Developing new varieties and improving *Elaeagnus orientalis* L. through selective breeding in Uzbekistan

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Abstract. Throughout ancient times, plants have played a crucial role in human life. They started off as a main source of food, and as agriculture developed, they turned into an essential supply of genetic material for growing plants. Increasing plant production and product quality via breeding and cultivation is a major part of our civilisation today. The *Elaeagnus orientalis* tree stands out among the many fruit trees that have been extensively grown in our nation for a long time. From ancient times, plants have played a significant role in human life. At first, they were mainly used for food, and with the development of agriculture, they became a crucial source of plant genetic material for cultivation. During the experimental observation, a total of 87 promising oriental *Elaeagnus orientalis* trees were identified in various regions of Uzbekistan, including Tashkent, Karakalpakstan and Khorezm, Fergana, Syrdarya, Samarkand, Kashkadarya, and Surkhandarya. Samarkand -7 varieties; clones had low growth indicators at the beginning of the growing season, but at the end of the growing season, they had an average of 132.9±5.9 cm, the Samarkand-7 variety showed a high result in terms of the number of bruised cuttings by 81%.

1 Introduction

Plants have been an integral part of human life since ancient times. Initially, they served as a primary source of sustenance, and with the advent of agriculture, they became a vital source of genetic material for plant cultivation [1-4]. Today, our civilization is closely linked with the cultivation and breeding of plants to increase their productivity and improve product quality. Among the various fruit trees that have been cultivated on a large scale in our country for centuries, the Elaeagnus orientalis tree holds a special position [5-7]. Its fruit has been a primary source of sustenance and medicine for the people of Central Asia and the Caucasus.

Our country is home to a diverse range of plants that are well-adapted to the climatic and soil conditions. Therefore, there is a need for scientific study of these plants, including the processing of their fruits and the exploration of their potential use in the food and pharmaceutical industries [6-8]. Additionally, breeding and developing new varieties of

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these plants with valuable economic characteristics is a pressing issue in today's world [5-7].

The cultivation of the oriental Elaeagnus orientalis in our country is currently hindered by the lack of promising and cultured varieties. Instead, local residents grow ordinary forms in various oases, but these forms often do not possess valuable economic traits. Therefore, large-scale cultivation of Elaeagnus orientalis is necessary, which involves selecting promising forms, improving and selecting from existing assortments [1-3, 7]. This requires extensive research on the gene pool of the oriental Elaeagnus orientalis, the identification of new forms, and a comprehensive assessment of their valuable economic and biological characteristics.

Currently, the use of oriental Elaeagnus orientalis in the food and pharmaceutical industry, land reclamation, and the creation of mother and industrial plantations is in its initial stages. Therefore, the creation of varieties based on the selection of promising forms of the oriental Elaeagnus orientalis holds significant practical importance.In order to preserve the valuable economic and biological traits of the mother tree, it is desirable to propagate the oriental Elaeagnus orientalis vegetatively through the cultivation of seedlings. This method of vegetative reproduction is commonly used in the cultivation of most fruit species [4-7].

2 Materials and methods

Following extensive scientific research and selection evaluation works, a total of 87 promising oriental Elaeagnus orientalis trees were identified in various regions of Uzbekistan, including Tashkent, Karakalpakstan and Khorezm, Fergana, Syrdarya, Samarkand, Kashkadarya, and Surkhandarya. Out of these, 27 promising forms were selected based on comprehensive evaluations of their fruits, taste, and biochemical properties [8-10]. The promising forms were further studied, and as a result, three new Elaeagnus orientalis varieties were created, namely Tashkent-16, Tashkent-22, and Samarkand-7 between the years 2014 and 2020. The evaluation of the Elaeagnus orientalis fruits was carried out during the fruit ripening period from September to October using complex assessment and tasting methods on healthy and fully harvested trees. Fruits picked from a common tree of oriental Elaeagnus orientalis were used as a control option for comparison purposes [5-8].

