

**VARIATION OF FRUITS MORPHOMETRIC PARAMETERS OF *ELAEAGNUS MULTIFLORA* THUNB. GERMPLASM COLLECTION***Olga Grygorieva, Svitlana Klymenko, Antonina Ilinska, Ján Brindza***ABSTRACT**

The aim of this study was to determine morphometric parameters of fruits within some genotypes of *Elaeagnus multiflora* Thunb., which are growing in the Forest-Steppe of Ukraine in M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG). Their morphometric parameters were following: fruit weight from 0.32 to 1.89 g, fruit length from 7.60 to 19.54 mm, fruit diameter from 4.39 to 10.32 mm, seed weight from 0.10 to 0.41 g, seed length from 7.40 to 13.30 mm, seed diameter from 1.34 to 5.07 mm. The shape indexes of fruits and seeds were found ranging from 1.25 to 1.56 and from 2.90 to 4.04, respectively. The analysis of coefficient of variation showed the difference of variability in morphometric characteristics between *Elaeagnus multiflora* samples. Data showed that the most variability of important selection characteristics is the average cumulative seeds weight – from 18.72 to 36.61%, seeds diameter – from 10.46 to 24.29%, fruits weight – from 9.15 to 22.24%. The other characteristics are more or less stable. Collected quantitative data were subjected to principal hierarchical cluster analysis. The cluster analysis of morphometric parameters exhibited that the *Elaeagnus multiflora* genotypes fell into two clusters. These cluster analysis results suggest that broad morphologic diversity was found in *Elaeagnus multiflora* genotypes examined in this study. The introduction population of the *Elaeagnus multiflora*, was created in the M.M. Gryshko National Botanical Garden in Kyiv, has a sufficient potential for successful selection work. These preliminary results could open the interest of farmers in this *Elaeagnus multiflora* and will be precedent for future domestication and introduction of the species in the agroproductive system in Ukraine and the rest of the world.

**Keywords:** *Elaeagnus multiflora*; fruits; seeds; morphometric parameters

**INTRODUCTION**

Species of the genus *Elaeagnus* L. belong to the family *Elaeagnaceae* Juss. *Elaeagnus multiflora* Thunb. (cherry elaeagnus, cherry silverberry, gumi, gumi) has long been grown in China, Korea, and Japan and has for centuries been cultured as a decorative as well as for food and medicinal plant (You et al., 1994). This species is known in Chinese traditional medicine (Sakamura and Suga, 1987), where some diseases such as a cough, foul sours, diarrhoea, itch and cancer have been treated for a long time (Lee et al., 2007). The fruits and leaves have characterized by high level of carbohydrate, crude protein, lipid, ash, reducing sugars, soluble proteins, and polyphenols (Hong et al., 2006a; Yoon et al., 2007; Bieniek et al., 2017). The organic acids found in fruits were acetic, citric lactic, and malic, succinic acids. The content of citric acid was the highest among organic acids (Hong et al., 2006a).

Fruits exhibit the antioxidant and anti-inflammatory activities (Hong et al., 2006b; Chang et al., 2006; Lee et al., 2007, 2011), antiproliferative (Kim et al., 2007; Lee et al., 2010), anticancer (Lee et al., 2010), antimicrobial (Patel, 2015). Kim et al. (2014), these results suggest that

*Elaeagnus multiflora* fruit extract is a potential possibility of application as a whitening functional cosmetic material through repression of melanin biosynthesis.

Biologically active compounds are not only in fruits but in different parts of the plant: bark, leaves, flowers, seeds (Shin et al., 2008; Patel, 2015). *Elaeagnus multiflora* seeds are considered to be a candidate for preventative and dietetic treatment as an anticancer functional food (Kim, Oh and Lee, 2008). The leaves, fruits and young branches of *Elaeagnus multiflora* could be exploited as phenolic, antioxidant additives and as nutritional supplements for prolonging existence (Ismail et al., 2015). The fruits of *Elaeagnus multiflora* are used in fresh condition and from them are prepared pastes, jams, compote.

