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Perspective for Vegetative Reproduction of *Eleaagnus macrophylla* Thunb Species and *Shepherdia canadensis* (L.) Nutt

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Abstract

Elaeagnaceae Juss. belongs to the family *Elaeagnus* L. and *Shepherdia* Nutt. This study aims at the significance and vegetative reproduction of species of the family (*Elaeagnus macrophylla* Thunb. and *Shepherdia canadensis* (L.) Nutt.) in the national economy. The trials were carried out in the experimental site of SamSU's Botanic Garden, which is named after Sharof Rashidov. The study's findings are based on the results obtained by planting cuttings of *S. canadensis* and *E. macrophylla* species of varying sizes and durations, as well as the cuttings' roots and the impacts of growth chemicals.

Keywords

Elaeagnaceae, Elaeagnus, Shepherdia, Vegetative Reproduction, Attractiveness, Bioactive Compound, Bush, and Cuttings

1. Introduction

In recent years, population growth has led to an increase in demand for medicinal essential oils and nutritious plants. Based on botanical research, it serves to determine the composition of medicinal plants in regions, introduce them into production, and meet the needs of the population for medicinal and food products. Accordingly, it is important to conduct studies on three genera and about 55 species of the (*Elaeagnaceae* Juss.), which are widespread in Europe, Asia, and North America and have great economic importance [1].

Shepherdia Nutt. is a plant that can be found in North America, from Alaska to the northern part of Mexico. *Elaeagnus canadensis* (L.) Nutt. and *Elaeagnus macrophylla* Thunb are two evergreen shrubs that grow in lowland thickets in Japan and Korea, particularly near the coast. These shrubs have aesthetic appeal and potential medicinal benefits, making them of interest to people [2].

Shepherdia canadensis (L.) Nutt. is a shrub that grows up to 2.5 m tall. Its shoots are covered in brown scales and have no spines. The leaves are egg-shaped, measuring 2 - 5 centimeters in length and 0.5 - 1 cm wide, with a rounded or heart-shaped base. The upper surface of the leaf is green and almost completely bare, while the underside is silvery. The flowers are yellowish in color and about 4 mm in diameter. The fruit is an edible berry known as sphalerocarpium. It is oval in shape, between 4 and 6 mm long, and has a yellowish-red color. Flowers appear between April and May, and fruits ripen between June and July [3].

In 1759, gardeners in the USA and Canada became interested in *S. canadensis* and began to cultivate it. The Russian scientist I. V. Michurin came to the conclusion that this plant was very promising for Russian gardens, and thanks to him, large-fruit varieties have been produced to date [4].

Shepherdia Nutt. was named after John Shepard, the business manager of the Liverpool Botanical Garden in the 18th century (J. Shepard 1764 - 1836). But before that, shepherdia was known to the Indians on the American continent. They used it to process and store bison meat for a long time [4].

Since the 20th century, with the beginning of serious interest in *Sh. canadensis* from a practical point of view, the inhabitants of Canada began to establish plantations and started breeding varieties of large-fruit Shepherd's [5].

In addition to the scientific name, Shepherdia has many other local names: American sea buckthorn, soapberry, bison berry, rabbitberry. And here it is often called red sea buckthorn. The residents of the USA like to decorate buildings with shepherds' bushes. It is widely used in landscape design [2].

The Shepherd's fruit contains a large amount of vitamin C, A, P, E, carotene, pectin, sucrose, tannins, and organic acids. Thanks to the presence of ascorbic acid, this fruit is an excellent immune modulator that helps fight colds and infections, eliminates depression, and rejuvenates the skin. Vitamin E in this fruit improves eyesight and maintains a healthy vascular system. Carotene cleanses the body of harmful substances and protects against harmful bacteria [3].

Decoctions from fruits and leaves of the shepherd's apple are useful for use in the autumn-winter period when influenza and acute infections begin to spread.

The largest genus in the Loch family (*Elaeagnaceae*)—Loch (*Elaeagnus* L.) has about 50 species. Species *Elaeagnus macrophylla* was identified by Swedish botanist and naturalist Carl Peter Thunberg in 1784 [5].

