sometimes even in March [10] .

Floral morphology and reproduction of the species have been extensively studied [12].

In the book "Nature pharmacy" [2] are presented for the first time recommendations regarding the technology of *Primula officinalis* in our country.

Current paper presents the results obtained in the second study year regarding the technology cultivation of this species and the possibility for its introduction in culture.

MATERIALS AND METHODS

Research has started with *Primula officinalis* plant harvested from spontaneous flora of Brasov County, which were acclimatized in the greenhouse of Technology Department, Laboratory of Medicinal and Aromatic Plants from National Institute of Research and Development for Potato and Sugar Beet Braşov [11].

The research aim is to highlight certain aspects of biology and technology regarding introduction in field of species *Primula officinalis* Hill.

These studies of biology and technology are required to obtain scientific information useful for the development of cultivation technologies that meet current requirements, both phytotherapeutic and economically.

Research has started by setting up an experience with variants having three rows in three repetitions. The length of a variant was 200 cm. Factor A - the distance between rows having graduations: 25 cm, 50 cm, 75 cm.

Factor B – the plant spacing per row: 10 cm, 25 cm, 50 cm.

The variant with density 10 cm between plants per row was considered the control variant of the experience.

Was followed the emergence and growth dynamics of the foliage until flowering, when three plants were harvested from each variant/repetition.

The following determinations were made for each harvested plant: the height of the plant, the weight of roots, the number of leaves and their weight, the number of floral stems and their weight, the number of inflorescences. The average of the results obtained was also the average of the experimental variants [13].

In order to establish the average yield of fresh herba/ha for each experimental variant, the yield obtained (g/plant) with the number of plants/ha /variant was multiplied.

Determinations for dry herba were carried out after the drying of the plants, when a new weighing was carried out, thus establishing the correlation between the freshly and the dried harvested herba.

RESULTS AND DISCUSSIONS

In Brasov, 2017 – 2018 year, until the end of August, was unusually warm and rich in rainfall. In the winter-spring period before the experimence emergence, the average air temperature was higher by 1.5°C compared to

the MMA value of 0.7°C [11], leading to a plants emergence earlier with 2 - 3 weeks.
The main phenological data in the experience to establish the optimal nutritional space for *Primula officinalis* in year 2018 are shown in Table 1.

Table 1. Main phenological data to establish the optimal nutritional space (Brașov 2016 – 2018)

Phenological observations	Data
planting data	20. 10. 2016
beginning of the emergence data	12. 03. 2018
issue data of floral steams	30. 03. 2018
beginning of the bloom	10. 04. 2018
harvest data for herba	27. 04. 2018
data of fructification	14. 05. 2018
harvest data for seeds	27. 06. 2018

Source: Own calculation.

From the emergence of first plants till the end of emergence of all plants/variant the emergence data was noted in dynamics. The beginning of the flowering was noted in dynamics and the results were processed graphically. The fructification data was recorded when 10% of the plants formed capsules. Harvesting was done when 90% of plants were blooming and harvesting for seeds when 90% of the capsules reached phenological maturity.

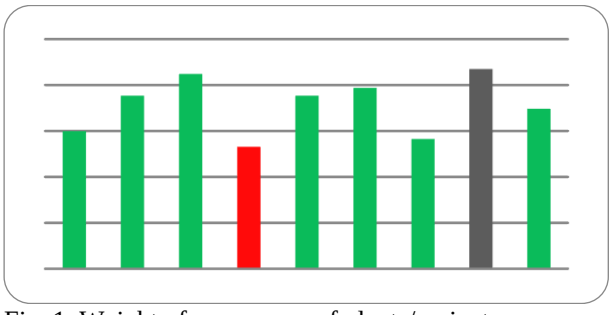

Fig. 1. Weight of emergence of plants/variants (12.03.2018)
Source: Own calculation.

Weight of plants/variants emergence in 2018

If, on March 12, 2018, V4 variant, with 10 cm between the plants per row and 50 cm between the rows, was inferior to the other variants with a 53%, increase (Figure 1) quickly recovered and on March 20, when the following observation (full blossoming) was done, overcome all other variants, reaching 90% (Figure 2).
Variant V2 (10/25) had the worst rising, registering 77%. However, the variants was good (84%), demonstrating that the plants were wintering well and did not suffer significant losses.

