Possibilities of increasing biodiversity in the genus *Elaeagnus L.* during reproduction by soft cuttings

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Abstract. In this article, for the first time in Russia, the reproduction results of four species of the genus *Elaeagnus L.* by soft cuttings are presented comparatively. The promising genus of *Elaeagnus L.* have been identified in terms of fruiting and ornamentally. Their reproduction methods by soft cuttings with growth regulators, which make it possible to obtain high-quality seedlings for planting plantations, have been studied. Experiments on reproduction by soft cuttings were carried out in 2018 - 2020 on the territory of the Fruit Station of the RSAU-Moscow Agricultural Academy, named after K.A. Timiryazev. The cuttings were treated with three different growth regulators, stimulants of root formation (IMA-indolylbutyric acid, GHC-hydroxycinnamic acid (Zircon), and BCI + GGA (Universal rooting agent) and water was used as a control. The obtained results were processed by analysis of variance, as a result of which the morphological variability of rooted soft cuttings was revealed when treated with growth and development regulators. It was found that the genotype and stimulants significantly affect the average length and number of roots, the growth of shoots, their number, and the number of leaves on the shoot. The most effective was the growth and development regulator GKK + IMC. The results obtained make it possible to increase the biodiversity of valuable genotypes of the genus *Elaeagnus L.*

1 Introduction

The research was and is carried out using biobjects of the unique scientific installation "Biocollections" of the VILAR (All-Russian Scientific Research Institute of Medicinal and Aromatic Plants). The genus Loch (*Elaeagnus* L.*)* - unites about 80 species of small trees and shrubs, growing mainly in southern Europe, temperate and tropical Asia, North America, and Australia, and is the most numerous in the family [1-5]. Species of the genus Loch occupy an extreme position in arid and saline territories because they are drought-

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resistant glycohalophytes and have a high osmotic pressure due to soluble ones in the cell. The attention is focused on the silvery foliage of most representatives of the genus, contrasting with other tree plantations, as well as noticeable, often edible fruits and numerous fragrant flowers. Lokhovye - shrubs, and trees with characteristic pubescence of thyroid scales or stellate hairs. Root nodules with nitrogen-fixing bacteria characterize representatives of the genus *Elaeagnus L.*, so they can also grow on impoverished soils. Their leaves are alternate, sometimes opposite, on short petioles, whole, evergreen, or falling. The fruits of *Elaeagnus* L. plants contain up to 75 dry substances, 21.5 - 25.2% of sugars, and sugars are represented by 10% sucrose, glucose, and fructose, 4.3 - 6.2 mg% ascorbic acid, 254 - 447 mg% catechins. The leaves contain 150-330 mg% vitamin C, the extract from the flowers is 2% oil. The fruits can be used for both food and medicinal purposes [6].

In the conditions of Russia, deciduous species have the most significant importance and distribution - the narrow-leaved oak (*E. angustifolia L.)* and the silvery oak *(Elaeagnus commutata* Bernh.ex Rydb.), Showing sufficient resistance in planting and high decorativeness as hedges, contrasting groups, and as tapeworms. Other species are also associated with excellent prospects for use in landscaping in the territory of Russia: the multiflora goose (Gumi) (*E. multiflora* Thunb) and the umbrella goose (*E. umbellate* Thunb) [7-12].

One of the least costly methods of obtaining planting material for plants of the Loch family is the method of propagation by soft cuttings. At different periods of the study of culture to obtain planting material, the species of sucker were proposed to be propagated in various ways. In Central Asia's hot, dry climate [13, 14], it was found that the best time for harvesting and planting lignified sucker cuttings is in autumn.

Rooting conditions are one of the main factors for successful propagation by soft cuttings of various crops. The most effective technique that stimulates rhizogenesis in stem cuttings is treatment with growth substances - growth regulators. Thanks to the discovery of the ability of hormonal preparations of the auxin series to induce root formation, many difficult-to-propagate crops were transferred to the rank of medium- and easily rooted. Researchers include P-indolyl-3-butyric acid (P-IBA, 5-100 mg / l) and treatment methods: weakly concentrated aqueous solutions (16-24 hours) or growth paste or powder to the most effective drugs. For berry crops, BCI is preferred [13]. Since the plants of the genus *Elaeagnus L.* are valuable species in the national economy, the goal was to increase the biodiversity of valuable genotypes through propagation by soft cuttings.