Elaeagnus macrophylla Thunb is an extensive evergreen shrub that grows up to 4 meters tall and 8 m wide. Its leaves are round and shiny, turning silvery when young. In autumn, the flowers are cream-colored, and red fruits grow in spring instead. *Elaeagnus* × *submacrophylla*, formerly known as *Elaeagnu* × *ebbingei* is a hybrid of the large-leaved sucker (*Elaeagnus macrophylla*) and the prickly sucker (*Elaeagnus pungens*). This hybrid and its variants are used in gardens as ornamental plants [6].

E. macrophylla Thunb. has several useful properties, ranging from decorative to medicinal. The plant is often grown as an ornamental shrub or small tree due to its attractive silvery foliage and fragrant flowers. These features make it popular in gardens, especially for use as hedges and for preventing soil erosion [6].

The fruits of this plant are utilized in Chinese medicine for the treatment of cough, sore throat, and other respiratory illnesses. Furthermore, this plant enhances soil fertility by converting atmospheric nitrogen into a form usable by plants.

Fruits are a significant source of vitamins A, C, and E, as well as flavonoids and other bioactive compounds. Additionally, an important aspect that is unique to fruits is the presence of fatty acids, which have the potential to prevent the formation of cancerous cells by inhibiting tumor growth [6].

2. The Object and Methodology of the Study

Common in the temperate latitudes of the globe is the family *Elaeagnaceae* Juss., which includes the following genera: *Shepherdia* Nutt. and *Elaeagnus* L. including *Shepherdia canadensis* (L.) Nutt. and *Elaeagnus macrophylla* Thunb., which were taken as objects for research. During the studies, methods and textbooks by S. Shalit and F. Mcmillan Brose were used.

This study was conducted through a comparative analysis of rooting of cuttings in the field, at the experimental site of the Sharof Rashidov Botanical Garden, Samara State University.

3. The Work Carried Out

S. canadensis and *E. macrophylla* can be propagated by both cuttings and seeds. The main reason for this is that vegetative reproduction is more convenient than generative reproduction (by seeds), as it requires less work and allows all maternal characteristics to be preserved in the offspring. This also allows plants to enter fruiting faster, as a result of vegetative propagation (cuttings). Cuttings are one of the methods of vegetative plant reproduction and they are widely used in fruit, ornamental and some medicinal, technical, and other plants cultivation. Cuttings rely on the ability of parts of stems, roots, and leaves to regenerate missing organs under appropriate conditions, and to maintain vital activity when separated from their parent plant. When propagated by cuttings, the young generation separates from the mother plant and develops completely independently. That is, there is no connection with the parent plant. However, the rooting of the cuttings depends on the supply of nutrients accumulated in the stems during the period when they are united with the parent. These substances are essential in the early stages, before the development of new roots and leaves in the cuttings.

Healthy specimens of the species *Sh. canadensis* and *E. macrophylla* were selected and cuttings were prepared from them. When preparing the cuttings, attention was paid to their size, age, harvest time, and the structure of the planting soil. The cuttings for the first experiment were taken at the end of November and planted, while the cuttings for the second experiment were planted in early spring, at the end of February, before the plants awoke. In both experiments, the cuttings were divided into five different sizes: 10 - 15 centimeters, 15 - 20 centimeters, 20 - 25 centimeters 25 - 30 centimeters and 30 - 35 centimetres. Annual branches were 3-5 millimeters in width, biennial branches were 6-9 millimeters wide, and triennial branches 10 -14 millimeters wide. After planting the stem cuttings they were watered, and the soil around them was loosened to promote aeration. Additionally, to accelerate root growth, the cutters were soaked in a solution of rooting hormone for 2 hours before planting in five different substrates: black sand, quartz sand peat vermicompost and turf. After planting the cuttings, they are immediately watered and treated to ensure that the soil is moist.

4. The Results Obtained and Their Analysis

Table 1. Results of rooting cuttings of *Sh. canadensis* and *E. macrophylla*, depending on planting method, time, and substrate.

