RESEARCH REGARDING THE DIVERSIFICATION OF THE METHODS OF BREEDING OF SOME OF THE SPECIES OF *SEMPERVIVUM*

CERCETĂRI PRIVIND DIVERSIFICAREA METODELOR DE ÎNMULȚIRE LA UNELE SPECII DE *SEMPERVIVUM*

ZAHARIA A., ZAHARIA D., CANTOR MARIA, DUMITRAŞ ADELINA
University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca

***Summary**: The species of the type Sempervivum are used more and more frequently in landscaping owing to their succulent nature, which explains their capacity to develop and withstand the conditions of long drought, barren soils and at levels of scarce vegetation. In the literature studied there were found no concrete specifications or results of the research concerning the breeding of these plants. This seems to justify the very limited assortment of species belonging to the Sempervivum type, as a consequence of the lack of information regarding the production of planting material. Considering that there are questions which have not been answered yet, questions regarding the types of slip seedlings used, the conditions of their rooting, of the substratum used for the rooting of the slip seedlings or of the leaf rosettes, some experiments were set up in the purpose of observing the behaviour of the species from the local assortment during its vegetative breeding.*

***Rezumat**: Speciile genului Sempervivum sunt din ce în ce mai frecvent folosite în amenajările peisagistice datorită naturii lor suculente, ceea ce explică capacitatea de a se dezvolta şi rezista în condiţii de secetă prelungită, pe soluri uscate şi cu nivele de troficitate scăzute. În literatura consultată nu s-au găsit precizări concrete sau rezultate ale unor cercetări privind înmulţirea acestor plante. Acest fapt justifică, se pare, sortimentul foarte restrâns de specii aparţinând genului Sempervivum ca urmare a lipsei de informaţii privind producerea de material săditor. Având în vedere unele întrebări care încă nu au primit răspunsul referitor la tipurile de butaşi folosiţi, a condiţiilor de înrădăcinare, a substratului folosit la înrădăcinarea butaşilor sau a rozetelor de frunze, s-au organizat unele experimente cu scopul de a se observa comportarea în procesul înmulţirii vegetative a speciilor din sortimentul autohton.*

MATERIAL AND METHOD

The material used to organize the research consisted of the plants belonging to two species of *Sempervivum*. The species under consideration may be found in the assortment of succulent plants, within the Faculty of Horticulture of the USAMV of Cluj-Napoca and were produced by the Botanical Gardens of Cluj and Iasi.

Sempervivum tectorum L. The plants have the appearance of rosettes, the diameter of which may reach up to 20 cm. The leaves are arrayed in concentric rows in upright position directed towards the center of the rosette, and the marginal ones are bent to the outside. The height of the rosettes is 4.0-5.5 cm.

The limb of the leaves is glabrous or lightly pubescent, the edges are covered with thin green small hairs. The limb has the shape of a spatula.

Its colour is green, and the top, ending into a thorn is reddish-brown. The rosettes form short pubescent offsets, of average thickness, on the edges of which daughter rosettes take shape, reddish-mauve coloured.

Sempervivum montanum L. It has smaller rosettes, with a diameter of 4.0-4.5 cm, the leaves are green, and the array of the leaves in the rosettes is tight in the center and loose on the outside. The leaves from the upper third are 5 to 7 mm thick. The daughter rosettes have few leaves and of small size. In May the mature rosettes give birth to inflorescences upheld by floral stems 10-15cm high. For the set up of the experiments, the substrata used for the rooting of the slip seedlings were the perlit and the river sand.

The degree of complexity of the experiments was average, the experiments depending on one factor and on two factors. The number of plants in one variant was 45, and then 15 in its repetition.

OBSERVATIONS AND MEASUREMENTS

At the moment of organization of the experiments, there were carried out measurements and analyses in the purpose of characterizing as thoroughly as possible the initial biologic material. These observations referred to the size and weight leaves or leaf rosettes. During the rooting phase, the values of the temperature of the air and of the substratum were recorded.

The observations and measurements carried out during or at the end of the experiment were calculated statistically and the arithmetical means were retained. They are presented in the tables, some of them being undergoing statistical calculations in order to establish the limit differences and the significations.

