THE INFLUENCE OF SOME CULTURE SYSTEMS ON THE ORNAMENTAL VALUE OF *SEDUM SPURIUM* 'FULDAGLUT' AND *SEMPERVIVUM TECTORUM* SPECIES

INFLUENȚA UNOR SISTEME DE CULTURĂ ASUPRA VALORII ORNAMENTALE A SPECIILOR *SEDUM SPURIUM* 'FULDAGLUT' ȘI *SEMPERVIVUM TECTORUM*

NEGREA Roxana [1], DRAGHIA Lucia[1], CIOBOTARI Gh. [1]
e-mail: roxana.acfrance@gmail.com

Abstract. *The purpose of the paper is to analyze the behavior of some ornamental flowering plants cultivated on roofs, on three types of substrate. The used biological material was comprised of mature Sedum spurium 'Fuldaglut' and Sempervivum tectorum samples, purchased from specialized nurseries and cultivated in 80/480 cm containers. The experimental scheme includes three variants, with three repetitions each in which various types of culture substrates were used: V_1- forest soil; V_2 -mixture of peat Novobalt (43%), coconut fiber (30%), composted bark (23%), alginate (4%); V_3-blonde peat (40%), brown peat (30%), sand 10% and forest soil (20%). It was found that the substrate type has influenced the growth and development of the Sedum spurium 'Fuldaglut' and Sempervivum tectorum plants. Comparing the types of substrate we concluded that the substrate a_3, a mixture of* blonde peat (40%), brown peat (30%), sand (10%) and forest soil (20%), *had the most positive influence, while the substrate a_2, a mixture of* Novobalt peat (43%), coconut fiber (30%), composted bark (23%), alginate (4%), *had the least influence.*
Key words: *substrates, green roofs, Sedum, Sempervivum.*

Rezumat. *Lucrarea are ca scop analiza comportării unor plante floricole ornamentale cultivate pe acoperiș, în trei tipuri de substrat. Materialul biologic utilizat a fost format din exemplare mature de Sedum spurium 'Fuldaglut' și Sempervivum tectorum, achiziționate din pepiniere de profil și cultivate în 12 containere de 80/480 cm. Schema experiementală cuprinde trei variante, cu câte trei repetiții în care s-au utilizat diferite tipuri de substraturi de cultură: V_1- pământ de pădure; V_2 – amestec de turbă Novobalt (43%), fibră de cocos (30%), scoarță compostată (23%), alginit (4%); V_3 - turbă blondă 40%, turbă brună 30%, nisip 10% și pământ de pădure (20%). S-a constatat faptul că tipul substratului a influențat creșterea și dezvoltarea plantelor de Sedum spurium 'Fuldaglut' și Sempervivum tectorum. Comparând tipurile de substrat, s-a constatat, la ambele specii, influența pozitivă a substratului a_3, alcătuit din - turbă blondă (40%), turbă brună (30%), nisip (10%) și pământ de pădure (20%); mai puțin favorabil a fost substratul a_2, format din amestec de turbă Novobalt (43%), fibră de cocos (30%), scoarță compostată (23 %), alginit (4%).*
Cuvinte cheie: *substraturi, acoperișuri verzi, Sedum, Sempervivum.*

[1] University of Agricultural Sciences and Veterinary Medicine of Iaşi, Romania

INTRODUCTION

Green roofs are a landscaping branch that combines esthetics with the ecologic functions of these types of setups. The esthetics and especially the functionality of such an area are primordial aspects, anchored in the selection of the most suited flower species to enter its composition.

Among the species recommended to be used in such setups we find *Sedum spurium* L., a specie native to the Caucasian area, (*Sedum spurium* (L.) M.Beib.) which has been introduced and naturalized in almost all of Europe, including in Romania (Sîrbu and Oprea, 2011). At the beginning of the last century, it was considered a „boyar" plant, as it was mainly found in the boyars' gardens, rarely in those of wealthy peasants; until the middle of the last century when it is mentioned as sub-spontaneous plan in some areas of Transylvania and Banat (Borza, 1947). In many studies, it is treated as an invasive plant (Zheng, 2013; Bruce, 2011; Higgins, 2005) with the ability to build dense populations in a short time (Zheng, 2013).