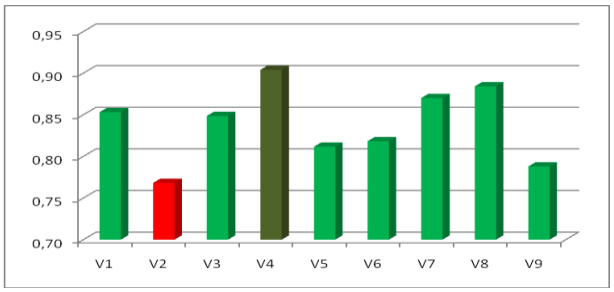

Fig. 2. Weight of emergence of plants/variants (20.03.2018)
Source: Own calculation.

The average number of flowering stems in the experience regarding the nutrition space in 2018

The number of floral stems was recorded when all the plants in experience reached full blossom. In Figure 3 are presented the number of floral stems in the second year. The V1 variant (10/25), with the smallest nutrient space and the highest plant density, presented only few floral stems. Variants V2 (25/25), V3 (50/25), V5 (25/50), V6 (50/50) and V8 (25/75) presented an average of 8 flowering stems per plant.

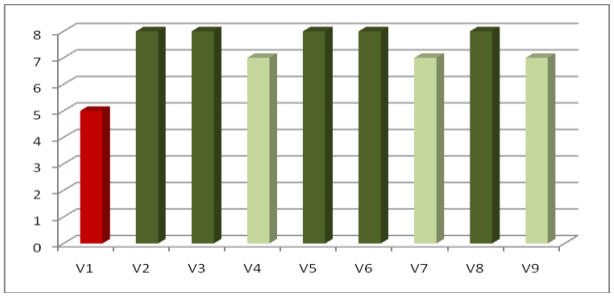

Fig. 3. The average number of floral stems/variant in 2018
Source: Own calculation.

Influence of distance between rows and between plants on rows on the height of the plants in 2018

Studying the influence of A factor (distance between rows) and B factor (plants on rows) on the height of *Primula* plants (Table 2), it was found that there were differences

regarding the influence of the two factors on the height of the plants, with a decisive role on the production achieved on each studied surface unit. Factor A responded favorably to both variants compared to the control variant. A2 variant (50 cm) showed distinctly significant differences and A3 variant (75 cm) significant differences. The influence of B factor on plants height provides distinctly significant differences in variant B2 (25 cm), with an average of 45.33 cm, B3 variant (50 cm) having values close to those of control B1 variant.

Table 2.Influence of factors (A) and (B) on the average height of plants in 2018

A factor influence					
Sym.	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
A1	(V1,V2,V3)	40.33	100.0	0.00	Mt.
A2	(V4,V5,V6)	45.11	111.8	4.78	**
A3	(V7,V8,V9)	43.56	108.0	3.22	*
DL (p 5%)				2.35	
DL (p 1%)				3.89	
DL (p 0.1%)				7.29	
B factor influence					
Sym	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
B1	(V1,V4,V7)	41.11	100.0	0.00	Mt.
B2	(V2,V5,V8)	45.33	110.3	4.22	**
B3	(V3,V6,V9)	42.56	103.5	1.44	-
DL (p 5%)			2.38		
DL (p 1%)				3.34	
DL (p 0.1				4.71	

Source: Own calculation.

The influence of the interaction between the distance between plants on rows (factor B) and the distance between rows (factor A) on the average height of plants in 2018 is shown in Table 3.

It is noted the variant V2 (25/25) with distinctly significant differences towards control variant (V1), having an average height of 44.33 cm.

Non-significant differences from the control (V4) were recorded to the variants V5 and V6, with an average height of 45.00 cm and 44.67 cm respectively.

n the last analyzed interaction, where V7 variant (10/75) is the control one, the V8 variant reaches an average height of 46.67 cm, the differences being distinctly significant.

Table 3. The influence of the interaction between the number of plants per row (B) and the distance between rows (A) on the height of the plants

Sym	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
B1 A1 (V1)	10/25	37.67	100.0	0.00	Mt.
B2 A1 (V2)	25/25	44.33	117.7	6.67	**
B3 A1 (V3)	50/25	39.00	103.5	1.33	-
B1 A2 (V4)	10/50	45.67	100.0	0.00	Mt.
B2 A2 (V5)	25/50	45.00	98.5	-0.67	-
B3 A2 (V6)	50/50	44.67	97.8	-1.00	-
B1 A3 (V7)	10/75	40.00	100.0	0.00	Mt.
B2 A3 (V8)	25/75	46.67	116.7	6.67	**
B3 A3 (V9)	50/75	44.00	110.0	4.00	-
DL (p 5%)				4.12	
DL (p 1%)				5.78	
DL (p 0.1%)				8.16	

Source: Own calculation.

