INTRODUCTION
Species of the genus Elaeagnus L. belong to the family Elaeagnaceae Juss. Elaeagnus multiflora Thunb. (cherry elaeagnus, cherry silverberry, goumi, gumi) has long been grown in China, Korea, and Japan and for centuries been cultivated 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 sores, 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.
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
such as Sachaliński pierwyj, Moneron, Taisa, Krił’on, Sizoktan, 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.

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

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

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.

**Figure 5** Comparison of the tested *Elaeagnus multiflora* Thunb. genotypes in the shape index of fruits and seeds.
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 6](image-url) Level of the variability of morphometric parameters of fruits and seeds *Elaeagnus multiflora* Thunb. (%).

![Figure 7](image-url) Cluster dendrogram based on morphometric parameters of *Elaeagnus multiflora* Thunb. fruits genotypes.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Fruit weight</th>
<th>Fruit length</th>
<th>Fruit diameter</th>
<th>Seed weight</th>
<th>Seed length</th>
<th>Seed diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit length</td>
<td>0.619*</td>
<td>0.647*</td>
<td>0.689*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit diameter</td>
<td>0.054*</td>
<td>0.015</td>
<td>-0.056</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed weight</td>
<td>0.160</td>
<td>0.202*</td>
<td>0.171*</td>
<td>0.157*</td>
<td>0.170*</td>
<td>0.233*</td>
</tr>
<tr>
<td>Seed diameter</td>
<td>-0.040</td>
<td>0.020</td>
<td>0.080</td>
<td>0.020</td>
<td>0.080</td>
<td>0.170*</td>
</tr>
</tbody>
</table>

Note: Significant according to the t-test (*p* <0.05).
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-Ruqai et al., 2016; Krishnapillai and Wijeratnam, 2016; Martinez-Nicolás 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 A1 and A2. In sub-sub-cluster A1 EM-06 and EM-07 were closely linked whereas in sub-sub-cluster A2 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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