Also originating in the mounting, but this time from the mountains in central Western and Southern Europe, *Sempervivum tectorum* L. is cultivated in our country as an ornamental plant on roofs, walls and in cliff arrangements, especially in Transylvania, since 1816 (Borza, 1925; Sîrbu and Oprea, 2011).

Suggestively called „mother hen and chicken" name referring to the tendency of this plant to expand (Șelaru, 2007), *Sempervivum tectorum* L. is one of the species with superficial root system frequently met in cliffy gardens or even on walls. It flowers starting with May until the end of August. The vigor, rusticity and abundance of the flowering make this species be almost always present in the ornamental assortment of alpine gardens. It is suited for the setup of green fences and cliffs (Draghia and Chelariu, 2011; Cantor, 2008).

MATERIAL AND METHODS

The biological material used was 108 mature *Sedum spurium* 'Fuldaglut' specimens and 108 *Sempervivum tectorum* specimens, purchased in 12 cm flower pots from specialized nursery gardens. The uniform vegetal material has been transplanted in the spring of 2014 in the field of the Floriculture department and on the roof of a building belonging to University of Agricultural Sciences and Veterinary Medicine of Iasi, by mounting 18 containers of 80/480 cm, in order to also make a comparative analysis between their development on the ground and on roofs. The experimental scheme for each place of culture (roof and field), includes three variants, of three repetitions each, with 9 repetition plants, in which various type of culture substrates were used: a_1 (control) - forest soil a_2– mixture of Novobalt peat (43%), coconut fiber (30%), composted bark (23%), alginate (4%); a_3– blonde peat (40%), brown peat (30%), sand (10%) and forest soil (20%). This results in a total of 6 variants: rooftop - variants V_1 (substrate a_1), V_2 (substrate a_2) and V_3 (substrate a_3); and field (ground level) - variants V_4 (substrate a_1), V_5 (substrate a_2) and V_6 (substrate a_3).

Thus, for the mounting of the containers innovative materials were used, meant to protect the insulation of the roof where they were mounted, and the plants involved in the experiment as well. For a proper insulation o the containers, a special

membrane called MacTex BN40.1 200 gr was used and in order to retain rainwater we used Maxistud, which is a membrane with troconical protuberations of HDPR with a thickness lager than 20mm and with exceptional mechanical characteristics, which can retain up to 6L of water per $1m^2$. Over this membrane, in order to distribute the weight of the substrate and for a better water drainage we used a Q-Drain ZM 8 membrane (fig. 1).

a) b) c) d)

Fig. 1 - Alveoli mounting: on the roof (a-b); on the field (c-d)

The study has focused on phenological observations made depending on the planting date, the date the sprouts and flowers appeared. During the experiments we have ascertained the morphologic characteristics of the species: the number of flowers and leaves, the length and width of bushes and flowers and the number of sprouts, floriferous stems length. The data was interpreted statistically by analysis of variance and the results were compared with the average of the variants.

RESULTS AND DISCUSSIONS

Following the investigations made for *Sedum spurium* 'Fuldaglut', planted on the experimental field on 25th May 2014 we have ascertained that buds started appearing approximately 20 days since planting, on the 14th of June (fig. 2) and only 5 days later at the *Sempervivum tectorum* samples, without any difference based on substrates variants.

The flowering start for la *Sedum spurium* 'Fuldaglut', happened 6 days later, continuing until 20th September (tab. 1).

