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PLANTING PERIOD - IMPORTANT SEQUENCE IN ESTABLISHING THE CULTIVATION TECHNOLOGY IN *Primula officinalis* Hill. SPECIES

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Abstract

The introduction into the system of sustainable agriculture is an alternative to the harvesting of medicinal plants from the spontaneous flora, ensuring the conservation of natural resources. By including in phytotherapy the active principles of the organs of this species, a qualitative leap was made. The aim was to determine the optimal planting period of the species Primula officinalis, in a experience lasting 4 years, in order to introduce it into culture. The best emergence in the following years, the plant being a perennial, had the version planted with seedlings on 28.03.2017, with an average of 7 plants, and the lowest emergence was recorded in the version planted on 10.04.2017. Analysing the influence of the planting date on the average height of the plants, it was observed that the V1 variant planted on 20.10.2016 has the highest values, with an average of 47.33 cm, the V2 variant planted on 11.11.2016 has a significant increase of 4, 00 cm compared to the control, variants V4, V5 and V6 registering negative differences. The favourable planting period proved to be autumn, in October and November, when the highest values were recorded.

Key words*: biology, planting date, Primula officinalis, technology.*

INTRODUCTION

For medicinal and aromatic purposes, from the spontaneous flora of Romania, over 2640 products are systematically obtained from plant parts: roots, rhizomes, bark, buds, stems, shoots, leaves, flowers, stigmas, fruits, seeds (in the References' list in MADR, 2016).

Primula officinalis is a herbaceous species, belongs to the *Primulaceae* family, being one of the more than 400 species of the *Primula* genus. It is distributed in almost all of Europe, it grows in warm, sunny, dry habitats, most frequently on meadows and pastures, but also in open deciduous forests (Hegi, 1965; Valentine & Kress, 1972).

Primula veris L. (synonymous with *Primula officinalis* Hill.) is a perennial species, 15-30 cm high, has adventitious roots, leaves arranged in basal rosettes, scapiferous aerial, erect, leafless stems, which develop from the ground and bears umbelliferous inflorescences (Tamas et al., 2021), the leaves - are elliptic ovate with an obtuse tip, the edge crenate and wavy, on the lower side, hairy, with prominent veins (Scarlat & Tohaneanu, 2019), the inflorescences - are arranged in umbella 6 - 18 each together, on type 5, the calyx persistent, connate or gamopetalous corolla, yellow-golden in color (Figure 1), the fruits - denticulate capsules with a length of 6-10 mm, present a persistent calyx (Muntean et al., 2007; Varban et al., 2009).

Figure 1. *Primula officinalis* Hill.

Primula veris L. ("ciuboţica cucului" in popular language) is a well-known it is an Eurasian species, not endemic in Romania plant it grows spontaneously in Romania, on poor, calcareous soils, with southern exposure, at a certain altitude. Being an endangered species, as a result of irrational harvesting, it is necessary to cultivate it in the areas of natural growth of the plant (Păun, 1986; Nițu-Năstase et al., 2021). *Primula veris* L. is a medicinal plant rich in triterpenic saponins, phenolic glycosides and flavonoids (Müller et al., 2006). It was found in a series of pharmacological studies that *Primula veris* L., extracts are rich in saponins, having antibacterial and antifungal effects (Başbülbül et al., 2008). It has beneficial effects on the nervous system, it is a good heart tonic. It is used in the treatment of headaches, migraines, against dizziness, neuralgia, nervous asthenia, insomnia, heart and lung diseases. It stimulates expectoration, sweats easily, is a good diuretic and favors metabolism. Also, the plant is recommended in the treatment of respiratory, kidney, bladder and insomnia (https:/www.descopera.ro/natura, 2016).

In recent years, in order to protect the spontaneous medicinal flora in Romania, the experimentation of some procedures for maintaining and increasing the economic potential has begun of it (Alexan et al., 1983).

The Loki Schmidt Foundation in Germany designated the "Cuckoo's Cuckoo" flower of the year 2016, drawing attention to the danger of the extinction of this species. In several German states, *Primula veris* L. is on the "red list" of protected plants (https://www.realitatea.net/stiri/actual/f, 2016).

MATERIALS AND METHODS

Experimental conditions

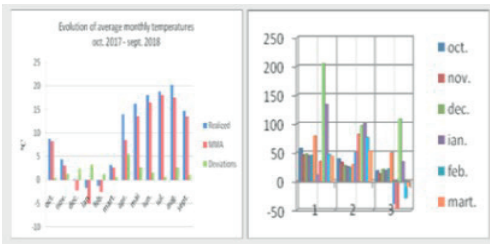
The experimental field of I.N.C.D.C.S.Z Braşov is located in the Braşov Depression (Tara Bârsei), located at 25°45' east longitude and 45°42' north latitude. The altitude at which the experimental field is located is 520 m (Mihai, 1975).

