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Vegetative Propagation Methods of Leonurus Cardiaca L. and L. Turkestanicus V.I. Krecz. & Kuprian

Bahodirova Gavharkhon Ikrom qizi
PhD student, Tashkent State Agrarian University, Tashkent

Maxkamov Trobjon Xusanboyevich
Professor, DSc in Biology, Tashkent State Agrarian University, Tashkent

Raxmatov Abdurashid Abdijabborovich
Head of the Department of Ornamental Horticulture, Floriculture, and Landscape Design, PhD in Biology, Institute of Horticulture, Viticulture, and Winemaking named after Academician M. Mirzayev

Qurbonova Sarvinoz Anvar qizi
PhD student, Institute of Horticulture, Viticulture, and Winemaking named after Academician M. Mirzayev

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Annotation: The botanical description, systematics, distribution range, bioecology, introduction, ontogenesis, phenology, phytochemistry, applications, methods of using raw materials, pharmacological effects, cultivation agrotechnology, and productivity of species of the genus Leonurus (motherwort) are widely reported in the scientific works of many researchers around the world. Sufficient information is also available on the generative propagation of Leonurus species by seeds. However, there is a lack of scientific studies on the vegetative propagation of these species. This article presents the results of research on the propagation of common and turkestan motherwort by dividing the clump and by rhizomes.

Keywords: vegetative propagation, clump division, rhizome, substrate types, sprouting.

Introduction

In natural conditions, reproduction occurs in plants, increasing the number of new individuals, and it is also directed towards expanding the territory they occupy, i.e., the dispersal of plants. However, when parts of a single plant are separated during the process of clump division, these parts remain together, and their formation does not lead to a significant expansion of the area occupied by the species.

It is known that particulation (dividing into small pieces) is observed in clump-forming plants. As a result of the premature drying of the main root or parts of the root system, they separate from the maternal clump and form independent fragments called particulae. Each particula consists of one or several aerial stems along with the corresponding root parts, and it possesses the ability to survive independently.

The separation of particulae usually occurs rarely or not at all. If it does occur, it is most often observed in the softest soils. However, even when such movement takes place, it is usually very weak. This phenomenon is caused by the pulling of lateral roots and the activity of adventitious roots. The presence of hidden buds at the base of the branches is also important, as they subsequently give rise to new shoots. Therefore, the process of particulation ensures the formation of independent plants [1].

Numerous scientific studies have been conducted on the propagation of the *Leonurus* species. In particular, according to the data of A.A. Terekhin and V.V. Vandishev [2], at the Middle Volga experimental station of VILAR, the “Samarskiy” variety of *Leonurus cardiaca* was developed and regionalized. This species is grown on farms specialized in cultivation of medicinal plants. This species is typically cultivated in the same location for 3–4 years.

The clumps of *Leonurus quinquelobatus* are planted in straight rows and divided into small groups (bouquets). The plants within each group are placed close to each other (20–30 cm), while a space of 30–40 cm is left between successive groups. This method is applied to ensure better plant growth and to facilitate ease of cultivation [3].

In Uzbekistan, the introduction of *Leonurus* species was carried out by researchers Y.M. Murdakhayev (1992) and B.Y. Tukhtayev (2009). In particular, Y.M. Murdakhayev conducted scientific studies on the species: *L. turkestanicus*, *L. cardiaca*, *L. tataricus*, and *L. quinquelobatus* in the Botanical Garden named after Rusanov in 1985.

B.Y. Tukhtaev (2009) introduced *Leonurus cardiaca* L. in saline soils in Bukhara and Mirzachol. It was propogated by seeds and seedlings.

Another representative of the genus, turkestan motherwort (*Leonurus turkestanicus*), is propagated by seeds and seedlings. The cultivation of turkestan motherwort is recommended in the districts of Asaka, Izboskan, and Kurgantepa of Andijan region; Bakhmal and Zomin districts of Jizzakh region; Pop and Kasansay districts of Namangan region; Kitab and Yakkabog districts of Kashkadarya region; Boysun and Sariosiyo districts of Surkhandarya region; as well as Bostanlyk and Akhangaran districts of Tashkent region (Sanoyev et al., 2023).

According to O. Ahmedov et al. (2018), motherwort is propagated with row spacing of 60–70 cm and plant spacing of 15–20 cm, leaving 1–2 plants per nest.

Leonurus cardiaca L. (common motherwort) and *Leonurus turkestanicus* V.I.Krecz. & Kuprian. (turkestan motherwort) also belong to the group of plants that form clumps and undergo the process of particulation.

