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The area of *Quercus hartwissiana (Fagaceae)* and opportunities of its extension in Bulgaria

Abstract

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In Bulgaria, Strandža oak grows naturally only in the Strandža mountains, in the catchment basins of the larger rivers, single or in groups mixed with other tree species. It needs a warm and humid climate. Two different ecotypes – dense-forest oak on deep and moist soils, karst oak on shallow, dry soils – are present. Plantations were studied on 6 experimental plots, situated centrally in, peripheral to or outside of the native range of the species. In suitable sites growth of the Strandža oak equals or exceeds that of other oak species *(Quercus conferta, Q. cerris).* One may conclude that extending the Strandža oak stands to suitable Bulgarian locations within or even outside its present distributional area is appropriate.

Introduction

Strandža oak (*Quercus hartwissiana* Stev.) is a pre-glacial relict. It is considered to be the ancestor of *Q. robur* L. and *Q. petraea* (Matt.) Liebl. as they now exist in Europe.

Strandža oak, also known as lužnik (deceiver), is described in the Bulgarian *Plant red data book* (Velčev & al. 1984: 447) as a rare species. It grows, though not in large numbers, along rivers in the Strandža mountain, on moderately moist to moist soils. Outside of Bulgaria, its geographical distribution extends into European Turkey, S.W. Asia and the Caucasus.

This species has been studied for the first time in Bulgaria by Stefanov (1924), who used the name *Quercus stranjensis* Turrill. In the period between 1966 and 1969, Penev & al. (1970) found that the Strandža oak was mainly spread in the catchment basin of the Veleka river, from the village of Brodilovo through the town of Malko Tărnovo up to the village of Mladežko, and that it also occurs, though in small numbers only, along the Rezvaja, Kitenska and Ropotamo rivers (Fig. 1). Only the dense-forest ecotype of this species, growing on alluvial soils in dense forest, mixed with *Fraxinus oxycarpa* Willd. and *Ulmus laevis* Pall., had been known previously. Penev & al. (1970) also found it in mixed stands, stocking right above meadows at the foot of hills, on fairly moist, rich and

deeply leached, cinnamon-coloured soils. There, the most typical companions of the lužnik are *Carpinus betulus* L., *Fagus orientalis* Lipsky, and *Sorbus torminalis* L. Penev & al. (1970) furthermore recognized a second, karst or xerophilous ecotype in this species, occurring on karstic ground in the uppermost part of the catchment basin of the Rezvaja river, by the village of Mahala, and the Veleka river, in the Pazlacite area. There it grows mixed with *Q. pubescens* Willd., *Q. cerris* L., *Q. conferta* Kit., *Carpinus orientalis* Mill. and the shrubs *Cistus creticus* L. and *Daphne pontica* L.

Strandža oak needs the warm and humid type of climate that is characteristic of the zonal oak-beech formation with evergreen Pontic scrub. The requirements of this species, when expressed by means of the complex hygrothermal index W, are in the order of 1.5-4.4 units (Penev & al. 1970). The dense-forest ecotype of the Strandža oak is an indicator of rich and moist alluvial-eluvial soils. Typical companions of this ecotype are woody climbers such as *Vitis vinifera* L., *Hedera helix* L., and *Smilax excelsa* L. Single 110-year old trees of this ecotype, growing by the village of Kosti, have a stem diameter of 110 cm and are 24 m high.

We have investigated 6 experimental plots (EP) with Strandža oak plantations: four in the central part of the Strandža mountains, one at their periphery, and one outside.

Fig. 1. Map of the known wild distribution of *Quercus hartwissiana* in Bulgaria.

Results

During our studies, we could establish that the growth of trees of the karst ecotype of the Strandža oak is almost as good as that of *Quercus conferta* and *Q. cerris*. In wood lot No. 423 of the Malko Tărnovo State Forestry, the average diameter of 120-year old lužnik trees is 45.8 cm and the average height, 20.4 m. The average diameter of *Q. cerris* at the same site is 43 cm and that of *Q. conferta,* 45 cm.

The trees of the dense-forest ecotype have the large, obovate-oblong leaves that are typical for the species, and semi-cylindrical acorn stalks varying between 1 and 3 cm in length. The leaves of karst ecotype trees are considerably smaller, and the acorn stalks reach half the length of the leaves. The bark of the Strandža oak closely resembles that of *Quercus robur*. Trees of the dense-forest ecotype have massive crowns with thick and rough branches and curved stems, while those of the karst ecotype have straighter stems, thinner branches, and smaller crowns.

