RUSSIAN OLIVE (ELAEAGNUS ANGUSTIFOLIA L.): A MULTIPURPOSE SPECIES WITH AN IMPORTANT ROLE IN LAND RECLAMATION

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Abstract
Elaeagnus angustifolia L. (Russian olive, oleaster) is generally regarded as a useful species across its distribution range. The aim of this review paper was to highlight the species’ multiple uses, especially in forest land reclamation. Data regarding the taxonomy, chorology, ecological requirements and biological characteristics were also presented. Even if it is listed as an invasive species in many countries worldwide, Russian olive is one of the most common used species for improvement by afforestation of several categories of degraded terrains, especially the salt-affected and arid lands. It is also very appreciated in folk medicine, human and animal alimentation, cosmetics and landscape architecture. Due to its tendency to spread and colonize bare terrains or areas where it is not desired, a carefully monitoring of cultures with this species is more than necessary. In the perspective of contemporary climate change, characterized by higher temperatures and lower rainfall, Russian olive could gain more attention from foresters, ecologists and land managers who should develop an integrated management plan for this species.

Keywords: Elaeagnus angustifolia, land reclamation, oleaster, Russian olive.

1. INTRODUCTION
Genus Elaeagnus L. (2n=28) belongs to the family Elaeagnaceae and consists of approximately 70-80 species (Patel, 2015). The generic name of genus originates from the Greek élaia, which means olive, because the fruit looks like an olive (Bucur et al., 2005). Elaeagnus angustifolia L. (Russian olive, oleaster) is a multiple-stemmed deciduous species of Elaeagnus, native to Eurasia. It was introduced in North America in the late 19th century for reclamation purposes or as a horticultural plant, but it has become invasive especially in riparian and other moist habitats (Schaffner et al., 2011; Collette and Pither, 2015), nowadays being reported to be an alien species also in New Mexico (Cox, 2001) and Argentina (Busso et al., 2013).
This species is usually a shrub or a small tree characterized by spiny thorns, silvery leaves and fruits, and a well-developed root system that makes it suitable for several categories of degraded terrains, as the ones affected by landslides or sheet erosion (Enescu, 2015). The vertical roots are capable of growing downwards to a depth of about 3.5 m (Feng et al., 2012). Across its wide distribution range, Russian olive is a component of several forest types, such as mixed Populus-Elaeagnus or Tamarix-Elaeagnus forests, E. angustifolia-dominated stands, and Haloxylon woodlands (Katz and Shafroth, 2003).
2. ECOLOGICAL REQUIREMENTS

Russian olive can tolerate a wide variety of environmental conditions (Pilinszky et al., 2015; Hamidpour et al., 2017). It is resistant to drought and frost (Stratu et al., 2016), withstanding temperatures ranging from -45 to +46 °C (Akbolat et al., 2008), with extreme fluctuation of diurnal temperature (Srivastava, 2010). *E. angustifolia* can grow in almost any type of soil (Aksoy and Şahin, 1999), even in soils affected by salinity (Katz and Shafroth, 2003), with different pH values (Doroftei et al., 2005). It grows best in deep sandy or loamy soils and it requires very low amount of precipitation per year (Akbolat et al., 2008).

3. BIOLOGICAL REQUIREMENTS

Russian olive has a rapid juvenile growth rate (Khamzina et al., 2009). It is an actinorhizal species that is forming nitrogen-fixing root nodules in symbiotic association with bacteria of the genus *Frankia* Brunchorst (Katz and Shafroth, 2003). *E. angustifolia* can be propagated in both vegetative and generative ways, the seed dispersal being mainly done by water and animals (Busso et al., 2013). The flowering occurs in March-April, and the fruiting in September-October (Jabeen et al., 2015), the optimum fruiting being observed at the age of 40 (Baranov and Kositzyn, 2003). The vegetative propagation can also be done by micropropagation. It was reported that shoots were successfully obtained from nodal segments of mature trees (Iriondo et al., 1995). Like other invasive shrub species, Russian olive is able to resprout following fire (Harrod and Reichard, 2002).

4. RUSSIAN OLIVE: A MULTIPURPOSE SPECIES

Firstly, due to its ability to grow under a wide spectrum of soil conditions and to colonize bare lands, *E. angustifolia* represents one of the main choices for establishment of protective and productive forest plantations in many regions worldwide. It is one of the most commonly planted species in mixed shelterbelts in many countries, such as Ukraine (Sudnik-Wójcikowska et al., 2009), Turkey (Tolunay et al., 2007), Romania (Enescu, 2015), China (Missall et al., 2015) or United States of America (Zhou et al., 2007). In many cases, together with sea-buckthorn (*Hippophaë rhamnoides* L.) or *Populus* spp. (Heshmati, 2011; Missall et al., 2015), Russian olive was used in creating windbreaks orientated perpendicular to the prevailing wind direction (Strat, 2013; Enescu, 2014).

Secondly, Russian olive is regarded as an important medicinal plant worldwide (Tashev and Tsavkov, 2008; Uysal et al., 2010; Asl et al., 2012). Different plant extracts have shown to have antioxidant, antimicrobial, antimitagenic (Okmen and Turkcan, 2014; Hamidpour et al., 2017), antinociceptive, anti-inflammatory (Ahmadiani et al., 2000; Nikniaz et al., 2014), antipyretic and diuretic effects (Karaman and Kocabas, 2001). Also, this species has some other therapeutic properties which fight against many serious diseases, such as gastric pain, dysentery, jaundice and hepatitis A, B and C (Jabeen et al., 2015; Uzun et al., 2015). Moreover, the extract obtained from the fruits is used against dyspepsia (Khan et al., 2011), cough and cold (Afzal et al., 2009), in treatment of malignant fevers (Ajaib et al., 2014) or to improve osteoarthritis (Maghzi et al., 2015). The oil extracted from flowers is used in treatment of bronchial affections (Ajaib et al., 2014). Last but not least, fruit extracts proved to have significant muscle relaxant and antinociceptive effects in the case of mice (Hosseinzadeh et al., 2003; Karimi et al., 2010).