The height of the trees was measured with height measuring devices (VUL-1, VN-1), while the trunk diameter was accurately measured using a measuring plug at ground level 1.3 meters from the base. The yield level of the Elaeagnus orientalis tree was evaluated using a 4-5 point evaluation scale. The length, diameter, grain length, and diameter of the fruits were accurately measured using a barbell circle with a precision of 0.01 millimeters. The weight of fruits, seeds, and flesh was accurately measured using an electronic scale with a precision of 0.01 grams. The promising forms of Elaeagnus orientalis were evaluated based on their biomorphological productivity and biochemical and tasting results and were submitted to the Agricultural Crops Varieties Testing Center of the Republic of Uzbekistan [1-5, 8]. After successfully passing the tests, these Elaeagnus orientalis varieties were registered with the state, and the required documents were submitted to the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan. The clones of these promising varieties, Tashkent-16, Tashkent-22, and Samarkand-7, were propagated vegetatively.

The Elaeagnus orientalis grows in different physical-geographical and ecological-phytocenotic conditions, leading to the development of various ecotypes and populations. Research has been conducted to identify promising forms with valuable economic characteristics to create varieties [4-7]. Important characteristics considered include cold

tolerance, overall plant condition, pest and disease resistance, degree of thorn coverage on branches, productivity, fruit size and weight, biochemical composition of fruits, and productivity stability. Drought resistance can be determined by the ability of leaves to retain water. In the summer, high temperatures and low soil moisture negatively affect the tree's condition, causing leaves to shrink and adopt a boat-like, twisted shape to protect themselves from water scarcity. This leads to reduced water evaporation, branch damage, fewer fruit buds, and easily crushed fruits [1-4, 7-10].

Sycamore trees can be damaged by frost, which is assessed visually on a scale of 0 to 5. The health of Elaeagnus orientalis trees is also visually assessed on a scale of 1 to 5 based on growth, leaf development, and signs of damage from frost, pests, and disease. Heterosporosis disease in Elaeagnus orientalis trees is assessed based on a point system from 0 to 5, with higher scores indicating more severe damage. A score of 5 indicates that the tree is about to die and may result in its complete death and regrowth. Multi-year observations are conducted to evaluate the overall health and adaptability of Elaeagnus orientalis trees. The evaluation criteria include the tree's general condition, frost damage, and Heterosporosis disease severity [3-5]. Frost damage can cause harm to the tree's vegetative and generative buds, and the extent of damage is visually scored on a scale of 0 to 5. Similarly, the adaptive flexibility of the tree is assessed visually and scored on a scale of 1 to 5 based on health, annual branch growth, leaf development, and signs of damage from frost, pests, and diseases. Heterosporosis disease severity is evaluated using a point system, with a score of 0 indicating no damage and a score of 5 indicating severe damage, where the tree is about to die [1].

Additionally, when evaluating promising forms of Elaeagnus orientalis, it is crucial to consider the presence of thorns on the branches. These thorns can make the maintenance and harvesting of the tree challenging. The coefficient of the tree covered with thorns can be determined by the following formula:

$$T = \frac{K \cdot L}{D};$$

T - the coefficient of thorn coverage,

K - the number of thorns on 5 one-year branches, pcs

L - the length of one spike, cm

D - the total length of branches developed from 5 main tree trunks, cm. If the coefficient of thorn coverage is less than 0.4, the form is considered to be low thorn, if it is up to 0.7, it is medium thorn, and if it is above 0.7, it is a strong thorn plant [1-6].

The productivity of sycamore trees is evaluated visually during September and October, when fruits are fully ripe and have maximum size and weight. The assessment ranges from 0 to 5 based on the yield: 0 for no harvest, 1 for very low yield of up to 3-4 kg per tree, 2 for low yield present only at the ends of the tree, up to 6 kg, 3 for average productivity located in the tip of the main branches, up to 7 kg based on the tree's general condition, 4 for a good yield located in the main branches of the tree, up to 10-12 kg, and 5 for high productivity with all branches and inner branches of the tree covered with fruits, yielding 15-25 kg or more according to the tree's overall health (for 10-year-old trees and above).