The unique biochemical characteristics of *Elaeagnus multiflora* are well documented. However, it is insufficient information about the morphological variability of *Elaeagnus multiflora* fruits. It is important to study the genetic variability of fruits for improving selected characteristics in the future.

The aim of this study was to separate, based on our research, the best genotypes from our collections *Elaeagnus*

*multiflora*, which can be successfully grown on plantations and can be utilized in future plant breeding programs.

### Scientific hypothesis

In our experiment we have been support that fruit phenotyping variability of evaluated genotypes collection cherry elaeagnus not predomined only cultivation conditions but also genetical features.

## MATERIAL AND METHODOLOGY

### Locating trees and data collection

The objects of the research were 30-year-old plants of *Elaeagnus multiflora*, which are growing in the Forest-Steppe of Ukraine in M. M. Gryshko National Botanical Garden of NAS of Ukraine (NBG). They are well adapted to the climatic and soil conditions. Observations on the collections genotypes of *Elaeagnus multiflora* in the period 2016 – 2017 were performed during mass fruiting. We have described 10 genotypes (referred as EM-01 to EM-10) of *Elaeagnus multiflora*.

### Morphometric characteristics

Pomological characteristics were conducted with four replications on a total 30 fruits per genotypes. In the study only one plant (bush) used for per genotype. The following measurements were taken: fruit weight, in g, fruit length, in mm, fruit diameter, in mm and seed weight, in g, seed length, in mm, seed diameter, in mm. Data, we are working with, were tested for normal distribution.

### Statistical analyses

Basic statistical analyses were performed using PAST 2.17; hierarchical cluster analyses of similarity between phenotypes were computed on the basis of the Bray-Curtis similarity index; multi-dimensional scaling (MDS) analyses were performed in PRIMER (Clarke and Gorley, 2006). Variability of all these parameters was evaluated using descriptive statistics. Level of variability determined by Stehlíková (1998).

## RESULTS AND DISCUSSION

Primarily, selection work of *Elaeagnus multiflora* started in Russia where are known the most widespread cultivars



Figure 1 Fruitage of *Elaeagnus multiflora* Thunb.



Figure 2 Variability in the shape of *Elaeagnus multiflora* Thunb. fruits.

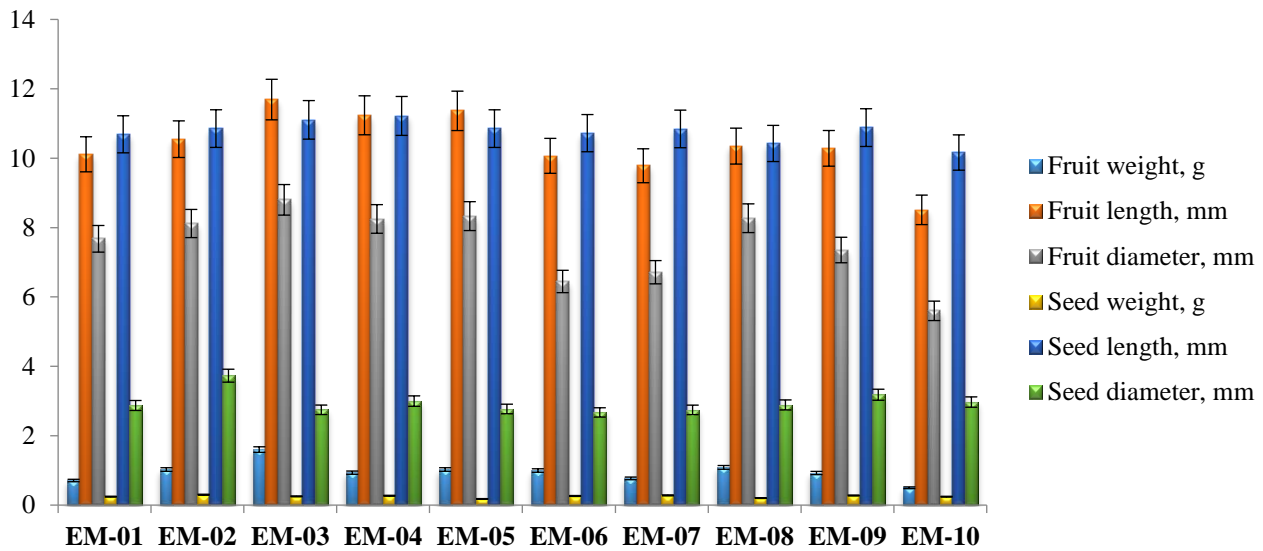


Figure 3 Variability in the shape of *Elaeagnus multiflora* Thunb. seeds.