The age of the branches is the age of the cutting	Cuttings size, cm	The term of planting cuttings and their maturity							
		In spring	planted	ingrained		In autumn	planted	ingrained	
			pieces	pieces	%		pieces	pieces	%
Annual cuttings	10 - 15		20	18	90		20	7	35
	15 - 20		20	19	95		20	19	95
	20 - 25		20	18	90		20	16	80
	25 - 30		20	16	80		20	11	55
	30 - 35		20	13	65		20	8	40
Two-year-old cuttings	10 - 15		20	16	80		20	8	40
	15 - 20		20	17	85		20	10	50
	20 - 25		20	16	80		20	9	45
	25 - 30		20	13	65		20	8	40
	30 - 35		20	11	55		20	5	25
Three-year-old cuttings	10 - 15		20	10	50		20	6	30
	15 - 20		20	12	60		20	7	35
	20 - 25		20	9	45		20	6	30
	25 - 30		20	7	35		20	5	25
	30 - 35		20	5	25		20	5	25

The results of the experiment showed that of 300 cuttings, 200 took root (67%), out of which 130 (43%) were planted in autumn. During the experiment, annual shoots were 3 - 5 cm wide and 15 - 25 long, biennial branches were 5 - 9 cm wide and up to 20 cm long, and triennial branches were between 10 and 14 mm wide and between 20 - 30 cm long. The annual cuttings planted in the autumn took root more quickly than the spring cuttings and had a higher growth rate at the end of the season compared to those planted in spring. Depending on their age, the survival rate for annual and biennial cuttings was greater than that for perennial ones. If annual cuttings were planted in spring rather than autumn, they had a better chance of surviving and 84% took root. In two-year-old cuttings, this figure was 73%. Based on our experience, 44% of three-year-olds showed that cuttings planted in black sand and peat provided with good external conditions have a positive effect on root growth and its further development. Black sand cuttings reached 9.7 cm by the end of the growing season, with an average decadal growth rate of 0.3 cm. Peat cuttings grew to 5.7 cm at the end of growing season, averaging 0.2 cm per decade, and were observed in 44% of cuttings. The results are presented in **Table 1**.

Our experience has shown that cuttings planted in black sand and peat, provided with good conditions, take root faster. Cuttings in black sand reach 9.7 cm at the end of the growing season, with an average decadal growth rate of 0.3 cm. The cuttings in peat reach 5.7 at the end, with a decadal average growth rate of about 0.2 cm (**Figure 1**).

Figure 1. The process of planting by cuttings of *Shepherdia canadensis* (L.) Nutt. and *Elaeagnus macrophylla* Thunb.

The results showed that the lowest rate was obtained from three-year-old branches planted in autumn and amounted to 29%. This is mainly due to the poor callus-forming ability of tissues in lignified three-year-old cuttings.

In addition, the effect of growth agents, root growth stimulants (rhizomes), on cuttings has been studied. To do this, 200 pieces of cuttings were harvested in early spring and before planting, the first 50 pieces were kept in 0.001% cornavin for 2 hours and the second 50 in a 0.1% water solution. The remaining 100 were planted without any treatment. The results are presented in **Table 2**.

As a result of the research, it was found that treated cuttings developed earlier than untreated ones, and their number was 60% of the total weight of those treated with a 0.01% kornevin solution, and 54% of those treated by a 0,001% kornevin. The increase in the number of untreated cuttings was 50%. It has been established that substances similar to kornevin affect root formation and further development of Triennial branches.

Table 2. The effect of stimulants on cuttings of *E. macrophylla* and *S. canadensis*.

Types of experiments	Number of cuttings (pieces)		Growth, %
	planted	ingrained	
Cuttings aged in 0.01% solution	50	30	60.0
Cuttings aged in 0.001% solution	50	27	54.0
Unprocessed cuttings	100	50	50.0

5. Conclusion

The result of the experiment showed that *E. macrophylla* and *Sh. canadensis* can root well in black sand and peat, depending on the structure of the substrate. In the experiment, it was found that planting annual and biennial cuttings in spring compared to autumn increases their rooting ability. It was also found that cuttings treated with kornevin have 100% of their total weight (out of 200) in the second experiment (Table 2) and have early development and roots faster than untreated ones.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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