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WHICH SHRUB SPECIES SHOULD BE USED FOR THE ESTABLISHMENT OF FIELD SHELTERBELTS IN ROMANIA?

Cristian Mihai ENESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania

Corresponding author email: mihaienescu21@gmail.com

Abstract

In the current context of increasing air temperatures and decreasing rainfall, the field shelterbelts play an important role in the management of agricultural lands in Romania. The aim of this study was to highlight the most preferred shrub species used for establishment of the filed shelterbelts in Romania. Ten of the most common shrubs, namely Cornelian cherry, common dogwood, European smoketree, common hawthorn, European spindle, wild privet, blackthorn, dog rose, black elder and common lilac, were selected and ten criteria were taken into consideration. An Analytic Hierarchy Process (AHP) was performed in order to assess the performance of the selected alternatives (i.e. shrub species) by means of pairwise comparisons. Expert Choice Desktop software was used for the analysis. Based on the results of the analysed scenarios, recommendations were made.

Key words*: AHP, field shelterbelt, shrub species.*

INTRODUCTION

In the current context of climate change recorded in Romania and concretized through increasing both air temperatures and number of summer days and decreasing rainfall amount in all seasons, except autumn (Dumitrescu et al., 2014), the field shelterbelts play and will continue to play an important role in the management of agricultural lands, especially in the areas with a low share of forest vegetation.

In Romania, the first field shelterbelts were established in 1880 by Stănculescu in Ialomița County (Southern Romania) on his private land (Catrina, 2007). Since the second part of the last century, these multi-purpose plantations started also to be regarded as a significant source of wild fruits that have an important economic contribution for the forestry sector in Romania (Constandache et al., 2016).

According to the official definition (Law no. 46/2008 Forest Code), the forest shelterbelts represent formations with forest vegetation, located at a certain distance from one to another or close to an objective in order to protect it against the effects of harmful factors and/or for the land improvement from climatic, economic and aesthetic perspectives. Law no. 289/2002 divides the forest shelterbelts into five types, field shelterbelts being among the most important in terms of integrated environmental management. The main roles of the field shelterbelts consist in protecting and assuring favourable micro-environmental conditions for the agricultural crops (Vasilescu, 2008).

Thanks to several other benefits, such as soil and water conservation, carbon sequestration, wildlife habitat, source of timber and non-timber products, aesthetics, etc., the field shelterbelts were the subject of several national programmes. Even if only a few steps were done in the last two-three decades in terms of establishing new field shelterbelts, in the future the area of forest shelterbelts at national level is expected to increase. The central authority responsible for forestry in Romania (*i.e.* Ministry of Waters and Forests) did another important step by including in the draft of the National Forest Strategy the budget needed for planting a significant area of these types of forest cultures (MAP, 2017).

Due to its high diversity in terms of shrub and tree species, in Romania more than fifty woody species are commonly used in afforestation of the degraded lands and in establishment of the protective shelterbelts (Enescu, 2015).

The aim of this study was to highlight the most preferred shrub species used for establishment of the filed shelterbelts in Romania.

MATERIALS AND METHODS

Ten of the most common shrubs, namely Cornelian cherry (*Cornus mas* L.), common dogwood (*Cornus sanguinea* L.), European smoketree (*Cotinus coggygria* Scop.), common hawthorn (*Crataegus monogyna* Jacq.), European spindle (*Euonymus europaeus* L.), wild privet (*Ligustrum vulgare* L.), blackthorn (*Prunus spinosa* L.), dog rose (*Rosa canina* L.), black elder (*Sambucus nigra* L.) and common lilac (*Syringa vulgaris* L.) were taken into consideration in this study.

An Analytic Hierarchy Process (AHP) was performed in order to assess the performance of the selected alternatives (*i.e.* shrub species) by means of pairwise comparisons. Within AHP, the decision problem (*i.e.* the goal of this study) was decomposed into a hierarchy sub-problems (*i.e*. the criteria used), each of which can be independently analysed.