From the interaction of A factor (distance between rows) and B factor (the distance between plants per row) on the average height of plants (Table 4), can be observed distinctly significant positive differences in V4 variant with a density of 50/10 and a height average of 45.67 cm.

Variants V6 and V9, (50/50 and 75/50, respectively), have positiv significance. The other analyzed variants have no statistical differences compared to the control variant.

Table 4. Influence of the interaction between rows distance (A) and plant on rows (B) to the average height of plants

Sym	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
A1B1 (V1)	25/10	37.67	100.0	0.00	Mt.
A2B1 (V4)	50/10	45.67	121.2	8.00	**
A3B1 (V7)	75/10	40.00	106.2	2.33	-
A1B2 (V2)	25/25	44.33	100.0	0.00	Mt.
A2B2 (V5)	50/25	45.00	101.5	0.67	-
A3B2 (V8)	75/25	46.67	105.3	2.33	-
A1B3 (V3)	25/50	39.00	100.0	0.00	Mt.
A2B3 (V6)	50/50	44.67	114.5	5.67	*
A3B3 (V9)	75/50	44.00	112.8	5.00	*
DL (p 5%)				4.08	
DL (p 1%)				6.01	
DL (p 0.1%)				9.35	

Source: Own calculation.

The influence of the distance between rows and between plants on rows on the average mass of plants

An analysis of each factor show the positive influences of factor A on variants V4, V5, V6, with distinctly significant differences. V7, V8,

V9 variants reaching values very significant in relation to control variants (Table 5).
The influence of B factor on the plant mass is distinctly significant to planting variant B3 variant, with a weight gain of 4.44 g compared to the control.

Table 5. Influence of factors (A) and (B) on the weight of plants in *Primula officinalis*

A factor influence					
Sym.	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
A1	(V1,V2,V3)	51.00	100.0	0.00	Mt.
A2	(V4,V5,V6)	70.00	137.3	19.00	**
A3	(V7,V8,V9)	78.22	153.4	27.22	***
DL (p 5%)			6.23		
DL (p 1%)			10.31		
DL (p 0.1%)			19.29		
B factor influence					
Sym	**Variant**	**Average**	**(%)**	**Dif.**	**Sig.**
B1	(V1,V4,V7)	64.78	100.0	0.00	Mt.
B2	(V2,V5,V8)	65.22	100.7	0.44	-
B3	(V3,V6,V9)	69.22	106.9	4.44	**
DL (p 5%)			2.51		
DL (p 1%)			3.53		
DL (p 0.1%)			4.98		

Source: Own calculation.

From Table 6, where is shown the influence of the interaction between B and A factors on the weight of *Primula* plants in the first year of vegetation, planting at the distance 50 cm/25 cm increase the yield significantly with a difference of 5.33 g compared to the control variant.

Table 6. Influence of the interaction between the number of plants per row (B) and the distance between rows (A) on the plant mass in 2018

Sym.	Variant	Average	(%)	Dif.	Sig.
B1 A1 (V1)	10/25	49.00	100.0	0.00	Mt.
B2 A1 (V2)	25/25	49.67	101.4	0.67	-
B3 A1 (V3)	50/25	54.33	110.9	5.33	*
B1 A2 (V4)	10/50	69.67	100.0	0.00	Mt.
B2 A2 (V5)	25/50	67.67	97.1	-2.00	-
B3 A2 (V6)	50/50	72.67	104.3	3.00	-
B1 A3 (V7)	10/75	75.67	100.0	0.00	Mt.
B2 A3 (V8)	25/75	78.33	103.5	2.67	-
B3 A3 (V9)	50/75	80.67	106.6	5.00	*
DL (p 5%)				4.35	
DL (p 1%)				6.11	
DL (p 0.1%)				8.63	

Source: Own calculation.

Regarding the influence of interaction between A factor (distance between rows) with B factor (plant spacing per row) on the plant mass in 2018 (Table 7), it can be observed that the results were very significant for the variants V4, V7, V8, V9 and distinct significant for the V5 and V6 variants compared to the control variant.

Table 7. Influence of the interaction between the rows distance (A) and the distance between plants (B) on the plant mass in *Primula officinalis* Hill. in 2018

Sym.	Variant	Average	(%)	Dif.	Sig.
A1B1 (V1)	25/10	49.00	100.0	0.00	Mt.
A2B1 (V4)	50/10	69.67	142.2	20.67	***
A3B1 (V7)	75/10	75.67	154.4	26.67	***
A1B2 (V2)	25/25	49.67	100.0	0.00	Mt.
A2B2 (V5)	50/25	67.67	136.2	18.00	**
A3B2 (V8)	75/25	78.33	157.7	28.66	***
A1B3 (V3)	25/50	54.33	100.0	0.00	Mt.
A2B3 (V6)	50/50	72.67	133.7	18.34	**
A3B3 (V9)	75/50	80.67	148.5	26.34	***
DL (p 5%)				7.13	
DL (p 1%)				11.27	
DL (p 0.1%)				19.74	

Source: Own calculation.