2 Material and research methods

The regenerative capacity of soft sucker cuttings was evaluated in 2018 (June-July) in greenhouses with a fogging installation using growth stimulants. The air temperature in the film greenhouse during the experiment was from 24° C to 30° C, and the substrate temperature varied from 21° C to 24° C. The air humidity was 95–100%, making it possible to keep the cuttings in a turgor state during the rooting period. The setting of the experimental variants was carried out in three repetitions, up to 170 soft cuttings 10-13 ± 0.5 cm long, harvested from the middle part of annual shoots of the original plants, were placed per 1 m2. In each variant of the experiment, 30 soft cuttings were studied. After cutting, the lower part of the cuttings was placed in containers with solutions of growth regulators for 12 hours, then planted in soil consisting of peat and agroperlite in a 1: 1 ratio. To prepare solutions, the following receptus were used: IBA (indole-butyric acid, 50 mg / l); Zircon (0.1 g / L mixture of hydroxycinnamic acids (HCA)); A universal rooting agent (a mixture of indole-butyric acid and a mixture of hydroxycinnamic acids (IBA + HCA)). Preparation of drug solutions was carried out according to the instructions. Water was used

as a control. The quantitative indicators of rooted cuttings were counted in pieces and measured with a measuring ruler in centimeters [14].

3 Results and discussion

For the first time in Russia, under the conditions of the Non-Black Earth Zone, experiments were laid on the reproduction of four species of the genus *Elaeagnus L.* by soft cuttings using plant growth regulators. Research is conducted from 2018 to 2020. One of the most important indicators of growth regulators on cuttings is the length of the roots of exposure. Analysis of the length over the years of research on average in cuttings (Table 1) of *Elaeagnus L.* species showed that the maximum value when using BCA (4.49 ± 0.56 cm) against the background of control (2.70 ± 0.71) cm). When assessing the species, the maximum root length was noted in *E. umbellata* (4.44 ± 0.75 cm), and the minimum in *E. multiflora* (2.67 ± 0.24 cm). The assessment of the reliability of differences between the species showed (HCP05 = 0.51) that E. multiflora is significantly different from other species; *E.commutata* is significantly different from *E. multiflora* and *E.umbellata; E.umbellata* is significantly different from all species. *E. Angustifolia* significantly differs from *E.mbellata* and *E. multiflora* (Table 1).

Table 1. Root length in cuttings of species of the genus *Elaeagnus L.* depending on growth regulators (2018-2020).

№	Type	Average root length, cm				
		H_2O (Control)	IBA	HCA	IBA+HCA	Average by type
1	*E.multiflora* Thunb.	2.93±0.24	2.41±0.18	2.65±0.20	2.81±0.32	2.67±0.24
2	*E.commutata* Bernh. ex Rydb.	4.24±0.74	4.01±0.64	2.92±0.38	3.69±0.70	3.55±0.62
3	*E.umbellata* Thunb.	5.36±1.28	4.14±0.62	3.77±0.46	4.72±0.65	4.44±0.75
4	*E.angustifolia* L.	3.14±0.60	4.15±0.78	4.75±0.93	3.11±0.49	3.85±0.70
Average by growth regulators		2.70±0.71	4.49±0.56	3.79±0.49	3.72±0.54	

When assessing the reliability of differences between growth regulators (HCP05 = 0.62), it was noted that the control significantly differed from other options and had the lowest indicators compared to growth regulators; the variant with IBA significantly differed from other variants and had the most significant effect on the length of the roots. An important indicator is the number of roots in rooted cuttings of species of the genus *Elaeagnus L.* (Table 2), which was most noticeable when using IBA (8.3 ± 1.3 pieces) compared with control (7.2 ± 1.2 pieces). When assessing the species among themselves, it was found that the maximum number of roots was observed in *E. multiflora* (12.8 ± 1.1 pieces), the minimum in *E. commutata* (4.7 ± 0.9 pieces).

