

The utilization of exotic woody plants in forest management of lowland areas in Slovakia

Ferdinand Tokár

Arboretum Mlyňany, Institute of Dendrobiology of SAS, 951 52 Slepčany,
Czecho-Slovakia

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ABSTRACT: In the paper, growth and production results as well as cultivation possibilities of exotic woody plants (*Quercus rubra* L., *Juglans nigra* L., and *Pinus nigra* Arnold) in lowlands of Slovakia are surveyed.

Quercus rubra L. at the age of 34 years reaches the volume stock of 294.48 m³.ha⁻¹ and the above ground biomass stock of 199.93 t.ha⁻¹ in pure stands of the group of *Carpineto-Quercetum* forest stands.

Juglans nigra L. at the age of 32 years reaches 343.03 m³.ha⁻¹ of the volume stock and 134.52 t.ha⁻¹ of the aboveground biomass stock in pure stands of the group of *Ulmeto-Fraxineum* forest types.

Pinus nigra Arnold at the age of 100 years reaches the volume stock of 464 m³.ha⁻¹ at 30 % representation in mixed stands of the group of *Querceto-Fagetum* forest types in the region of the Malé Karpaty Mts.

KEYWORDS: *Quercus rubra* L., *Juglans nigra* L., *Pinus nigra* Arnold, production, aboveground biomass

The interest of forest economic organizers in the past as well as at present has often been directed to woody plant introduction. Main aims of the introduction were:

- a/ to increase timber production of native forests
- b/ to enrich the assortment of home wood processing industry in new sorts of wood in order to take full advantage of their special technological (furniture-making, inside architecture, etc.) properties
- c/ to utilize introduced woody plants for special purposes (afforestation of karsts, damp, eroded areas, localities at the timber line, areas

affected by pollution, etc.)

d/ to raise forest aesthetics (actual question in recreation and town forests as well as in forest-parks).

On the other hand GURSKIY (1957) considered the following characteristics decisive for introduction of woody species:

1. full cold resistance, spring and autumn frost resistance
2. good growth and shapable stems
3. full-woodiness and ability to reach a great age
4. ability to produce germinant seeds securing further reproduction.

In addition, to the requirements of GURSKIY (1957), the resistance of introduced species against biotic pests and fungal diseases (HRUBÍK 1989, JUHÁSOVÁ and HRUBÍK 1984) should be added. The introduction of woody plants becomes more important nowadays as the aspects of interspecies hybridization are taken into consideration, which is a highly actual matter especially in firs (GREGUSS 1989, KORMUŤÁK 1985), pines (KORMUŤÁK 1984), and oaks (OSTROLUCKÁ 1989), but also in other genera such as willow and poplar (KOHÁN 1983, VOJTUŠ 1973, VARGA 1981). Such hybrids are noted for welcome economic properties (high productivity, resistance against diseases and pollution, better wood quality, etc.).

Relatively high stand stock in Slovakia, wood species variability and productively favourable mixing of forests in Slovakia, especially in its central and east parts, did not force the forest practice to introduce exotic woody species more intensively in order to reach higher productivity. In the last years, having in mind the unsolved problems of continuous retreat tendency of *Picea abies* and rising tendency of the negative influence of pollution as the so called oak graphiosis, more resistant and perspective introduced species have begun to be grown in these areas.

Our primary institutions concerned with introduction (arboreta, botanical gardens, parks) where a rich gene pool of exotic woody species can be found, played an important role in selection of suitable species. This gene pool has been subjected to a detailed taxonomic (BENČAŤ 1982), ecological-productive (HOLUBČÍK 1968, TOKÁR 1973, 1974, 1976, 1978), and protective (JUHÁSOVÁ and HRUBÍK 1984, HRUBÍK 1989) research.

Red oak (*Quercus rubra* L.), walnut (*Juglans nigra* L.) and black pine (*Pinus nigra* Arnold) rank among the exotic woody species which are able to become a part of the assortment for the forest cultivation in lowland areas of Slovakia. Their priorities include strikingly quick growth at the young age, modest ecological demands, great adaptability,

resistance against fungal diseases and harmful insect, frost resistance and aesthetical appearance. Red oak and walnut enable high wood production by quick growth, they can successfully replace the wood of oaks of home origin, especially in furniture-making, and their resistance against industrial immissions and tracheomycosis may play a significant role in endangered areas in Slovakia.

Red oak in forest stand of Slovakia is being cultivated in 2769 ha large area. It grows as a part of mix stands with native oaks or other broad-leaved trees in groups of forest types *Carpineto-Quercetum* and *Fageto-Quercetum* (RÉH 1989).

Intensive introduction of walnut in Slovakia began relatively late although its oldest plantation was known 90 years ago at the Forest district Veľké Uherce (HOLUBČÍK 1968). Altogether it has been planted in 74 ha area, of which 43 ha at Želiezovce (HOLUBČÍK 1968, TOKÁR 1990). It has been planted most often in flood plain forests of the group of forest types of *Ulmeto-Fraxinetum*.