The stem of the plant is quadrangular, with a hollow structure, which prevents propagation

through stem cuttings.

In our research, the effect of different substrates on propagation was determined during artificial particulation-i.e., propagation by dividing plant clumps and rhizome cuttings.

Research object and methods

Two species belonging to the *Lamiaceae* family, *Leonurus cardiaca* L. (common motherwort) and *Leonurus turkestanicus* V.I. Krecz. & Kuprian. (turkestan motherwort), were selected as research objects. Research was carried out to determine the effects of organic fertilizers on the vegetative propagation of turkestan and common motherwort.

In autumn, the cuttings were prepared from 2-year-old motherwort plants in the field using two methods: division of clumps and cutting of rhizomes. Cuttings obtained through clump division possessed roots, whereas those prepared from rhizomes did not contain roots.

The cuttings were grown in special polyethylene cups using four different substrates to determine sprouting rate in different soil composition. The substrates are given below:

1. Control (soil 100%);

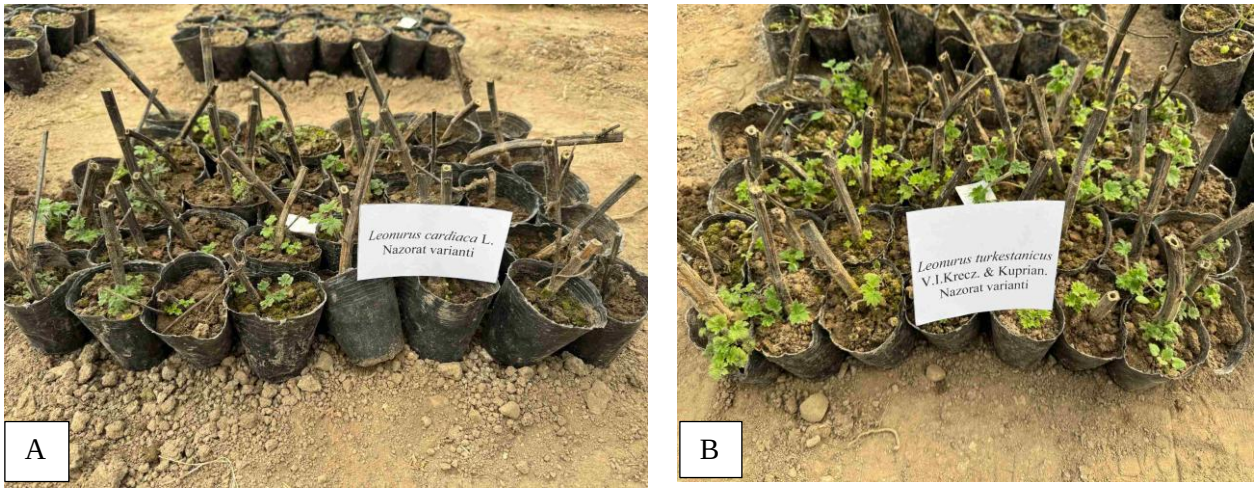
2. Soil + biohumus (70:30 ratio);

3. Soil + decomposed cattle manure (70:30 ratio);

4. Soil + neutralized peat (70:30 ratio).

Results and their analysis.

Propagation by division of clumps. In autumn, clumps of *Leonurus* plants were divided into 18–20 cm long segments together with the stems, and propagated in four substrate variances. Each plant was divided into as many segments as the number of main stems it had produced. To ensure that the vegetation in spring did not delay, the clumps were divided in autumn and planted into the substrates given below (Figure 1).



Leonurus cardiaca *Leonurus turkestanicus*

Figure 1. Propagation of *Leonurus* species by clump division in different substrates: A and B – control; C and D – biohumus; E and F – decomposed cattle manure; G and H – neutralized peat variances.

After approximately 1–1,5 months, the motherwort clumps sprouted. According to the results, the sprouting rate of the cuttings varied depending on the substrate. In both common motherwort (*Leonurus cardiaca*) and turkestan motherwort (*Leonurus turkestanicus*), the buds located around the root were activated and little white shoots started to appear. Yellow leaves formed on these shoots turned green over time. (Figure 2).

Leonurus cardiaca *Leonurus turkestanicus*

Figure 2. Propagation of *Leonurus* plants by clump division.