Table 1

Phenological and technological data for the *Sedum spurium* 'Fuldaglut' and *Sempervivum tectorum* plants

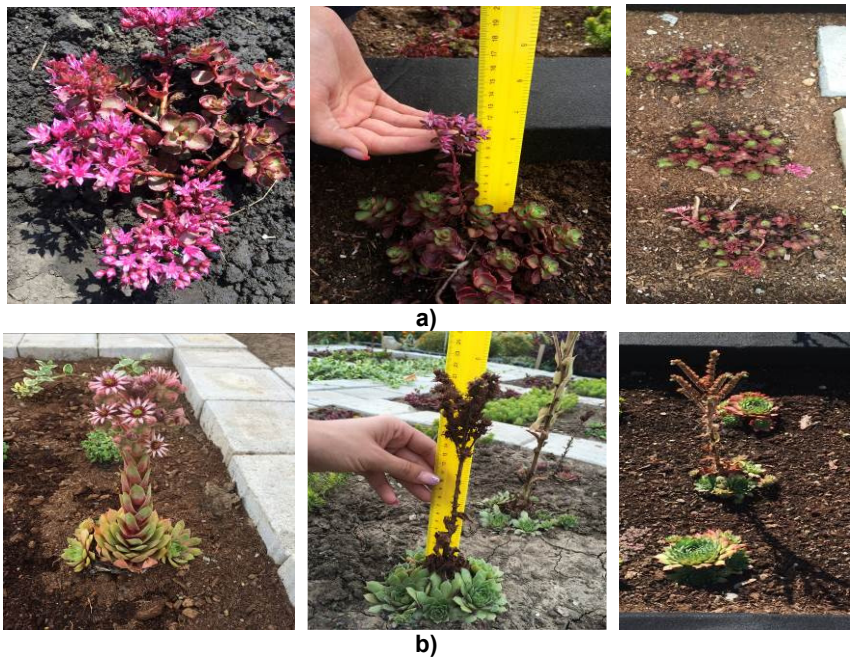
Species	Planted	Occurance of buds	Flowering		
			Start	Full	End
Sedum spurium 'Fuldaglut'	25.05.2014	14.06.2014	20.06.2014	1.07.2014	20.08.2014
Sempervivum tectorum	20.05.2014	25.05.2013	30.05.2013	28.06.2013	3.08.2013

The two species assured blossoming for approx. 3 months (fig. 2), starting with *Sempervivum tectorum* (late May - early June) and ending with *Sedum spurium* 'Fuldaglut' (until almost the end of August).

Species/month	May			June			July			August		
Sedum spurium 'Fuldaglut'												
Sempervivum tectorum												

Fig. 2 - Flowering period of *Sedum spurium* 'Fuldaglut' and *Sempervivum tectorum*

The biometric measurements (fig. 3) performed during the vegetation period (from late May to early September), to the specimens belonging to the species under study highlighted the fact that the plants had a normal development specific to each gender.



a)

b)

Fig. 3 - Flowering plants: a) *Sedum spurium* 'Fuldaglut'; b) *Sempervivum tectorum*

The *Sedum spurium* 'Fuldaglut' results concerning the bush diameter recorded values between 18,0 to 19,7 cm, and the differences from the average of the variants was not statistical relevant.

Table 2 presents the results on the number of tillers per plant, length of the floriferous stems, number of flowers per plant and number of flowers in an inflorescence at *Sedum spurium* 'Fuldaglut'. In regard to the number of tillers/plant, by comparing the values obtained for each variant to the average of the variants, we found that the highest values and significant positive differences from the average were recorded for V_4 and V_6 versions; above average values were recorded for V_1 and V_3 variants, but the differences were not significant. Weaker and fewer tiller growth was recorded for V_2 and V_5 (grown on a substrate made of a mixture of Novobalt peat, coconut fiber, composted bark and alginate), where the difference from the average was distinctly significant negative. A similar trend was registered also for the

other characters (number and length floriferous stems, number of flowers/inflorescence), meaning that the worse results, below average, have been the variants V_2 and V_5. It stands out to be more obvious (very significant) differences in the number of formed floriferous rods. Regarding the number of flowers/inflorescence, the richest flowering plants have grown on the substrate made from blonde format peat, brown peat, sand and forest soil placed in the field (V_6).