The analysis of the correlation between the height and weight of plants and that of fresh and dry herba yield

Following the correlation coefficient between the average height of the plant and its mass, was obtained value r = 0.53659 (Figure 4).
Comparing this value with the probability of 5%, r = 0.54> 0.50, it can be observed that there is a slightly significant correlation between the average height of the plant and its mass.

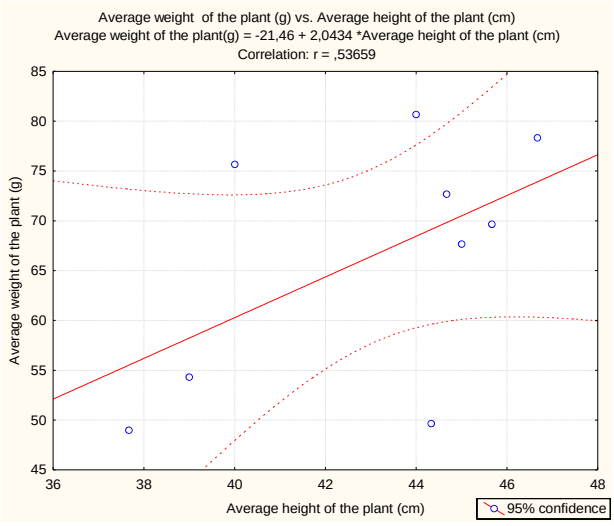

Fig. 4. The correlation between the average height of the plant and its mass
Source: Own calculation.

Analyzing the correlation between fresh herb and dry herba yield (g/plant), the coefficient increases (r = 0.95347), being very significant (Figure 5). The higher value of the correlation

coefficient shows a very close relation between the two studied parameters.

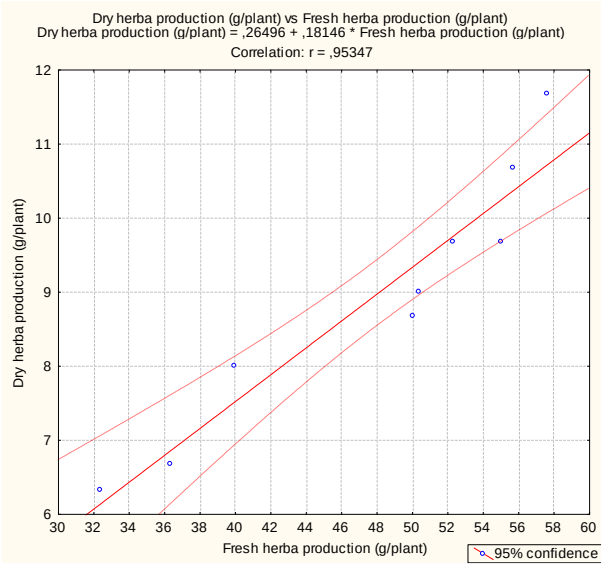

Fig. 5. The correlation between fresh and dry herba yield
Source: Own calculation.

CONCLUSIONS

Analyzing the results obtained regarding the technology of *Primula officinalis* Hill. species to establish the possibility for introduction into culture, the following conclusions can be list:

In climatic and soil conditions from NIRDPSB Braşov, *Primula officinalis* Hill species finds good growth and breeding conditions.

Experiences set up in the autumn of 2016 were well wintering, without losses in the spring.

The percentage of emergence plants/varieties in 2018 was very good to the V4 variant (with graduations of 10 cm between the plants per row and 50 cm between the rows), which exceeded all the other variants to 90%.

Variants V2 (25/25), V3 (50/25), V5 (25/50), V6 (50/50) and V8 (25/75) presented an average of 8 flowering stems per plant, being superior to the other variants.

It was observed that there were differences in the action of the two factors on the height of the plants, with a decisive role for the yield achieved on each studied surface unit.

Comparing the value of the correlation coefficient with the probability of 5%, r = 0.54> 0.50, it can be said that between the average height of the plant and its mass there is a little significant correlation.

Between the yield of fresh and dry herba (g/plant), the correlation coefficient is high (r = 0.95347), being very significant and reflecting a close relation between the two studied parameters.

In the case of large areas where the work is done mechanically, planting at a distance of 50 cm between rows and 10 cm between plants per row ensures high yields of herba/ha.

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