**Table 1** The variability of some morphometric parameters of fruits for the whole collection of *Elaeagnus multiflora* Thunb. genotypes.

Characteristics	Unit	n	min	max	mean	CV%
Fruit weight	g	300	0.32	1.89	0.95	31.85
Fruit length	mm	300	7.60	19.54	10.39	11.88
Fruit diameter	mm	300	4.39	10.32	7.55	15.38
Seed weight	mm	300	0.10	0.41	0.25	24.90
Seed length	mm	300	7.40	13.30	10.77	8.09
Seed diameter	mm	300	1.34	5.07	2.95	19.46

Note: n – the number of measurements; min, max – minimal and maximal measured values; mean – arithmetic mean; CV – coefficient of variation (%).



**Figure 4** Mean values for various morphometric parameters of fruits and seeds of *Elaeagnus multiflora* Thunb. genotypes.

such as Sachaliński pierwszy, Moneron, Taisa, Kril'on, Szikotan, Juznyj, Kunaszir, Cunai, Paramushir. Cultivar Sweet Scarlet cultivates in the Europe and USA.

The collection of *Elaeagnus multiflora* has created at the M.M. Gryshko National Botanical Garden since 1980 – 1982. The primary material (seeds from free pollination) was imported from Sakhalin (Sakhalin Scientific Research Institute of Agriculture). Nowadays the collection of *Elaeagnus multiflora* includes 45 genotypes. We selected the most promising genotypes of this species.

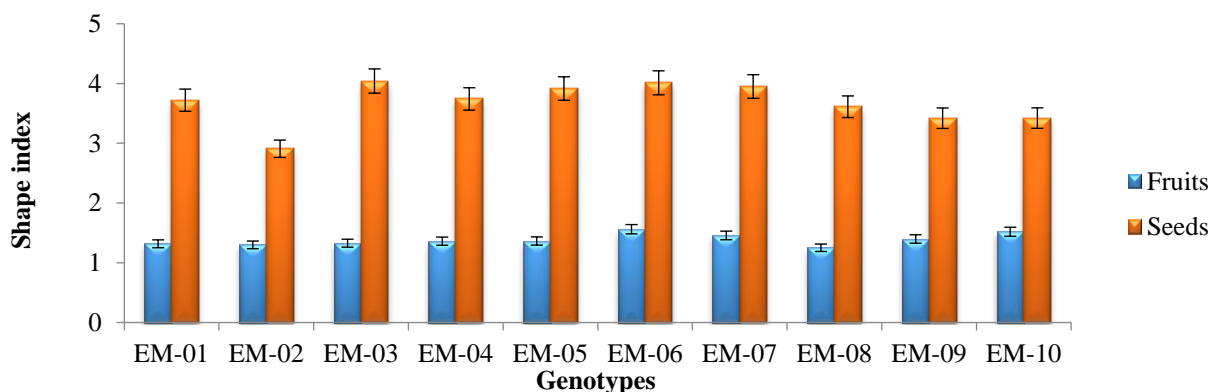
The weight of the whole fruit is one of the significant production characteristics of plant species. These parameters of the *Elaeagnus multiflora* fruit varied significantly. The images of *Elaeagnus multiflora* fruits and seeds of various genotypes are shown in Figure 1, 2, 3. High

variability of the size and shape of these fruits and seeds are evident.

The weight of *Elaeagnus multiflora* fruits of the present study was in the range from 0.32 (EM-10) to 1.89 (EM-03) g (Table 1, Figure 4).

The coefficient of variation was 31.85%, which shows a very high degree of variability of fruit weight. Investigations of **Bieniek et al. (2017)** established the range of fruits weight of variety from 1.03 to 1.29 g.