On the basis of the results obtained, one has drawn conclusions and recommendations for the floristic practice.

RESULTS AND DISCUSSIONS

Vegetative breeding and producing the planting material to the species of *Sempervivum*. The specialty literature mentions in unanimity the possibility of vegetative breeding of the species *Sempervivum* by rooting the leaf rosettes that are formed around the mother-plants.

There are very few sources that state that perhaps there is the possibility of vegetative breeding by the rooting of the leaves (leaf seedlings) as well. Starting from these affirmations, one has organized an experiment in which the leaves taken from the rosettes of *S.tectorum* which has reached a development specific to the mature plants were used as slip seedlings. For these to be characterized, they were measured and weighted (Table 1). The leaves were splitter into three categories: outward (large) ones, middle ones and those of the center of the (small) rosette.

Analyzing the data of table 1, these lead to a first conclusion, namely: the leaves from the *Sempervivum* rosette decrease in dimensions going from the outside towards its centre. Both absolute values and relative ones confirm these affirmations.

From the features analyzed, the length and weight of the leaves undergoes the biggest differences between categories. Thus, the length decreases by about 27% from the outside towards the middle and by 17% more towards the center of the rosette. The leaves in the centre of the rosette are shorter by 46% than the marginal ones. The maximum breadth and the thickness of the leaves from the upper third keeps the same tendency of decreasing the values (going) from the outside towards the centre of the rosette, but the differences between the categories are much smaller (maximum 10%).

Tabelul 1

Average values of the *Sempervivum tectorum* leaves' dimensions used as slip seedlings

No. crt.	Species	Length of leaves		Breadth of leaves		Thickness of leaves		Weight of leaves	
		mm	%	mm	%	mm	%	gr.	%
1.	*Sempervivum tectorum* (small leaves)	29.3	100	13.6	100	3.3	100	0.62	100
2.	*Sempervivum tectorum* (middle size leaves)	21.5	73	13.0	96	3.0	91	0.33	53
3.	*Sempervivum tectorum* (large leaves)	16.3	56	12.2	90	2.7	82	0.15	25

With respect to the weight of the leaves, this feature is the most variable one, with values intensely decreasing from the outside to the middle of the rosette (47%) and reaching up to 75% in the centre of the rosette.

The leaf slip seedlings were planted for the rooting in the perlit, being introduced with the bottom in the substratum in upright position. From that point on, one has created the optimal conditions for rooting, preserving a moderate humidity in perlit and air, keeping the temperature between the limits of 10°C and 22°C. After 18-20 days one has checked if the leaves rooted but the result was negative.

The experiment went on with verifying regularly the rooting. 50 days after the performance of the experiment, the leaves originating from the centre of the rosette began to turn brown and to lose their vigour. In the aftermath the same phenomenon was noticed with the leaves originating in the middle part of the rosette, and then those from the outside of the rosette grew brown as well.

The conclusion following this attempt is that the leaves of *Sempervivum* do not root in usual conditions using the classical methods.

In parallel with this experiment, one has used for the breeding of plants, rosettes of *S. montanum* which had been separated from the mother plants and which have been put for rooting in different substrata being maintained in different conditions of humidity (Table 2).

Analyzing these values one notices that the number of rosettes formed by a mother plant differs, in our case from 3 to 14, even though the mother plants were relatively uniform. One notices also that the rosettes formed by a mother plant vary both with respect to weight and the other parameters (the diameter of rosette and its height.

These rosettes were planted for rooting in substrata of river sand, perlit and grinded peat (2:2:1). Later on the conditions of rooting differed especially regarding the humidity in the atmosphere and in the substratum.

The rosettes maintained in tough conditions (of laboratory) - low atmospheric humidity (20-30%) and great variations in substratum from very dry to very wet, maintained their viable aspect for almost 100 days, whereas with other rosettes, especially the smaller ones, the leaves from the outside of the rosette began to fade; the phenomena continued, and finally, some of the rosettes faded without growing roots (Table 3).