The present status of the dense-forest oak stands is quite different now from what it was at the beginning and until the middle of this century. The greater part of their typical sites along the rivers has been converted to arable land. Elsewhere, due to continuous and intensive grazing, the Strandža oak has been ousted by *Quercus cerris*, *Q. conferta* and *Carpinus betulus*. Single trees and small clusters of Strandža oak still grow in-between. While appropriate forest management and preservation activities might save and increase the share of the highly productive lužnik eco- and bioforms, not even the existence of this species is mentioned in the control and management plans of Bulgarian forestry.

The oldest cultivated Strandža oak forests in the central subregion of the Strandža mountains are now 40 years old. Experimental patch (EP) No. 1 is located in the Bosnia area, belonging to the Novo Paničarevo State Forestry, and EP No. 2 in the Moskov dol area, which is part of the Kosti State Forestry. The plantations arose through pit-sowing of acorns, obtained locally in the case of EP No. 1 and collected from trees of the dense-forest ecotype in the case of EP No. 2. A *Quercus conferta* plantation, out of acorns from neighbouring trees, developed in EP No. 2 alongside with the lužnik one. The soil in EP No. 1 is leached, cinnamon-coloured forest soil, deep and fairly moist. The forest site is of the C_{2-3} type (Pogrebnjak, according to Penev & al. 1969: 349). Humus and total nitrogen contents in the top soil layer, down to 1 m of depth, are high (231.7 t/ha and 19 t/ha, respectively). The soil in EP No. 2 is of the same type, dry to fairly moist, moderately stony, the type of the forest site is C_{1-2}, humus content in the top soil layer down to 58 cm is 81.2 t/ha, and nitrogen content, 8.7 t/ha.

The trees in EP No. 1 are straight-stemmed and well developed, with thin branches, an average stem diameter of 14.3 cm, and an average height of 14 m. The trees in EP No. 2 have a slower growth and lesser diameter (by 21 %), their stems are not so straight, and their branches thicker. The main reason for this difference is in the origin of the acorns. The *Quercus conferta* trees in EP No. 2 have a much lesser diameter (by 43.9 %) and lower growth (by 43.8 %) than the lužnik trees.

In EP No. 3, located near EP No. 2, we studied 26-year old plantations of lužnik and *Quercus conferta*. The soil is of the same type, but fairly stony, shallower and drier than in EP No. 2. The forest site type is CB_1. The lužnik trees attain 27 % less in diameter and are 8 % lower than those of *Q. conferta*.

EP No. 4 is an 8-year old plantation of lužnik, located in the Čaena plantacija area of the Kosti State Forestry. The soil is alluvial-eluvial, deep, and the forest site type is D_2. The growth of the trees is quite good for their age: the average diameter is 3 cm, the average height, 3.8 m, and the current year's increment, 70 cm.

The climatic conditions in EP No. 1-4 are favourable for the growth and development of the Strandža oak. The values of the hygrothermal index W range from 1.78 to 2.43 units.

EP No. 5, with a 16-year old plantation, is located in the Stredec State Forestry at the village of Dračevo, in the peripheral region of the Strandža mountains. The soil is deep, cinnamon-coloured forest soil, and the forest site is of type BC_1. The climatic conditions in this region are not favourable for the growth of the lužnik (W = 0.50 units). The average diameter and average height of *Quercus conferta* trees exceed those of the lužnik trees by 36.8 % and 15 %, respectively.

EP No. 6 is located in the eastern part of the Balkan (Stara planina) range, in the Nesebăr State Forestry, at the village of Rakovskovo. The soil is a deep, leached, cinnamon-coloured forest soil, the type of the forest site is $C_{2\text{-}1}$. The 11-year old lužnik plantation was grown from acorns of two different ecotypes, dense-forest and xerophilous. At the time of our study of the cultivation, there were no major differences in growth between the ecotypes, save for a slight predominance of the xerophilous type which better correspond to the forest site. The *Quercus conferta* trees are slower in growth than lužnik (15 % lesser diameter and 12.5 % lesser height). The growth the lužnik, though outside its natural area here, is quite good. The value of the hygrothermal index W is 1.55 units.

Conclusion

The studies confirm the need of Strandža oak of air-moistening in limits of the hygrothermal.

On fairly moist, medium deep, leached, moderately nutrient-rich, cinnamon-coloured forest soils and on north-facing slopes, Strandža oak features quite well, with growth rates considerably higher than those of *Quercus conferta*. On dry and shallow soils exposed to the south, *Q. conferta* shows a better growth.

Strandža oak should be cultivated mainly in its natural area of distribution, the central subregion of the Strandža mountains. By broadening its native range, its xerophilous form in particular can also be successfully cultivated in some regions of the eastern Balkan range.

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