The multiannual average air temperature in this area is 7.6°C, the absolute maximum temperature recorded in August being 37°C. Air humidity has an average annual value of 75%. Atmospheric precipitation has average values of 600-700 mm/year. The wind on the ground it has predominant directions from the west and northwest and average speeds between 1.5 and 3.2 m/s.

Climatic characterization of the year 2017-2018 in Braşov

The agricultural year 2017-2018, in Braşov, was warmer and richer in precipitation.

In the autumn-winter period, the average air temperature was higher by 1.5ºC compared to the MMA value (0.7ºC). Average monthly temperatures were higher, compared to multi-year values, throughout the October - March interval, with deviations between 0.5 and 3.3ºC. The largest thermal deviation was recorded in January (+3.3ºC). During the vegetation period (April - August), the air temperature was higher on average by 2.7ºC, compared to MMA (Figure 2a). Average monthly temperature deviations were between 0.5 and 5.5ºC, the maximum deviation being registered in April. This period of the year was richer in precipitation (Figure 2b), compared to the values characteristic of the area, their sum exceeding by 141.3 mm the multiannual value of 177.0 mm. It is worth noting that, in all the months preceding the crops, the sum precipitation was higher. Between April and September, the precipitation fell was generally below the multiannual values, except for the months of June and July, when they exceeded the multiannual values, especially in June, by more than 100 l/m^2.



a) **b)**

Figure 2. The average air temperature (ºC) (a); the amount of precipitation (mm) (b) (2017-2018)

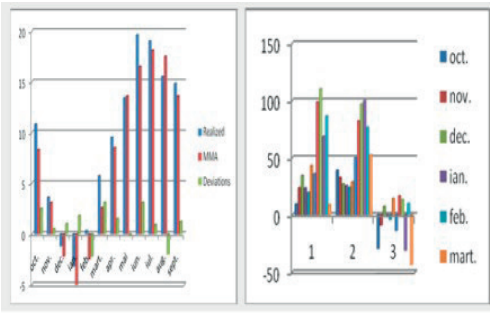
From a climatic point of view, the 2017-2018 agricultural year can be characterized, for the Braşov area, as a warm year (+2.4ºC) and rich in precipitation (+157.9ºC) (source: weather station: Ghimbav, I.N.C.D.C.S.Z. Braşov).

Climatic characterization of the year 2018-2019 at I.N.C.D.C.S.Z. Brasov

The 2018-2019 agricultural year, in Brașov, was characterized by a particularly mild autumn-winter with little precipitation. During the month of March, when the *Primula veris* L., plants emerged, abundant precipitation was recorded (Figure 3a), with deviations of (+14.2 mm) compared to the MMA, with temperatures having deviations of (+3.2ºC).

From the beginning of plant emergence (18.03.2019) to the date of harvesting for herb (10.05.2019), the cumulative temperatures had a positive deviation of 4.4ºC compared to MMA (Figure 3b).

The level of precipitation during this period exceeded the multiannual average of 160.9 mm by 16.4 mm (source: weather station: Ghimbav, I.N.C.D.C.S.Z. Brașov).



a) **b)**

Figure 3. The average air temperature (ºC) (a); the amount of precipitation (mm) (b) (2018-2019)

The chernozemic type soil, on which the experiment was located, has a pH between 5.3 and 6.5, being a moderately acidic to weakly acidic soil,with a humus content between 3.5 and 5%, which indicates an average to good supply of organic matter (Rusu et al., 2009; Vidican et al., 2013).

The biological material, on which the research on biology and cultivation technology was carried out in order to introduce the species *Primula veris* L., in culture (Figures 4 and 5), was brought in the spring of 2016, from the spontaneous flora of Brașov county (Rucăr-Bran lane). After sampling from the spontaneous flora, the plants were selected, then they were transplanted into seedling cups, with the dimensions of 7 x 7 x 6.5 cm, on blond peat substrate.

From te date of replanting to the establishment of experences, the plants went through a period of acclimatization, in the greenhouses of the Laboratory of Technology and Good Agricultural Practices, the Medicinal and Aromatic Plants Department of the I.N.C.D.C.S.Z. Brașov, during which environmental conditions and their phytosanitary status were constantly monitored.