Differences in species reliability when using regulators showed (HCP05 = 1.78) that *E. multiflor*a significantly differs from other species; *E.commutata* is significantly different from *E. multiflora* and *E.umbellata; E.umbellata* significantly differs from *E.multiflora,*

E.commutata; E.angustifolia is significantly different from *E.multiflora and E.commutata*. The differences between *E. angustifolia and E.umbellata* in the number of roots are not significant.

Table 2. Number of roots in cuttings of species of the genus *Elaeagnus L*. depending on growth regulators.

№	Type	Number of roots, pcs				
		H_2O (Control)	IBA	HCA	IBA+HCA	Average by type
1	*E.multiflora* Thunb.	12.1±0.8	11.5±1.1	14.2±1.4	13.5±1.1	12.8±1.1
2	*E.commutata* Bernh. ex Rydb.	4.7±1.1	5.0±1.0	4.4±0.8	4.7±0.7	4.7±0.9
3	*E.umbellata* Thunb.	6.8±1.7	7.5±1.5	7.7±1.5	8.1±1.1	7.5±1.4
4	*E.angustifolia* L.	5.4±1.1	9.1±1.7	5.3±1.0	5.1±0.9	6.2±1.2
Overall average by growth regulators		7.2±1.2	8.3±1.3	7.9±1.1	7.8±0.9	

The reliability of differences between growth regulators (HCP05 = 0.91) showed that the control significantly differs from the variant with IBA. Other variants do not differ in a significant effect on the number of roots.

A standard seedling must have branched shoots, and therefore, when analyzing the number of shoots in cuttings of species of the genus *Elaeagnus L*. (Table 3), the maximum value was observed when using Zircon (1.4 ± 0.2 pcs) compared with the control (1.2 ± 0.2 pcs). Also, the maximum number of shoots was noted in the species *E. angustifolia* (1.9 ± 0.4 pcs), the minimum in *E. multiflora* (1.0 ± 0.1 pcs).

The assessment of the reliability of differences (HCP05 = 0.65) between the species showed that E. multiflora significantly differs only from the species *E. angustifolia*, there are no significant differences from other studied species; the species *E.commutata, E. multiflora, and E.umbellata* do not have significant differences between themselves; the species E. angustifolia significantly differs in the number of shoots from *E. multiflora, E.commutata*, and *E.umbellata* (Table 2).

According to the effect of growth regulators, when comparing them with each other (HCP05 = 0.15), it was found that the control differs significantly lower from the variant with HCA and IBA + HCA, the version with IBA in terms of the number of shoots does not differ significantly from the control.

Table 3. Number of shoots in cuttings of species of the genus *Elaeagnus L*. depending on growth regulators.

№	Type	Number of shoots, pcs				
		H_2O (Control)	IBA	HCA	IBA+HCA	Average by type
1	*E.multiflora* Thunb.	1.0±0.1	0.9±0.1	1.1±0.1	1.1±0.1	1.0±0.1
2	*E.commutata* Bernh. ex Rydb.	1.1±0.3	1.7±0.6	1.5±0.7	0.6±0.2	1.2±0.4
3	*E.umbellata* Thunb.	1.0±0.2	1.1±0.3	1.5±0.3	1.1±0.2	1.2±0.2
4	*E.angustifolia* L.	1.6±0.4	1.4±0.3	1.7±0.3	2.8±0.5	1.9±0.4
Average by growth regulators		1.2±0.2	1.3±0.3	1.5±0.4	1.4±0.2	

For better growth of seedlings, they need an increase in cuttings, which was the maximum in the species of the genus *Elaeagnus L.* (Table 4) when using Zircon (13.9 ± 1.1 cm) the smallest in control (12.7 ± 0.7 cm). When assessing the species among themselves, the maximum length of increments was noted in *E.umbellata* (14.7 ± 1.4 cm), the minimum in *E.commutata* (12.3 ± 0.7 cm). Comparing the species in terms of shoot growth (HCP05 = 0.82), it was found that the species *E.umbellata* significantly differs from all species of *Elaeagnus*; *E.angustifolia* had significant differences in the growth rate of cuttings with *E. multiflora* and *E.umbellata*; *E.multiflora* was significantly different from *E.umbellata* and *E.angustifolia.*

Table 4. Shoot growth in cuttings of species of the genus *Elaeagnus L.* depending on growth regulators.