A scale ranging from 1 to 10 was used for each criterion, namely: criterion 1 - *growth rate* (from 1 - very slow growing rate to 10 - very fast growing rate), criterion 2 - *vegetative propagation* (from 1 - no vegetative propagation to 10 - very intense vegetative propagation), criterion 3 - *seed dimensions* (from 1 - the smallest seeds to 10 - the biggest seeds), criterion 4 - *height* (from 1 - the smallest to 10 - the highest), criterion 5 - *crown density* (from 1 - rare crown to 10 - very dense crown), criterion 6 - *root system* (from 1 - very less developed in depth and sidewise to 10 - very developed in depth and sidewise), criterion 7 - *demand for light* (from 1 - very shade tolerant to 10 - very high demand for light), criterion 8 - *soil requirements* (from 1 - extremely low requirements to 10 - very high requirements), criterion 9 - *temperature requirements* (from 1 - resistant to low temperatures to 10 - resistant to high temperatures) and criterion 10 - *ornamental value* (from 1 - very low value to 10 - very high value).

For each criterion Expert Choice Desktop software (version 11.5.1683) was used for the analysis.

Two scenarios were taken into consideration, namely scenario 1 (all criteria received equal importance) and scenario 2 (special attention - 40% of the overall variation - was given to the criterion *growth rate*).

RESULTS AND DISCUSSIONS

Based on the information available in the specialized manuals and studies, a detailed description of the ten selected shrub species was made in accordance with the ten selected criteria. The description took into consideration only the information related with the ten selected criteria.

Cornelian cherry has a very slow growing rate; it regenerates in a vegetative way; its seeds are 12-15 mm; it can reach 6-8 m in height; its crown is rare; it has a strong root system; it is a light-demanding species; it can grow on light sandy to heavy clay soils, with a pH ranging from slightly acid to very alkaline; it is a thermophilous species, but it can survive up to -30°C; it has a high ornamental value - its yellow flowers appear before the leaves and its leaves are reddish during autumn (Clinovschi, 2005; Constandache et al., 2006; Şofletea and Curtu 2008; Constandache et al., 2012; Da Ronch et al., 2016).

Common dogwood can be propagated in a vegetative way; its seeds are 5-8 mm long; it can reach 3-6 m in height; its root system is superficial; it is a light demanding species, but it can tolerate also the shade; it prefers consistently moist, well-drained soils, but it is also able to grow in a wide range of soils, from dry to humid with different pH levels; it is adapted to a high range of temperatures; it has a high ornamental value thanks to its reddish shoots (those that are situated in full light) and its reddish leaves during autumn (Clinovschi, 2005; Constandache et al., 2006; Şofletea and Curtu, 2008; Constandache et al., 2012; Popescu et al., 2016).

European smoketree has a rare crown; its seeds are small (3-4 mm); it can reach 1-3 (5) m in height; it grows in semi-shade conditions, on superficial soils, including the ones with moderate amount of carbon; it is a thermophilous species and it is resistant to drought and frost (-30ºC); it is very appreciated from the ornamental point of view due to its

very rich inflorescence and its yellow to purple leaves during the fall (Clinovschi, 2005; Constandache et al., 2006; Șofletea and Curtu, 2008).

Common hawthorn has a slow growing rate; it can reach up to 8-10 m in height; its globulous seeds are 7-10 (14) mm in diameter and they are ussualy bird-dispersed; its root is deeply developed in depth, with numerous lateral branches; it could be either a light-demanding or a semi-shade species; it is able to grow on several types of soils and it can tolerate a large amplitude of temperatures (Forman and Baudy, 1984; Clinovschi, 2005; Șofletea and Curtu, 2008; Constandache et al., 2012).

European spindle can be vegetative propagated; it can reach 6 m in height; its seeds are 10-15 mm in diameter; it has a strong root system; it can grow in full or partial shade; it usually grows on well-drained, preferably alkaline soils; it is a thermophilous and a drought resistant species and it is appreciated for its coloured fruits (Clinovschi, 2005; Șofletea and Curtu, 2008; Constandache et al., 2012; Popescu et al., 2016).

Wild privet can be propagated in both vegetative and generative ways; its bird-dispersed fruit is a small black berry, 6-8 (10) mm in diameter; its root system is superficial; it is a shade tolerant species; it is able to tolerate a wide spectrum of soil conditions; it is resistant to drought; it has an ornamental value, specially thanks to its white flowers (Forman, Baudy, 1984; Clinovschi, 2005; Constandache et al., 2006; Șofletea, Curtu, 2008; Enescu et al., 2015).