The fruit length in our analyses was determined in the range from 7.60 (EM-10) to 19.54 (EM-03) mm. The value of the coefficient of variation was 11.88%, which shows an average degree of variability of fruit weight. **Bieniek et al. (2017)** determined the length of the fruits in the range from 1.24 to 1.28 cm.



**Figure 5** Comparison of the tested *Elaeagnus multiflora* Thunb. genotypes in the shape index of fruits and seeds.

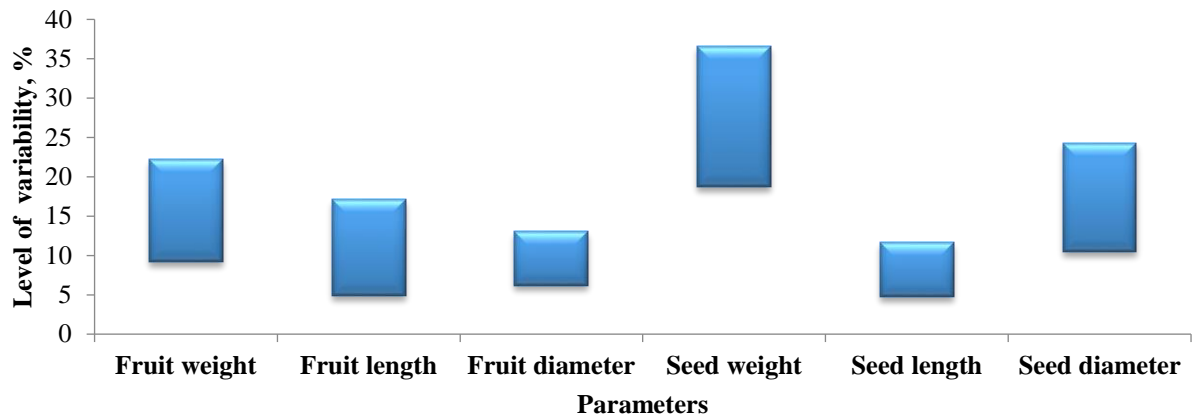


Figure 6 Level of the variability of morphometric parameters of fruits and seeds *Elaeagnus multiflora* Thunb. (%).

Table 2 The matrix of Pearson correlation coefficients for 15 pairs of variables.

Parameters	Fruit weight	Fruit length	Fruit diameter	Seed weight	Seed length
Fruit length	0.619*				
Fruit diameter	0.647*	0.689*			
Seed weight	0.054*	0.015	-0.056		
Seed length	0.160	0.202*	0.171*	0.157*	
Seed diameter	-0.040	0.020	0.080	0.170*	0.233*

Note: Significant according to the *t*-test ( $p < 0.05$ ).

In our experiments, the fruit diameter was determined in the range from 4.39 (EM-10) to 10.32 (EM-01) mm (Table 1). The variation coefficient (15.38%) confirmed an average degree of variability within the collection.

The seed weight in our analyses was determined in the range from 0.10 (EM-08) to 0.41 (EM-02) g. The value of the coefficient of variation was 24.90%, which shows a very high degree of variability of fruit weight. Investigations of **Bieniek et al. (2017)** established the range of seed weight of varieties from 0.10 to 0.12 g.

Seed length was identified in the range from 7.40 (EM-10) mm to 13.30 (EM-02) mm (Table 1). The variation coefficient characterizes the average degree of variability within the testable collection.

Seed diameter was identified in the range from 1.34 (EM-06) to 5.07 (EM-09) mm. The value of the coefficient of variation fixed the high degree of variability of this characteristic.

The shape of each object can be characterized by the shape index, i.e. the length to width ratio. Figure 5 represents the shape indexes of fruits and seeds. The shape index of the fruits was found in the range from 1.25 (EM-08) to 1.56 (EM-06). The shape index of the seed – ranged from 2.90 (EM-02) to 4.04 (EM-03), so the genotypes collection demonstrates significant variability in the shape of the seed, as seen in Figure 2. These parameters can be used for the identification of the genotypes.