Table 2

Values of the quantitative parameters of the rosettes used for rooting (*S.tectorum*)

Specification	Symbol	Weight (g)		Diameter (cm)		Height (cm)		Stem diameter (mm)	
		maxim	minim	maxim	minim	maxim	minim	maxim	minim
Mother plant	1	8.5	-	5.0	-	2.2	-	5.0	-
Daughter rosettes	1-5	7.3	1.5	2.6	1.5	2.4	1.4	6.0	2.0
Mother plant	2	7.8	-	5.8	-	2.4	-	4.0	-
Daughter rosettes	1-14	7.9	0.5	2.6	1.0	2.3	1.1	4.0	2.0
Mother plant	3	8.5	-	7.8	-	2.8	-	4.2	-
Daughter rosettes	1-6	8.2	2.9	2.9	2.2	2.5	1.6	5.0	3.5
Mother plant	4	7.9	-	6.5	-	2.2	-	3.5	-
Daughter rosettes	1-3	8.4	1.5	2.9	1.5	2.3	1.2	3.3	3.0
Mother plant	5	7.6	-	4.8	-	2.5	-	4.0	-
Daughter rosettes	1-3	7.4	1.4	2.8	1.5	2.3	1.3	4.5	3.5
Mother plant	6	6.8	-	5.5	-	2.3	-	4.0	-
Daughter rosettes	1-4	6.5	1.6	2.8	1.7	2.3	1.2	3.5	3.0

Table 3

Experimental results regarding the rooting and growing of rosettes of *Sempervivum montanum* in tough environment conditions

Variant	No. of rosettes for rooting	Rooted rosettes		Average values of the rosettes		
		nr.	%	diameter (cm)	height (cm)	No of rosettes formed
Big rosettes - > 2.5 cm	24	14	58.3	3.2	2.3	-
Average rosettes - 2.5 < 2.0 cm	24	11	45.8	2.9	1.8	-
Small rosettes - 2.0 cm >	24	7	29.2	2.2	1.2	-

The number of rosettes that rooted and were viable is small, the percentage of rooting wavers between 29.2% and 58.3%. One notices also a very weak development as compared to their initial size, as well as the lack of daughter rosettes. One notice that no rosette started to grow any daughter rosettes. Some rosettes of the same categories have been planted in the same substratum and have been maintained for rooting in hothouse conditions, with high values of the atmospheric humidity, and keeping the humidity in the substratum at low values.

The results of this experiment are presented in Table 4 and they emphasize the great differences from the results obtained in laboratory conditions.

Table 4

Experimental results regarding the rooting and growing of rosettes of *Sempervivum montanum* in optimal environment conditions

Variant	No. of rosettes for rooting	Rooted rosettes		Average values of the rosettes		
		nr.	%	diameter (cm)	height (cm)	No of rosettes formed
Big rosettes - > 2.5 cm	24	23	95.8	5.8	2.5	6.2
Average rosettes - 2.5 < 2.0 cm	24	21	87.5	5.1	2.3	5.6
Small rosettes - 2.0 cm >	24	20	93.3	4.2	2.1	4.8

The rooting of rosettes occurs in great number, being equivalent to a percentage wavering between 83.3 % and 95.8 %. The data in the table above support the hypothesis that bigger rosettes have greater chances in becoming mature plants which would form new rosettes.

The conditions of the experiment influences favorably the growth of the rosettes, reaching dimensions typical for their species (4.5-6.5 cm in diameter), as well as the formation of daughter rosettes. Their number is greater (6.2) for the plants originating from the rosettes the initial size of which was larger, and it decreases 4.8 for the plants stemming from smaller rosettes (Table 5).