Blackthorn has a slow growing rate; it is reproducing both in vegetative and generative ways; its seeds are 10 to 15 mm in diameter; it can reach a height of 2-3 (5) m; its roots are deeply developed in depth, with numerous lateral branches; it is a light-demanding species; it can grow on several types of soils; it is a xerophyte species, that is resistant to drought; thanks to its white flowers, it is appreciated from an ornamental point of view (Clinovschi, 2005; Șofletea and Curtu, 2008; Constandache et al., 2012; Popescu and Caudullo, 2016).

Dog rose can reach 2-3 m in height; its fruits are 15-20 mm in diameter; it is a light-demanding species; it has low requirements to soil conditions; it is able to tolerate a wide spectrum of soil conditions; it has an ornamental value especially thanks to its red fruits (Clinovschi, 2005; Șofletea and Curtu, 2008; Constandache et al., 2012; Soare et al., 2015).

Black elder usually reaches 4 to 5 m in height; it is able to reproduce both in vegetative and generative ways; its seeds are 6-8 mm in diameter; its root system is deeply developed in depth, with numerous lateral branches long up to 8 meters; it is a semi-shade species; it is a very exigent species, preferring rich in humus and nitrogen and deep soils; it is not drought tolerant (Clinovschi, 2005; Șofletea and Curtu, 2008; Constandache et al., 2012; Enescu et al., 2016).

Common lilac has a fast growing rate; it can be propagated both in vegetative and generative ways; its seeds are 10-15 mm long; it can reach a height of 3-4 (7) m; its crown is branched from the base; it is a light-demanding species; it prefers the soils with high amount in calcium; it is a thermophilous species, resistant to drought and frost; it is very appreciated thanks to its very diverse colored flowers (Clinovschi, 2005; Șofletea, Curtu, 2008; Constandache et al., 2012; Horț et al., 2013).

The AHP alternative ranking for the ten criteria, based on the information available in the specialized manuals and on the author's opinion, is given in Table 1.

Table 1. AHP alternative ranking

Criterion	*Cornus mas*	*Cornus sanguinea*	*Cotinus coggygria*	*Crataegus monogyna*	*Euonymus europaeus*	*Ligustrum vulgare*	*Prunus spinosa*	*Rosa canina*	*Sambucus nigra*	*Syringa vulgaris*
1. Growth rate	1	7	6	2	4	8	3	5	9	10
2. Vegetative propagation	4	9	2	1	5	10	8	3	5	7
3. Seed dimensions	9	2	1	5	8	4	8	10	3	8
4. Height	8	6	3	9	7	4	2	1	10	5
5. Crown density	2	5	1	10	3	4	8	9	6	7
6. Root system	7	1	6	9	3	2	8	4	10	5
7. Demand for light	7	6	4	5	1	2	10	9	3	8
8. Soil requirements	7	6	5	4	8	1	3	2	10	9
9. Temperature requirements	1	3	10	7	4	5	9	8	2	6
10. Ornamental value	7	5	10	1	6	4	3	2	8	9

In scenario 1 (all criteria received an equal share), the most preferred shrub species were: *Syringa vulgaris*, *Sambucus nigra* and *Prunus spinosa*, respectively (Figure 1). This means that these three shrub species should be used with priority in establishing new field shelterbelts to the detriment of the other seven, when the ten criteria taken into consideration are equally important. In the case of common lilac, its placing in the top could be explained by the fact that it is a fast growing species, that is able to reproduce both in vegetative and generative ways (thanks to its medium-size seeds, which can be disseminated at great distances), with medium requirements in terms of temperatures and with a high ornamental value. Its rare crown, very low developed root system and medium to high requirements in terms of soil conditions represent its drawbacks.

In the case when special attention - 40% of the overall variation - was given to the criterion *growth rate*, wild privet appeared in top three (Figure 2).