The analysis of coefficient of variation showed the difference of variability of morphological signs between

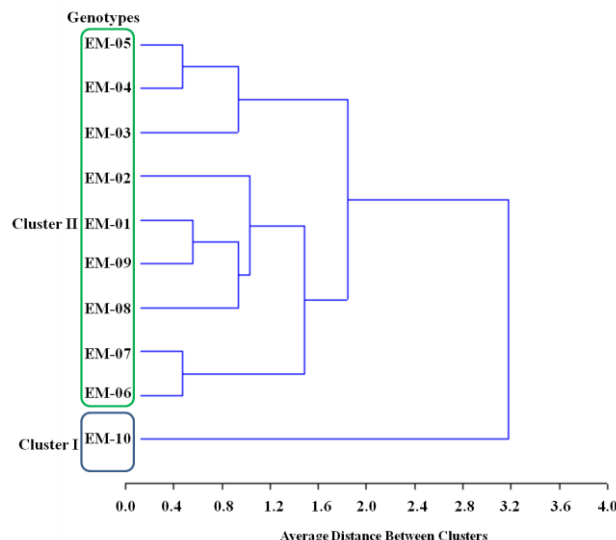


Figure 7 Cluster dendrogram based on morphometrics parameters of *Elaeagnus multiflora* Thunb. fruits genotypes.



*Elaeagnus multiflora* samples (Figure 6). Data showed that the most variable important selection signs are the seeds weight – from 18.72 to 36.61%, seeds diameter – from 10.46 to 24.29%, fruits weight – from 9.15 to 22.24%. These results indicate the promise of breeding in this way of investigations. The stable signs are seed length – from 4.77 to 11.66%.

The results indicated moderate positive correlations between the fruit diameter and the fruit length ( $r = 0.689$ ), fruit weight ( $r = 0.647$ ), fruit length and fruit weight ( $r = 0.619$ ) (Table 2). The slight correlation was found between the seed diameter and seed length ( $r = 0.233$ ).

The cluster analysis on the morphological characters have been carried out earlier for studying the genetic variability of some other plant species (Milotic et al., 2005; Henderson, 2006; Abdali et al., 2014; Al-Ruqaie et al., 2016; Krishnapillai and Wijeratnam, 2016; Martinez-Nicolas et al., 2016; Grygorieva et al., 2017; Vinogradova et al., 2017).

The *Elaeagnus multiflora* genotypes were divided into two main clusters cluster I and cluster II (Figure 7). Cluster I contained the genotype (EM-10) only, which differs from other genotypes of collection by all parameters.

Cluster II was further sub-divided into two sub-clusters: A and B. Sub-cluster A was further sub-divided into sub-sub clusters A<sub>1</sub> and A<sub>2</sub>. In sub-sub-cluster A<sub>1</sub> EM-06 and EM-07 were closely linked whereas in sub-sub-cluster A<sub>2</sub> EM-09 and EM-01 were connected in the same group, while EM-08 and EM-02 were linked as an outlier. Sub-cluster B contained only two *Elaeagnus multiflora* genotypes EM-04 and EM-05 were connected in the same group while EM-03 linked as an outlier.

## CONCLUSION

Evaluating of 10 genotypes of *Elaeagnus multiflora* determined the weight of the fruits in the range from 0.32 to 1.89 g, fruit length from 7.60 to 19.54 mm, fruit diameter from 4.39 to 10.32 mm, seed weight from 0.10 to 0.41 g, seed length from 7.40 to 13.30 mm, seed diameter from 1.34 to 5.07 mm. Data showed that the most variability of important selection characteristics found for average cumulative seeds weight – from 18.72 to 36.61%, seeds diameter – from 10.46 to 24.29%, fruits weight – from 9.15 to 22.24%.

This study is significant as first selection work in Ukraine. Obtained results are important for breeding new varieties of *Elaeagnus multiflora* as well as their practical use. Study of adaptation characteristics will also be required for the selected *Elaeagnus multiflora* genotypes. The results of the study are helpful for understanding the variability and attempting the selection of superior desirable *Elaeagnus multiflora* accessions for bringing to commercial cultivation.

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