Table 5

The synthesis of the experimental results regarding the formation of new rosettes to the plants of *Sempervivum* under the influence of the species and of the culture substratum

Variant	Size of rosettes, diameter (cm)		Rosettes formed		± d	Significance of the difference
	initially	after 100 days	no.	%		
S. tectorum x gravel (Mt)	7.2	11.5	4.3	100	-	-
S. tectorum x gravel + garden soil	7.5	14.6	5.2	121	0.9	*
S. tectorum x gravel + perlit	7.4	9.3	3.1	72	-1.2	o
S. montanum x gravel	2.7	3.8	6.5	151	+2.2	*
S. tectorum x gravel + garden soil	3.0	5.5	8.3	193	+4.0	***
S. tectorum x gravel + perlit	2.8	4.0	6.2	144	+1.9	*

DL 5% = 1.21 DL 1% = 2.36 DL 0.1% = 3.45

Along the idea of answering the question „In what conditions do the species of *Sempervivum* form a greater number of rosettes" one has set up an experiment with three different substrata in order to emphasize their influence.

Substrata consisted of coarse sand (gravel), gravel blended with garden soil (1:1) and gravel blended with perlit. (1:1). Analyzing the results of the table, one notices a variation of the number of newly formed rosettes, depending on the variants. Thus, the witness is surpassed by all the variants of the species *S. montanum* regardless of the culture substratum used, and it is surpassed even by variant 2, which differs from the witness by the culture substratum. The witness is superior to variant 3, where the species is the same, but the substratum is made up of gravel mixed with perlit.

In order to establish the influences of the two factors, the results were calculated so that one may determine the influence of the species (Table 6).

Table 6

The synthesis of the experimental results regarding the formation of rosettes of *Sempervivum* under the influence of the species

Variant	Rosettes formed		± d	Significance of the difference
	nr.	%		
Sempervivum tectorum	12.6	100	-	-
Sempervivum montanum	21.0	167	8.4	***

DL 5% = 2.16 DL 1% =4.04 DL 0.1% = 6.12

The results in the table emphasize that the species *S.montanum* forms more rosettes than *S.tectorum*, and the difference between them is very significant. In order to determine to what extent the culture substratum influences the rosette formation we analyze the data in the Table 7.

Table 7

The synthesis of the experimental results regarding the formation of rosettes of *Sempervivum* under the influence of the culture substratum

Variant	Rosettes formed		± d	Significance of the difference
	no.	%		
Gravel	10.8	100	-	-
Gravel + garden soil	13.5	125	2.7	**
Gravel + perlit	9.3	86	-1.5	o

DL 5% = 1.42 DL 1% = 2.53 DL 0.1% = 3.71

The data in the table show that the culture substratum does have an influence upon the rosette formation. The gravel - considered as witness - is surpassed by its mixture with garden soil, the difference obtained is distinctly significantly positive. Mixing the gravel with the perlit negatively influences the rosette formation, thus their number is smaller than that of the witness, and the difference is significantly negative.

CONCLUSIONS AND RECOMMENDATIONS

1. The species of *Sempervivum* do not allow for vegetative breeding using their leaves as slip seedlings in usual conditions and with classical technologies.

2. The rosettes without roots undergoing conditions of severe drought especially atmospheric one together with insufficient water in the soil preserve their viability for 50-60 days, they do not form daughter rosettes, and the leaves of the rosette begin to fade from the outside to the centre of the rosette.

3. The rosettes separated from the mother plant, provided they enjoy atmospheric and soil humidity, will grow numerous very thin adventitious roots, which stimulate the growth of the rosettes as well as the forming of new rosettes.

4. The number of formed rosettes by the plants of *Sempervivum* depends on the species but also on the culture substratum. A well drained substratum which has enough nutritious elements favors the formation of a greater number of rosettes.

REFERENCES

1. Barocio I., 1993 - *Una specie nueva de Sempervivum encondrata cerca de Epazoyucan*, Hidalgo-Mexico, Cactaceas y Suculentas Mexicanas.
2. Carlstrom A.L., 1995 - *Two new species of Sempervivum*, Willdenowia.
3. Gilbert M.G., 1985 - *The genus Sempervivum* in Ethiopia, Bradleya.
4. Preda M., 1989 - *Dicționar dendrofloricol*, Ed. Științifică, Bucureşti.
5. Zaharia D., 1994 - *Floricultură*, Tipo Agronomia, Cluj-Napoca.
6. www.plantdelights.com
7. www.plantsdatebase.com