Figure 4 *Primula veris* L., in spontaneous flora

Figure 5. Harvesting *Primula veris* L. from spontaneous flora (photo original)

Primula veris L., forms in the first year of vegetation, in greenhouse conditions, a rosette of leaves and flowers. After transplanting, the plant develops harmoniously. A pronounced development in the number of leaves is observed until the end of June - the beginning of July, when they begin to increase their surface at the expense of the appearance of new leaves. At the end of the vegetation period of the first year, in the greenhouse, the seedling shows an average of 7-10 leaves/plant (Figure 6).

Figure 6. *Primula veris* L.,during acclimatization in the greenhouse (photo original)

After the acclimatization of the material, before establishing the field experiments, a rigorous selection was carried out, choosing the most uniform plants as number of leaves, height and health. For the success of the experience, the soil moisture and the correct execution of the planting operation were taken into account at the establishment.

After 6-7 days from planting, an evaluation of the plants in the experimental field was made and the gaps were filled. During the three years of research, 4-5 manual weedings per year and weeding were carried out, for a good development of the foliar and reproductive apparatus.

In order to establish the main phenological data in the experiment regarding the establishment of the optimal planting season for the species *Primula veris* L., in the fall of 2016 and in the spring of 2017, an experiment was established according to the randomized block method, with 6 planting variants, in three repetitions, each variant having three rows. The surface of a plot was 9 m^2, the experimental surface including the paths was 72 m^2; the number of plants per variant was 72 plants, and the total per experience 432 plants.

Planting was done with seedlings produced in the greenhouse, during 2016.

Phenological observations

For experimentation, two planting periods were established: the fall of 2016 and the spring of 2017, in several autumn and spring variants.Variant number three, planted in emergency I, at the beginning of March 2017, is considered the control variant of experience.

The planting was carried out with material (seedlings) produced in the greenhouse, during 2016.

Table 1 shows the data, on which the experience regarding the optimal planting period for the *Primula veris* L. species was established.

Table 1. Date of planting at experience regarding the establishment of the optimal planting period to *Primula veris* L. species (Braşov 2016-2017)

V_1 - planted in the last decade of October	20. 10. 2016
V_2 - planted in the first decade of November	11.11.2016
V_3 - planted in emergency I, - the beginning of March (witness)	03. 03. 2017
V_4 - planted in, the last decade of March	28. 03. 2017
V_5 - planted in the first decade of April	10. 04. 2017
V_6 - planted in the first decade of May	03. 05. 2017

The date of emergence was noted at the end of emergence of all plants/variant.

The date of the start of flowering was noted in the dynamics, from the emission of flower stalks, until full flowering, the obtained results were processed graphically.

The date of the start of fruiting was noted when 10% of the plants formed capsules.

The harvest date for seeds was noted when 90% of the capsules reached phenological maturity (Table 2).

Table 2. Phenological observations at experience regarding the optimal planting period to *Primula veris* L.

Phenological observations	Year 2018	Year 2019
Emerged tart date	12. 03. 2018	18.03.2019
The date when flower stalks appeared	30. 03. 2018	09.04.2019
The date of the start of flowering	10. 04. 2018	20.04.2019
Harvest date for herb	27. 04. 2018	10.05.2019
The date of the start of fruiting	14. 05. 2018	20.05.2019
Harvest date for seeds	27. 06. 2018	05.07.2019

Phenological observations on the experience regarding the optimal planting period for the

species *Primula veris* L., reveals the fact that the physiological processes that take place in the plant are directly influenced by the environmental conditions and less influenced by the planting period (Figure 7).

Figure 7. Experience regarding the optimal planting period to *Primula veris* L. species

Determinations when harvesting plants for herb

The growth dynamics of the leaf apparatus until full flowering were analyzed, when three plants were harvested from each variant/experimental repetition.

For each harvested plant, determinations were made regarding: the height of the plant and its weight. Average results are presented.

Statistical analyses

The processing of the experimental data and the writing of the paper were carried out with the help of Windows Vista, Windows XP, Excel and Word programs. The analysis of variance was calculated for all the elements taken into the study, using the statistical program PoliFact- for completely randomized polyfactorial experiments, the theoretical t values and the limit differences Dl for 5%, 1% and 0.1%.

The elaboration of the paper and the interpretation of the experimental data were carried out according to: Analysis of biological variants (Bonnier & Tedin, 1957); Principles of agronomic and veterinary medical research methodology (Ardelean, 2010).

RESULTS AND DISCUSSIONS

The percentage of plants sprouted in 2018

In the spring of 2018, the evaluation of the sprouted plants on each planting variant was carried out.