№	Type	Average growth, cm				
		H_2O (Control)	IBA	HCA	IBA+HCA	Average by type
1	*E.multiflora* Thunb.	10.4±0.3	13.0±0.5	13.8±0.5	12.8±0.4	12.5±0.4
2	*E.commutata* Bernh. ex Rydb.	10.7±0.6	12.2±0.6	13.8±1.2	11.5±0.4	12.1±0.7
3	*E.umbellata* Thunb.	10.9±1.3	14.0±1.2	16.0±2.1	14.0±0.7	13.7±1.4
4	*E.angustifolia* L.	10.0±0.6	11.8±0.5	12.0±0.5	12.8±0.5	11.7±0.5
Average by growth regulators		10.5±0.7	12.8±0.7	13.9±1.1	12.8±0.5	

When assessing the reliability of differences in growth regulators (HCP05 = 1.15), it was found that the variant with HCA had significant differences with both the IBA variant

and the IBA + HCA variant. The variants with HCA, IBA, IBA + HCA significantly differed in the average growth of cuttings from the control.

The work of the photosynthetic apparatus of plants depends on the number of leaves on cuttings of species of the genus *Elaeagnus L.* It was revealed (Table 5) the maximum number of leaves with the use of HCA (5.8 ± 1.4 pcs), the smallest - IBA (4.5 ± 1.1 pcs.). When comparing the species among themselves by the number of leaves, it was revealed that the maximum number of leaves was observed in *E. umbellata* (6.9 ± 1.4 pieces), the minimum in *E. commutata* (3.2 ± 0.9 pieces).

The significant differences (HCP05 = 2.65) between the species showed that *E.multiflora* has significant differences only with *E.commutata; E.commutata* significantly differs from all *Elaeagnus L.* species in the number of leaves; *E.umbellata* does not differ significantly from *E.angustifolia* and *E.multiflora*, and the species *E. angustifolia* has significant differences from *E.commutata.*

Table 5. The number of leaves in cuttings of species of the genus *Elaeagnus L.* depending on growth regulators.

№	Type	Number of leaves, pcs				
		H_2O (Control)	IBA	HCA	IBA+HCA	Average by type
1	*E.multiflora* Thunb.	5.1±0.6	5.1±0.9	6.9±1.0	6.7±0.9	6.0±0.8
2	*E.commutata* Bernh. ex Rydb.	3.6±0.9	2.1±0.7	3.8±1.1	3.1±0.8	3.2±0.9
3	*E.umbellata* Thunb.	7.1±1.8	5.4±1.0	8.6±1.7	6.6±1.3	6.9±1.4
4	*E.angustifolia* L.	5.6±2.3	5.4±1.8	4.0±1.7	12.1±3.3	6.8±2.3
Average by growth regulators		5.3±1.4	4.5±1.1	5.8±1.4	7.1±1.6	

The significance of the differences (HCP05 = 1.11) of growth regulators in the number of leaves showed that the IBA + HCA variant has significant differences in both IBA and HCA. At the same time, the IBA and HCA variants did not differ significantly from the control. The HCA variant was significantly different from the variant with IBA + HCA.

4 Conclusion

1. A significant effect on the growth parameters of the length of roots and the number of roots over the years of research was noted when using IBA (4.49 ± 0.56 cm) compared with the control (2.70 ± 0.71 cm). The maximum root length was noted in *E. umbellata* (4.44 ± 0.75 cm) and the minimum in *E. multiflora* (2.67 ± 0.24 cm) when assessing the species.
2. The growth stimulator Zircon promoted the formation of the maximum growth (13.9 ± 1.1 cm). Depending on the species, the maximum growth length was observed in *E.umbellata* (14.7 ± 1.4 cm).
3. The most significant effect on the formation of the photosynthetic apparatus was exerted by the stimulant HCA + IBA (7.1 ± 1.4 items), the least - IBA (4.5 ± 1.1 items), and

the maximum number of leaves was observed in *E. umbellata* (6, 9 ± 1.4 pcs), the minimum in *E. commutata* (3.2 ± 0.9 pcs).

4. The conducted research on the reproduction of species of *Elaeagnus L.* made it possible to identify the stimulant HCA + IBA as the most reliably influencing the growth and development of plants.

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