Furthermore, to determine the productivity of a whole hectare of a plantation, the average productivity of each tree is multiplied by the total number of trees in the hectare. The yield per tree is determined by measuring the length, diameter, and weight of 100 fruits and seeds. The weight of the fruits and seeds is measured three times on an electronic scale with an accuracy of 0.1 grams, and their length and diameter are measured using a caliper with a precision of 0.1 cm [1-5]. The size of the fruits is evaluated based on the weight of 100 freshly picked fruits, and the following scores are used:

1 point - very small fruits, weighing up to 105 grams per 100 fruits;

2 points - small fruits, weighing between 110 and 150 grams per 100 fruits;
3 points - medium-sized fruits, weighing between 160 and 180 grams per 100 fruits;
4 points - large fruits, weighing between 200 and 240 grams per 100 fruits;
5 points - very large fruits, weighing 255 grams or more per 100 fruits (Fig. 1 and 2).

Fig. 1. The process of biomorphological research of fruits and seeds of breadfruit.

Fig. 2. Selected breadfruit.

The weight of the fruit pulp in the Eastern gypsy is an important factor for food and pharmaceutical industries. Medicinal preparations are made using the weight of fruit pulp or the percentage of fruit pulp to fruit weight. To evaluate the fruit pulp, fruit productivity is measured using an electronic scale with an accuracy of 0.01 g. The productivity is evaluated on a 5-point scale, with 0.4-0.5 grams considered too low, 0.6-0.8 grams

considered less, 0.9-1.0 grams considered average, 1.5-2.0 grams considered good, and 2.5 grams and above considered high yield [3, 5].

The nutritional value of Eastren Elaeagnus orientalis fruits is considered high due to their sugar content, which is higher than fruits like apples, pears, and cherries. To cultivate them for industrial plantations, varieties with at least 40% sugar content in fruits are preferred. The amount of carbohydrates in promising forms of Elaeagnus orientalis is evaluated to determine their biochemical activity, with a scoring system as follows:

1 point - very low, carbohydrate content up to 20%;
2 points - low, carbohydrate content up to 25-30%;
3 points - average, carbohydrate content 32-38%;
4 points - a lot, the amount of carbohydrates is 40-50%;
5 points - very much, the amount of carbohydrates is 51% and above. Assessing and identifying promising forms and varieties of Eastern Elaeagnus orientalis based on these criteria is an important practical task [2-4, 6-8].

3 Results and discussion

As a result of these recommended studies, Samarkand-7, Tashkent-16 and Tashkent-22 "Elaeagnus orientalis" varieties were created. As a result of the scientific research carried out in the period of 2009-2020, 3 selection achievements of the eastern region, "Tashkent-16" CERTIFICATE #065, "Tashkent-22" CERTIFICATE #064 and "Samarkand-7" CERTIFICATE #065, were the varieties of agricultural crops of the Republic of Uzbekistan. received by the test center (2020). NAP 00278 (Samarkand -7), NAP 00279 (Tashkent -16) and NAP 00280 (Tashkent -22) "Elaeagnus orientalis" varieties were created and received a PATENT by the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan (2020).

Vegetative reproduction is crucial for the continued existence of cultivated plants. The ability to reproduce vegetatively is formed and strengthened in the genetics of each plant during evolutionary development. Trees and shrubs with this ability are highly adaptable to changing environmental conditions. In forestry and horticulture, vegetative reproduction is a promising method, particularly for large-fruited local varieties of Elaeagnus orientalis. This method produces genetically identical clone-seedlings, which are almost indistinguishable from the parent plants in terms of their characteristics. Rooting cuttings is a promising method for growing seedlings with their own roots. This approach avoids the loss of valuable economic and biological characteristics that often occur in seedlings grown from seeds due to high heterozygosity.

We achieved the following results in determining the parameters of growth, rooting and preservation of clones of Tashkent-16, Tashkent-22 and Samarkand-7 during the growing season (Table 1):

Table 1. Dynamics of growth of Tashkent-16 and Tashkent-22 clones of the eastern sorghum during the growing season.