Thirdly, thanks to the fact that the fruits are rich in fructose, glucose, carbohydrates and vitamin C, they are consumes directly in many regions across its distribution (Ayaz et al., 1999; Ranjit et al., 2008; Özdemir and Kalyoncu, 2011; Ullah et al., 2014). The berries are also eaten by the Mountain

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Bluebird (*Sialia currucoides* Bechstein.) (Burnett and Fair, 2008) and the leaves have a superior fodder potential (Khamzina et al., 2006; Kumar, 2006; Djumaeva et al., 2009). The fruits may be used as seasoning in soups and can also be prepared into sherbets or jellies (Ajaib et al., 2014).

Fourthly, this species is very appreciated in landscape architecture (Christensen, 1963), being one of the most common urban trees, planted both in parks or street alignments (Guvensen et al., 2005; Corzo et al., 2009). In Turkey, it is used also for hiding bad views (Irmak and Yilmaz, 2008). Actually, its ornamental use played an important role in the artificially extending its distribution range, nowadays being quite common also in North America, for example.

Last but not least, *E. angustifolia* can have other less common utilizations. Its wood is used for fuel (Lamers and Khamzina, 2008; Jabeen et al., 2015) or for posts, beams and domestic items (Ajaib et al., 2014) or even timber (Khan et al., 2011). It is also a melliferous plant (Zima, 2007; Irimia et al., 2015; Yilmaz, 2016). The flower extracts may be used in perfumery (Bucur et al., 2009; Ajaib et al., 2014). The gum of this species is used as shampoo and as a tonic for long, healthy and shiny hairs (Khan et al., 2011; Jabeen et al., 2015). It plays also a significant role in carbon sequestration (Zhou et al., 2007).

5. THE ROLE OF RUSSIAN OLIVE IN LAND RECLAMATION

*E. angustifolia* is suitable for several categories of degraded lands, *i.e.* eroded soils, landslides, etc. (Gokturk et al., 2006), but in many cases it serves as a reforestation species of the salt-affected and/or sandy soils (Djumaeva et al., 2010; Heshmati, 2011; Lai et al., 2012; Dubovyk et al., 2014). Moreover, this species can grow in forest cultures installed also on alluvial soils (Negrea et al., 2013; Constandache and Nistor, 2014), or even on tailing dumps (Cântar et al., 2014) or mining dumps (Neţoiu et al., 2012).

It provided also good results in mixed plantations in steppe region, on highly eroded lands. For example, in Romania, at the age of 18 the average height of the young individuals was 2.9 m and the survival rate accounted for 84 % (Greavu and Mănescu, 2001).

Russian olive is also appreciated for its role in soil protection, producing large amounts of leaves, forming a thick litter that is rapidly decomposed. For example, in Uzbekistan, in the cultures installed on degraded, irrigated croplands, the leaf production of *E. angustifolia* was about 2.5 times higher compared with *Ulmus pumila* L. (Lamers et al., 2010). Thanks to its well-developed root system, this species is able to pierce the very compact top soil (Roth, 1940), like in cases of the sites with lands affected by aridization (Qi and Cai, 2007). Similar to sea-buckthorn (Enescu, 2014) and black locust (Enescu and Dănescu, 2013), two species often used in forest land reclamation worldwide, Russian olive has the ability to fix atmospheric nitrogen, so it enriches the soil in nutrients (Ajaib et al., 2014).

6. RUSSIAN OLIVE: RISKS AND DRAWBACKS

Russian olive meets the features for an invasive species, *i.e.* nitrogen fixation and rapid vegetative propagation (Daehler, 1998), and the biogeographic, spread and impact criteria described by Katz and Shafroth (2003). As a result, *E. angustifolia* is regarded as one of the most aggressive invasive plant worldwide. For example, in North America it was listed among the exotic invasive species with the potential to reduce local diversity (D’Antonio et al., 2004). The risk of local biodiversity loss is more pronounced in the cases when plantations containing Russian olive individuals are located within protected areas (Irimia et al., 2015).

In urban areas another risk can occur. It was reported that its pollen can generate allergic reaction to sensitive people (Sastre et al., 2004). Moreover, when it is introduced in the urban green areas, its...
multiple-stemmed could play a double role. On one hand, this feature could limit the development of other desired species planted in its proximity, and, on the other hand, it could act as a veritable barrier that covers the bad views.

A shortcoming of Russian olive is represented by the lack of an efficient method for fruit collection. Usually, the harvesting is done manually. Due to the small dimensions of the fruits and to the presence of the thorns on twigs the quantities collected are small.

7. CONCLUSIONS
According to this brief review, Russian olive should be regarded more as a very useful multi-purpose tree species with a high potential for forest land reclamation, rather than a dangerous invasive one. Nevertheless, due to its tendency to spread and colonize bare terrains or areas where it is not desired, a carefully monitoring of cultures with this species is more than necessary in order to keep it under control or to prevent possible reduction of local diversity, especially in fragile sites.

In the perspective of contemporary climate change, characterized by higher temperatures and lower rainfall, Russian olive could gain more attention from foresters, ecologists and land managers who should develop an integrated management plan for this species.

8. REFERENCES


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