Table 2

Results regarding plant morphological characteristics of *Sedum spurium* 'Fuldaglut'

Var.	No. tillers/plant		Floriferous stems length (cm)		No. floriferous stems / plant		No. flowers/ inflorescence	
	Abs.	±d	Abs.	±d	Abs.	±d	Abs.	±d
V_1	28.0	+0.9	6.2	+0.2	2.7	0	11.0	+0.1
V_2	24.5	-2.6 ^{00}	4.7	-1.3 ^{00}	1.8	-0.9 ^{000}	9.0	-1.9 ^{0}
V_3	28.0	+0.9	7.0	+1.0 ^{x}	3.5	+0.8 ^{xxx}	12.0	+1.1
V_4	29.0	+1.9 ^{x}	6.0	0	3.0	+0.3 ^{x}	11.0	+0.1
V_5	24.7	-2.4 ^{00}	5.0	-1.0 ^{0}	1.5	-1.2 ^{000}	8.3	-2.6 ^{00}
V_6	28.7	+1.6 ^{x}	7.3	+1.3 ^{xx}	3.4	+0.7 ^{xxx}	14.0	+3.1 ^{xxx}
Average	27.1	-	6.0	-	2.7	-	10.9	-
LSD 5%		1,4		0.9		0.3		1.4
LSD 1%		1,9		1.2		0.4		2.0
LSD 0,1%		2,8		1.8		0.6		2.9

For *Sempervivum tectorum* plants the results obtained from measurements done on the bush diameter were similar, and the differences were insignificant from the average, with values between 9.7 and 11.7 cm. Similar results, with insignificant differences from the average, have been obtained for floriferous stems height (where the values were between 8.0 and 9.7 cm), and the number of flowers in inflorescence (values between 9.7 and 12 cm).

Table 3 presents the results of measurements performed at *Sempervivum tectorum* just for the characters that yielded statistically differences (no. rosette/plants also no. leaves/rosette).

Table 3

Results regarding the morphological character of *Sempervivum tectorum* plants

Var.	No. rosette/plants		No. leaves/rosette	
	Abs.	±d	Abs.	±d
V_1	7.3	+0.2	30.7	-0.2
V_2	6.3	-0.8 ^{0}	26.7	-4.2 ^{000}
V_3	7.3	+0.2	33.8	+2.9 ^{xxx}
V_4	7.6	+0.5	31.3	+0.4
V_5	6.5	-0.6	29.0	-1.9 ^{0}
V_6	7.8	+0.7	34.0	+3.1 ^{xxx}
Average	7.1	-	30.9	-
LSD 5%		0.7		1.4
LSD 1%		1.0		2.0
LSD 0,1%		1.5		2.9

Greater differences between variants occurred in the number of leaves in rosette. Both crops, from the roof and at the field, the substrate a_3, in variants V_3 and V_6, had a positive influence, leading to the formation of a larger number of leaves, with significant differences from the average. On the contrary, the substrate a_2 led to a poorer development of the plants, especially on crops located on the roof (V_2).

CONCLUSIONS

1. Composition of substrate used to grow *Sedum spurium* 'Fuldaglut' and *Sempervivum tectorum* placed both on the roof or in the field, influences plant growth and development.

2. Both species recorded positive influence from substrate a_3, made up of blond peat (40%), brown peat (30%), sand (10%) and forest soil (20%); less favorable was a_2 substrate, consisting of peat Novobalt (43%), coconut fiber (30%), composted bark (23%), alginates (4%).

3. Plant response to the type of substrate was more obvious at *Sedum spurium* 'Fuldaglut'

4. Regardless the type of substrate, the cultivated plants on the roof had weaker growth and lower flowering capacity than those situated at ground level.

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