

Prospects for year-round cuttings of *Sedum morganianum* E. Walther for further use in interior landscaping

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Abstract. The *Sedum* L. genus is extensively represented in the Tolstiaceae family, (more than 600 species). Diversity in the market of species makes genus *Sedums* popular and promising in landscape gardening, urban and interior gardening. In indoor floriculture, there are more than 20 species of sedums, which are herbaceous, succulent semi-shrubs that can be either single or perennials. Decorative effect is given to the plant primarily by decorative leaves, their structure and coloring. *Sedum* are in demand in modern interior landscaping.

1 Introduction

The aim of the work was to evaluate the prospects of year-round cuttings of *Sedum morganianum* E. Walther for further use in interior landscaping. The objectives were: to conduct morphological and phenological observations; to analyze rooting and shoot formation ability of plants in the autumn-winter period; to evaluate the effect of the term of cuttings on growth dynamics; to evaluate the influence of factors (light, substrate, growth regulator) on the growth dynamics of *Sedum morganianum* E. Walther

Research conditions. Studies were carried out on the basis of the Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, in the winter glazed greenhouse in the production department of the Botanical Garden named after S. I. Rostovtsev at the Timiryazev Agricultural Academy in a glass greenhouse in 2018-2021. Sodium glass lamps, Dna3 / Reflux 400 type, 400 W power, E40 socket, were used for lighting in the greenhouse.

The object of the study is leaf cuttings of *Sedum morganianum* E. Walther.

2 Methods of research

Summer rooting of leaf cuttings of *Sedum morganianum* E. Walther. 2018. Study of the effect of growth regulator (EPIN) and term of cuttings.

Study of the effect of growth regulator (EPIN), substrate, and timing of cuttings on the rooting of leaf cuttings of *Sedum morganianum* E. Walther in fall 2020.

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A study of the effects of growth regulators and timing of cuttings of the greenhouse species *Sedum morganianum* E. Walther was conducted in 2018-2020.

The effects of growth regulators and light were studied in May 2021. Summer rooting of leaf cuttings of *Sedum morganianum* E. Walther. were conducted in 7*7 cassettes. Autumn rooting of leaf cuttings of *Sedum morganianum* E. Walther. were carried out in 4 substrates, the control variant - peat, in trays 40*15 cm in size.

Composition of substrates by mass fraction:

- Peat + sand + perlite + keramsite + wood charcoal 4:3:1:1:1
- Peat + sand + perlite + keramsite 4:3:1:1
- Coconut + sand + perlite + keramsite + charcoal 4:3:1:1
- Coconut + sand + perlite + keramsite 4:3:1:1
- Peat - control variant.

Table 1. Schematic of the experiment.

		Peat + sand + perlite + keramsite + wood charcoal	Peat + sand + perlite + keramsite	Coconut + sand + perlite + keramsite + charcoal	Coconut + sand + perlite + keramsite	Peat	Total	
Summer, 2018	without a growth regulator	-	-	-	-	30	60	360
	with a growth regulator	-	-	-	-	30		
Autumn, 2018	without a growth regulator	30	30	30	30	30	300	
	with a growth regulator	30	30	30	30	30		

To study the effect of cuttings term on the rooting process of sedum leaf cuttings and growth dynamics, the experiment was conducted in 2 stages: spring-summer cuttings term (May 31) in 2018; fall cuttings term - October 2020.

3 Results and discussion

In summer 2018, the beginning of rooting in most of the cuttings was observed after 5-5.5 weeks. Active growth of vegetative part of plants began 3 weeks after the beginning of rooting. Shoots of commercial appearance and size (5-10 cm) were formed 15-16 weeks after the experiment.

In the autumn period, the beginning of rooting also came in 5-5.5 weeks, and active growth of the vegetative part of plants - 8 weeks after planting.

Table 2. Calendar dates of plant development of *Sedum morganianum* E. Walther.

Year of research	Starting date of experience	Date of rooting initiation	Number of weeks before the beginning of rooting cuttings	Beginning of active vegetative mass growth	Beginning of active vegetative mass growth	Period of young plants commercial appearance
2018	31.05.2018	03.07.2018	5-5.5 weeks	From 25.07.2018	From the eighth week	10-12 month
2020	03.10.2020	09.11.2020	5-5.5 weeks	From 30.11.2020	From the eighth week	Did not arrive

Shoots with a well-formed root system, (height of about 20 cm) were formed in 10-12 months (experience of summer cuttings in 2018). In autumn cuttings of 2020, the growth of the root system and lateral shoots of cuttings is weak.

Table 3. Leaf rosette density rating scale.

Number of leaves in the rosette, pcs.	Characteristics	Score
0	without rosette	0
1-3	not dense	1
4-6	dense	2
7-9	very dense	3

A one-factor analysis of variance was carried out to assess the effect of cuttings term on rooting process and shoot formation ability.

The results of the analysis of variance showed that the term of rooting has no effect on rooting, so the process of planting material production in greenhouse conditions does not depend on the time of year. However, it should be taken into account that the percentage of rooting in the autumn-winter period is 10% less.