Varieties name	Average height of clones, cm					
	May 15	**June 15**	**July 15**	**August 15**	**End of vegetation (September 15)**	**Seedlings diameter mm**
Tashkent-16	13.8±1.33	34.7±3.82	78.5±4.09	148.6±4.15	190.0±6.88	12.1 ± 0.41
Tashkent-22	15.5±1.27	36.7±3.22	75.2±4.57	133.1±5.24	183.9±5.46	11.7 ± 0.38

The results showed that Tashkent-16 and Tashkent-22 variety clones had almost the same parameters in terms of growth indicators of Elaeagnus orientalis varieties during the growing season. However, the preservation of Tashkent-16 variety at the end of the growing season was lower (73%). Rooting indicators became known mainly in August. During the vegetation, the length of the branches grown from the clones increased, and the degree of rooting, i.e., preservation, was observed to decrease (Table 2).

Table 2. Dynamics of rooting and maintenance of clones of promising forms.

Varieties name	Number of growing cuttings in %					
	March 15	**May 15**	**June 15**	**July 15**	**August 15**	**End of vegetation (September 15)**
Tashkent 16	100	94.6	87.8	78.5	78.5	73.3
Tashkent 22	100	96.0	86.0	86.0	81.0	77.0

At the end of the growing season, the highest result for the amount of preservation of clones was recorded for the Tashkent-22 variety, 77%. Cuttings with an independent root continued to grow by forming new shoots in the next month until the third decade of October (Table 3).

Table 3. Samarkand clones of 7 varieties of Eastren Elaeagnus orientalis during the growing season growth dynamics

A variety of Elaeagnus orientalis	The average height of seedlings cm					
	May 15	**June 15**	**July 15**	**August 15**	**Height and diameter of seedlings at the end of vegetation**	
					h/cm	**d/mm**
Samarkand-7	11.3 ±0.66	29.1±1.65	47.9± 3.75	74.7 ± 3.52	132.9 ± 5.91	6.2 ±0.3 9

Samarkand -7 varieties; clones had low growth indicators at the beginning of the growing season, but at the end of the growing season, they had an average of 132.9±5.9 cm, the Samarkand-7 variety showed a high result in terms of the number of bruised cuttings by 81%. During the growing season of the cuttings, the growth rate and the degree of rooting changed, and the average diameter of the seedlings kept until the end of the growing season was 6.2±0.39 mm (Table 3).

It was reported that the height of Samarkand-7 reached 200 cm at end of growing season (Fig. 4). Furthermore, the results of the experiment on the amount of growing cutting of Samarkand-7 showed that it was 100 on March 15, followed by May 15 (90), June 15 (87), and it was 83 on July and August 15 (Table 4).

Table 4. Rooting and seedlings of clones of the Samarkand 7 variety of the Eastren Elaeagnus orientalis conservation dynamics

Variety name	The number of growing cuttings in %					
	March 15	**May 15**	**June 15**	**July 15**	**August 15**	**The degree of preservation of seedlings at the end of vegetation**
Samarkand-7	100	90	87	83	83	81

According to general economic-biological characteristics of Elaeagnus orientalis and assessment criteria, productive varieties are separated from them, seedlings are grown on the basis of their clones, and collection and mother plantations are created.

A collection or mother plantation is selected from among the highly valued cultivars based on several valuable traits as mother trees and sourced for breeding purposes and used for purpose. Valuable husbandry - forms with low biological characteristics are discouraged from further study, but retained in the collection to preserve genetic biodiversity.

4 Conclusions

Scientific research conducted between 2009 and 2020 led to the creation of three new varieties of agricultural crops in Uzbekistan, namely “Tashkent-16” CERTIFICATE #065, “Tashkent-22” CERTIFICATE #064, and “Samarkand-7” CERTIFICATE #065. These varieties were developed through the selection and evaluation of promising forms of the oriental ginseng and the application of a method for creating new varieties. The Intellectual Property Agency under the Ministry of Justice of Uzbekistan granted patents for these new varieties in 2020.

The new varieties were developed specifically for cultivation on an industrial scale. They are expected to be used by horticulturists, foresters, and farmers, and have shown rapid growth during the growing season. Seedlings of Tashkent-16, Tashkent-22, and Samarkand varieties grew from an average height of 25-30 cm in late June to a height of 125-200 cm by the end of the growing season. These new varieties are expected to be useful for large-scale cultivation and are readily available in standard seedling form.

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