The best emerging was to the planted variant on 28.03.2017, with an average of 7 plants sprouted, the variants planted in the fall of 2016 recorded an average of 5-6 plants sprouted per variety, the lowest sprouting was for the variant lanted on 10.04.2017, according to Figure 8.

The percentage of sprouted plants in 2019

The graph presented in Figure 9 shows the percentage of sprouted plants of the species *Primula veris* L., in 2019, where a slight decrease in sprouted plants is noticeable, compared to 2018, the best sprouting also being recorded for the variant planted on 28.03.2017, and the lowest emergence was also recorded for the variant planted on 10.04.2017.

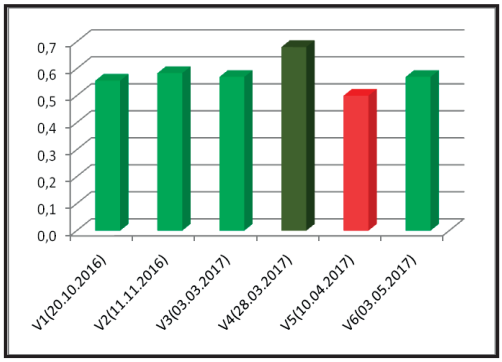


Figure 8. The percentage of *Primula veris* L., plants emerged in 2018

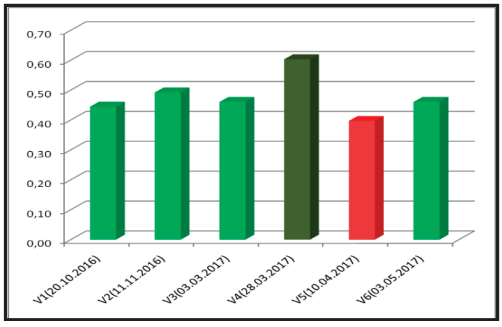


Figure 9. The percentage of *Primula veris* L., plants emerged in 2019

Analysis of the influence of planting date on plant height 2018-2019

Analyzing the data from Table 3, in which the influence of the planting date on the average height of the plants in 2018 is observed, it is observed that the V1 variant planted on 20.10.2016 has the highest values, with an average of 47.33 cm, the variant V2 planted on 11.11.2016 has a significant increase of 4.00 cm compared to the control, the variants V4, V5 and V6 registering significant negative differences, distinctly significant, respectively very significant, in relation to the control of the experience.

Table 3. The influence of planting date on the height of plants *Primula veris* L., 2018

Var.	Date	Aver.	%	Dif.	Sig.
V3	03.03.2017	41.67	100.0	0.00	Mt.
V1	20.10.2016	47.33	113.6	5.66	**
V2	11.11.2016	45.67	109.6	4.00	*
V4	28.03.2017	38.00	91.2	-3.67	0
V5	10.04.2017	35.67	85.6	-6.00	00
V6	03.05.2017	33.33	80.0	-8.34	000
DL (5%)				3.29	
DL (1%)				4.67	
DL (0.1%)				6.76	

In 2019, significantly positive differences can be observed in the variant planted on 20.10.2016, with an average plant height of 46.00 cm (Table 4).

The other experimental variants show lower values, from insignificant to distinctly significantly negative compared to the control.

Table 4. The influence of planting date on the height of plants *Primula veris* L., 2019

Variant	Date	Aver.	%	Dif.	Sig.
V3	03.03.2017	43.67	100.0	0.00	Mt.
V1	20.10.2016	46.00	105.3	2.33	*
V2	11.11.2016	45.00	103.1	1.33	-
V4	28.03.2017	42.33	96.9	-1.33	-
V5	10.04.2017	41.33	94.7	-2.33	0
V6	03.05.2017	40.00	91.6	-3.67	00
DL (5%)				1.87	
DL (1%)				2.66	
DL (0.1%)				3.85	

The experimental variants planted in the fall of 2016 present an average number of 7 flowering stems in the spring of the following year; the other experimental variants did not develop flowering stems (Figure 10).

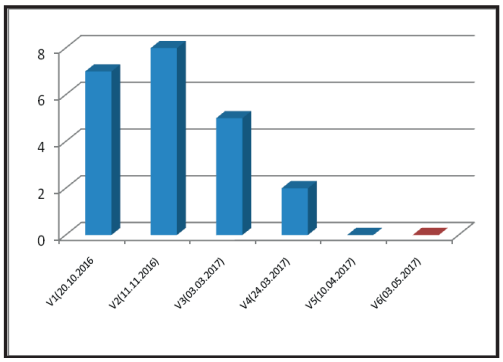


Figure 10 . *Primula veris* L., number of flowering stems dated 13.04.2017

The date of the start of flowering in 2018 was noted from the emission of the first flower stalks until full flowering, and the results obtained were processed graphically in Figure 11.