Table 4. Percentage of rooting of *Sedum morganianum* E. Walther on different substrates, with and without growth regulator treatment at different times.

Term of cuttings	Untreated/ treated	Percentage of rooting					Average percentage of rooting	Average percentage of rooting
		Peat + sand + perlite + keramsite + wood charcoal	Peat + sand + perlite + keramsite	Coconut + sand + perlite + keramsite + charcoal	Coconut + sand + perlite + keramsite	Peat		
Autumn, 2020	Water	57	47	47	65	57	55	57
	EPIN solution	63	50	57	65	63		
Summer, 2019	Water	65	60	57	72	65	64	68
	EPIN solution	70	65	70	83	72		

When studying the effect of substrates and growth regulator (EPIN) on rooting and ornamental qualities of the peeler, the rooting rate of cuttings was found to vary from 47 to 83%. On average, 10% more cuttings take root in summer than in autumn. This is due to the conditions of light and air temperature. However, with a growth regulator treatment 60% of

cuttings can be rooted in autumn whereas in summer 60% of the cuttings take roots without EPINOM treatment. Similarly, with the treatment, it is possible to achieve 72% of cuttings rooting in summer.

A two-factor analysis of variance was performed to evaluate the effect of substrates and growth regulator on rooting process and shoot formation capacity. The data were taken 2 months after planting.

According to the results of two-factor analysis of variance of 8-week cuttings, the influence of both factors was established. The interaction of factors has no effect on the length of the root system. The influence of substrate composition is 5% of the total variation, factor-treatment with a growth regulator, 10% of the total variation, and random factors are 85%.

Roots of cuttings treated with EPIN solution are on average 2 times longer than those of untreated cuttings. The greatest growth of the root system, observed on the substrate number 4 - coconut + sand + perlite + keramsite, and on average is 0.5 cm, the smallest growth on the substrate number 2 - peat + sand + perlite + keramsite. In general, rooting was better on substrates that included coconut.

When evaluating the effect of factors on the height of the above-ground part of plants, it was found that the interaction of factors is insignificant, the influence of substrate composition is 12% of the total variation, factor - growth regulator treatment - 9% of the total variation, random factors - 78%.

Table 5. Results of two-factor analysis of variability of root system growth on *Sedum morganianum* E. Walther plants depending on substrate and growth regulator treatment in 8 weeks after planting.

Source of variation	SS	df	ms	σ^2	F	F ₀₅	F ₀₁	p ⁱⁿ	HCP ₀₅
Total	64.74	299	-	0.23	-	-	-	100	-
Factor A (substrate)	3.47	4	0.87	0.01	4.52	2.40	3.38	5	0.238
Factor B (regulator)	3.72	1	3.72	0.02	19.35	3.87	6.72	10	0.136
AB interaction	1.81	4	0.45	-	2.35	2.40	3.38	-	-
Random	55.74	290	0.19	0.19	-	-	-	85	-

The reliable influence of factors on growth of above-ground part of plants was established. The greatest share of influence has random factors, the share of influence of the factor substrate is 12%, treatment with a growth regulator - 9%. The greatest growth of vegetative mass, observed on substrate number 5 - peat, without the addition of other components, and on average is 3 mm, the smallest growth on the substrate peat + sand + perlite + keramsite + charcoal.

Table 6. Results of two-factor analysis of variability of aboveground growth on *Sedum morganianum* E. Walther as a function of substrate and growth regulator treatment.

Source of variation	SS	df	ms	σ^2	F	F ₀₅	F ₀₁	p ⁱⁿ	HCP ₀₅
Total	8.86	299	-	0.032	-	-	-	100	-
Factor A (substrate)	1.05	4	0.26	0.004	10.44	2.40	3.38	12	0.086
Factor B (regulator)	0.47	1	0.47	0.003	18.83	3.87	6.72	9	0.049
AB interaction	0.07	4	0.02	-	0.68	2.40	3.38	-	-
Random factors	7.27	290	0.03	0.025	-	-	-	78	-

4 Influence of factors on leaf rosette density

When treated with a growth regulator, the density of the rosette is noticeably higher. The number of plants with denser rosette in the sample with the regulator treatment is 2-2.5 times higher. Accordingly, EPIN has a favorable effect on rosette density; the plant looks most decorative in this case.

On different substrates the density of the leaf rosette hardly differs, so this factor has no effect on this trait.

5 Conclusion

Cuttings are rooted for 8 - 10 weeks. The beginning of their rooting process was noted in 5 weeks, active growth of roots and vegetative mass - in 8 weeks after laying the experiment. The process of production of planting material *Sedum morganianum* E.Walther in greenhouse conditions does not depend on the time of year, so cuttings of mother plants can be rooted all year round, including the autumn-winter period. For rooting and cultivation of *Sedum morganianum* E.Walther, the best results were obtained using substrate coconut + sand + perlite + keramsite (4:3:1:1) and treatment with EPIN solution. Under conditions of insufficient light, the best results were obtained using the preparation REGGI.

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