In general, for both species the lowest values were recorded under control conditions (ordinary soil). For common motherwort (*Leonurus cardiaca*), it was 83.83 ± 0.7%, while for turkestan motherwort (*Leonurus turkestanicus*), it was 87.50 ± 0.3%. The outcome can be explained by insufficient supply of nutrients and lack of siutable physio-chemical environment for the cuttings under the control variance (Table 1).

Table 1. Sprouting rate of *Leonurus* clumps in different substrates, %

Variances (variations)	*L.cardiaca* L.	*L. turkestanicus*
Control	83.83±0.7	87.50±0.3
Biohumus	87.67±0.8	91.00±0.6
Decomposed manure	85.83±0.4	88.67±0.9
Neutralized peat	89.67±0.3	93.50±0.7

The sprouting of cuttings was considerably higher in substrates rich in organic matter- biohumus and decomposed manure. 87.67 ± 0.8% of common motherwort's cuttings sprouted, whereas the figure for turkestan motherwort (*Leonurus turkestanicus*) reached 91.00 ± 0.6% in biohumus variance. In decomposed manure, these values were 85.83 ± 0.4% and 88.67 ± 0.9%, respectively. This indicates that these substrates provided more nutrients, higher microbiological activity, and improved moisture retention capacity.

The best results were recorded in neutralized peat variance. The sprouting rate of common motherwort cuttings reached 89.67 ± 0.3 %, whilst in turkestan motherwort it was slightly higher at 93.50 ± 0.7 %. Soft structure and high aeration capacity of neutralized peat created favorable conditions for root formation and growth processes in the cuttings.

Based on the obtained results, all the applied substrates provided an opportunity to achieve higher sprouting rates compared to the control. At the same time, in each substrate, turkestan motherwort exhibited higher values than common motherwort.

In conclusion, the applied substrates influenced the sprouting rate of cuttings, and among them, neutralized peat can be recommended as the most effective substrate.

Propagation by rhizome division. In late autumn, the rhizomes of motherwort plants were cut: shoots of 2–3 cm in length formed during autumn were cut, trimmed to remove leaves, and prepared as rhizome cuttings. Subsequently, they were grown in four substrate variances.

Overall, in all substrates, the cuttings of turkestan motherwort indicated higher growing rate compared to those of common motherwort. Moreover, the sprouting ability varied across the four different substrates (Figure 3).

Leonurus cardiaca *Leonurus turkestanicus*

Figure 3. Propagation of *Leonurus* plants by rhizomes.

When comparing the variants, the control group (100 % of soil) showed the lowest values. In this substrate, the sprouting rate of common motherwort (*Leonurus cardiaca*) cuttings was 26.00 ± 0.8 %, while that of turkestan motherwort (*Leonurus turkestanicus*) was slightly higher, 30.50 ± 1.04 %. These low values are explained by the lack of sufficient reserves of nutrients and moisture in the ordinary soil (Table 2).

In the biohumus substrate, the sprouting rate was considerably higher in comparison with the control. For common motherwort, the number was 30.67 ± 1.2%, whereas for turkestan motherwort it was 35.33 ± 0.9%. This can be attributed to the existence of organic matter and beneficial microorganisms in the substrate, which enhanced root formation activity in the cuttings.

Table 2. Sprouting rate of motherwort rhizomes in different substrates, %

Variances (variations)	Common motherwort	Turkestan motherwort
Control	26.00±0.8	30.50±1.04
Biohumus	30.67±1.2	35.33±0.9
Decomposed manure	33.50±1.5	37.67±1.4
Neutralized peat	35.67±1.01	39.83±1.3

According to the table, the growth rate of common and turkestan motherwort rhizomes in decomposed manure stated at 33.50 ± 1.5% and 37.67 ± 1.4%, respectively. The high content of organic matter and microelements in the decomposed manure likely supported the root formation process.

The highest percentage was observed in the neutralized peat substrate. In this substrate, the

number for motherwort cuttings reached 35.67 ± 1.01%, while that of turkestan motherwort cuttings accounted for 39.83 ± 1.3%. It might due to favorable structure of neutralized peat, improved aeration, optimal moisture retention capacity, and neutral pH value created the most suitable environment for rooting of the cuttings.

In conclusion, the neutralized peat proved to be the most effective substrate for cuttings prepared from rhizomes. Although positive results were recorded for improving the germination of cuttings in other substrates, the process was significantly more efficient in neutralized peat. Moreover, in every substrate, turkestan motherwort showed slightly higher potential for vegetative propagation compared to common motherwort.

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