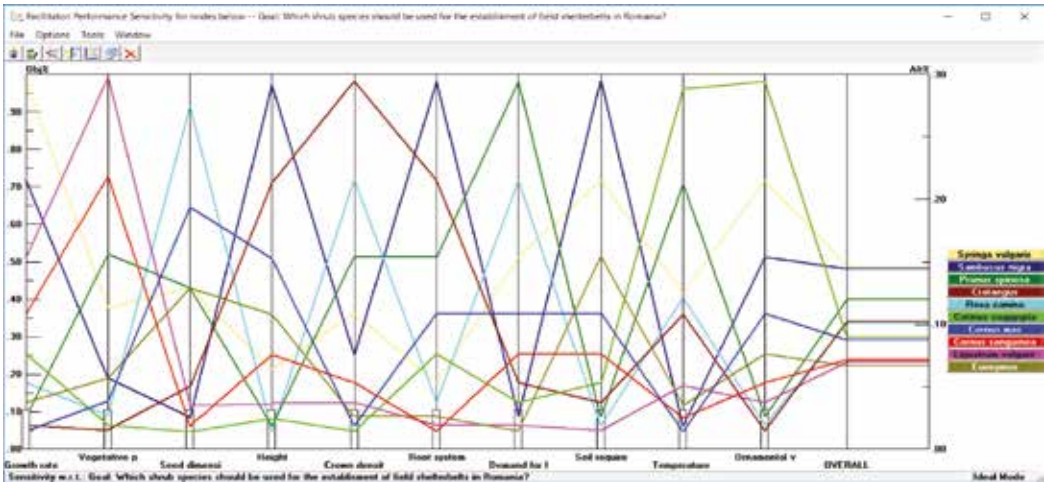

Figure 1. The ranking of the ten shrub species in the first scenario

The results of this second scenario could be useful in the case when someone wants to establish in a very short time a field shelterbelt composed by fast-growing species that are able to reproduce both in vegetative and generative ways (thanks to their small seeds), but in this situation the height of the shelterbelt, its density or its combined root system are not of great interest.

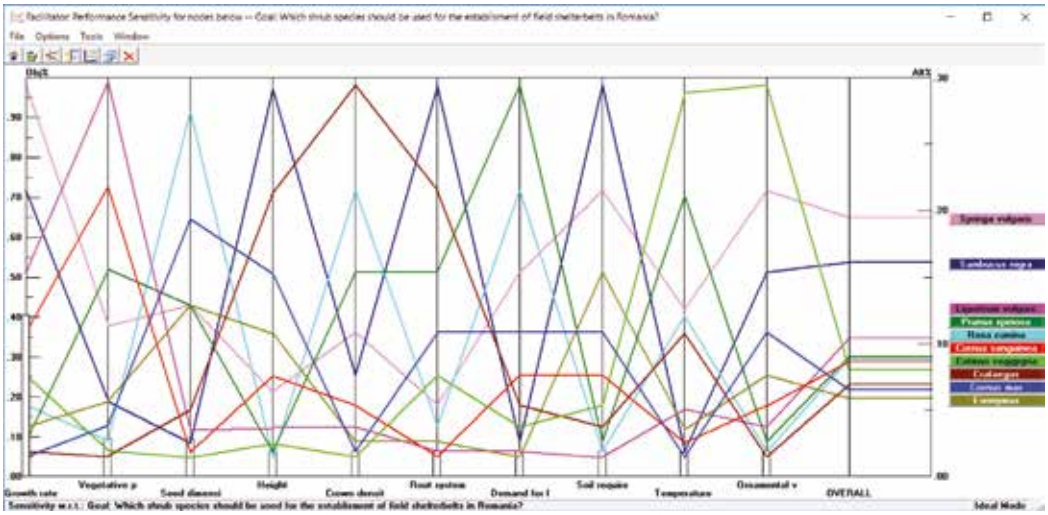

Figure 2. The ranking of the ten shrub species in the second scenario

CONCLUSIONS

The results of this study could be regarded as an attempt to take a decision regarding the shrub species that could be used in several scenarios, with special focus on biological characteristics, morphological traits, ecological requirements or other aspects.

By using the combination of the principles of AHP and a very easy to use software, such as Expert Choice Desktop, solving a multi-decision problem becomes very easy.

In the perspective of increasing the area of forest shelterbelts at national level, we believe that this multi-decision analysis approach will become of great interest both for the land owners but also for the foresters or other designers of different categories of shelterbelts, especially thanks to the fact that it is a very easy-to-use tool.

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