Varieties planted in autumn had a higher production of flowering stems (8); variants planted in the spring of 2017 decreased in proportion to the date of planting.

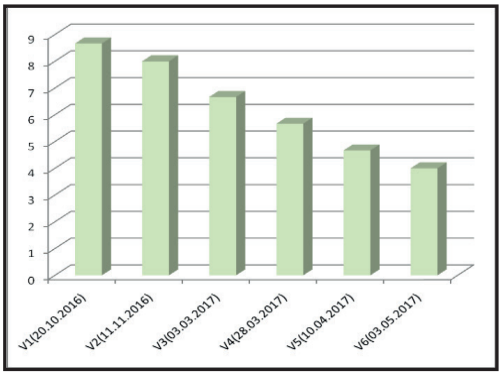


Figure 11. *Primula veris L.,* number of flowering stems dated 27.04.2018

Table 5.The influence of planting date on the mass of plant in *Primula veris* L., experimental year 2018

Symbol	Variant	Average	%	Dif.	Sig.
V3	03.03.2017	61.00	100.0	0.00	Mt.
V1	20.10.2016	69.00	113.1	8.00	*
V2	11.11.2016	66.00	108.2	5.00	-
V4	28.03.2017	54.67	8.6	-6.33	0
V5	10.04.2017	51.00	83.6	-10.00	00
V6	03.05.2017	46.33	76.0	-14.67	000
DL (p 5%)				5.67	
DL (p 1%)				8.06	
DL (p 0.1%)				11.67	

In 2019, the variant planted on 20.10.2016, after three years of vegetation, has a number of 18 flowering stems; the other experimental variants, regardless of the planting date, record close values of the number of flowering stems. From Figure 12 it can be seen that the planting date no longer obviously influences the number of flowering stems.

Table 6.The influence of planting date on the mass of plant in *Primula veris* L., Experimental year 2019

Symbol	Variant	Average	%	Difference	Signifi-cance
V3	03.03.2017	88.33	100.0	0.00	Mt.
V1	20.10.2016	101.33	114.7	13.00	***
V2	11.11.2016	94.00	106.4	5.67	*
V4	28.03.2017	81.00	91.7	-7.33	00
V5	10.04.2017	75.33	85.3	-13.00	000
V6	03.05.2017	70.33	79.6	-18.00	000
DL (p 5%)				4.30	
DL (p 1%)				6.12	
DL (p 0.1%)				8.86	

In conclusion, the *Primula veris* L., culture consolidates in the field, after 2-3 years from establishment.

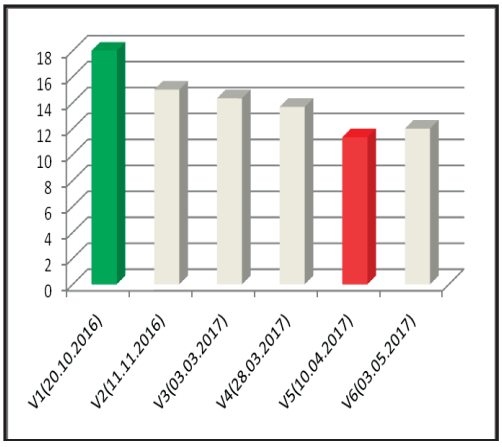


Figure 12. *Primula veris* L., number of flowering stems dated 27.04.2019

Analysis of the influence of the planting date on the plant mass 2018-2019

From the study of the influence of the planting date on the plant mass, in 2018 it can be observed that the first variant has a significant increase compared to the control, the variant planted in late autumn shows similar values, and in the variants planted in spring, the mass of the plant decreases with the delay in planting (Tables 5 and 6).

The process is repeated in the experimental year 2019, with the variants planted in autumn having higher values than those planted in the spring of the following year.

CONCLUSIONS

Analysing the results obtained in the experiment regarding the establishment of the optimal planting period for the species *Primula veris* L., established by seedling, under the conditions of I.N.C.D.C.S.Z. Brasov, Romania, which aimed to develop the cultivation technology of this species, in the experimental years 2016 - 2019, the following conclusions can be drawn:

Phenological observations on the experience regarding the optimal planting period for the species *Primula veris* L., reveals the fact that the physiological processes that take place in the plant are directly influenced by the environmental conditions and less influenced by the planting period.

Regarding the optimal period for planting the species, so for establishing the culture of *Primula veris* L., analysing the height of the plants, the mass of fresh grass/plant practically for all components of plant growth and development, it turned out to be autumn, in the months October and November or early spring, when the highest values were determined.

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