Black pine is, according to the data of HOLUBČÍK (1968), cultivated in 4102 ha of the real forest area and in 2829 ha of the reduced forest area which in 1957 represented 0.23 % of the total forest area in Slovakia. According to the data of TOKÁR (1985, 1989) in 1977 black pine in forest stands of the Malé Karpaty Mts. was grown in 2212 ha of the real forest area and 1537 ha in the reduced forest area. Its most common occurrence has been recorded in the group of forest types *Fageto-Quercetum* (617 ha of the reduced area) at the age of 51-60 years (395 ha of the reduced area) and at the age of 1-10 years (404 ha of the reduced area).

According to TOKÁR (1989, 1990) red oak in lowland areas of Slovakia in the group of forest types *Carpineto-Quercetum* at the age of 34 years reaches its volume stock in pure stands $292.48 \text{ m}^3 \cdot \text{ha}^{-1}$, total volume production $363.16 \text{ m}^3 \cdot \text{ha}^{-1}$, dry matter stock of the aboveground biomass $199.93 \text{ t} \cdot \text{ha}^{-1}$ and total production of the aboveground biomass dry matter $250.09 \text{ t} \cdot \text{ha}^{-1}$. The mean annual volume increment is $8.60 \text{ m}^3 \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$, mean annual increment of aboveground biomass dry matter $5.88 \text{ t} \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$, total mean volume increment $10.68 \text{ m}^3 \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$ and total mean increment of aboveground biomass dry matter $7.35 \text{ t} \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$.

Walnut in pure stands (FD Nitra, FR Palárikovo) in the group of forest types *Ulmeto-Fraxinetum* at the age of 32 years reaches volume stock of $34.02 \text{ m}^3 \cdot \text{ha}^{-1}$ and total volume production $404.79 \text{ m}^3 \cdot \text{ha}^{-1}$, aboveground biomass dry matter stock represents $134.52 \text{ t} \cdot \text{ha}^{-1}$ and aboveground biomass dry matter production is $168.66 \text{ t} \cdot \text{ha}^{-1}$. Mean annual volume increment is $10.72 \text{ m}^3 \cdot \text{ha}^{-1} \cdot \text{year}^{-1}$, mean annual increment of

Table 1. Basic information on stands of chosen broad-leaved exotic woody plants.

Woody plant (Stand)	Site (Forest Board)	Group of forest types	Age	Number of trees (no.ha ⁻¹)	Stock		Leaf area index (ha.ha ⁻¹)
					of volume (m ³ .ha ⁻¹)	of total above-ground biomass (t.ha ⁻¹)	
<i>Castanea sativa</i> Mill.	Lefantovce (Nitrianska Streda)	CQ	18	5865	133.05	84.81	2.36
<i>Castanea sativa</i> Mill.		CQ	18	4880	178.23	120.85	2.86
<i>Quercus petraea</i> (Matt.)Liebl.			19	526	8.21	7.63	0.21
Total				5406	186.44	128.44	3.07
<i>Castanea sativa</i> Mill.	Lefantovce (Nitrianska Streda)	CQ	18	3069	92.55	75.48	1.67
<i>Tilia cordata</i> Mill.			19	2559	33.84	20.49	0.48
Total				5628	126.39	95.97	2.15
<i>Castanea sativa</i> Mill.	Lefantovce (Nitrianska Streda)	CQ	18	3177	68.49	46.35	1.39
<i>Pinus silvestris</i> L.			19	974	41.30	23.62	1.77
Total				4151	109.79	69.97	3.16
<i>Quercus rubra</i> L.	Ivanka (Nitra)	CQ	29	3328	262.80	175.49	6.02
<i>Quercus rubra</i> L.			29	3706	193.05	134.63	4.95
<i>Juglans nigra</i> L.			28	533	65.54	33.01	1.35
Total				4239	258.59	167.64	6.30
<i>Juglans nigra</i> L.	Ivanka (Nitra)	CQ	27	1093	245.28	117.44	4.90
<i>Juglans nigra</i> L.			28	1056	173.44	86.92	3.72
<i>Quercus rubra</i> L.			29	856	28.40	20.62	0.84
Total				1912	201.84	107.54	4.56
<i>Juglans nigra</i> L.			26	1412	134.41	88.31	3.60
<i>Tilia cordata</i> Mill.	22	4980	41.58	33.85	7.89		
Total		6392	175.99	122.16	11.49		

aboveground biomass dry matter 4.20 t.ha⁻¹.year⁻¹, total mean volume increment is 12.65 m³.ha⁻¹, and total mean increment of aboveground biomass dry matter is 5.27 t . ha⁻¹.year⁻¹.

Mixed stands of red oak and walnut are also highly productive. They reach, at the age of 34 years, volume stock 274.67 m³.ha⁻¹, total volume production 381.68 m³.ha⁻¹, aboveground biomass dry matter stock 181.96 t.ha⁻¹ and total production of aboveground dry matter is 256.90 t.ha⁻¹, their production can consequently be compared with the production of pure stands.

The most productive stands of black pine are those with the representation of pine to 30 %. Volume stock in groups of forest types *Querceto-Fagetum* is 464 m³.ha⁻¹, *Fageto-Quercetum* 432 m³.ha⁻¹, and *Fagetum pauper* 443 m³.ha⁻¹. Mixed stands are from 10 to 64 % more productive than the pure ones.

Súhrn

V referáte sa zhodnocujú výsledky rastu a produkcie ako aj možnosti pestovania významných cudzokrajných drevín (*Quercus rubra* L., *Juglans nigra* L. a *Pinus nigra* Arnold) v nížinných oblastiach na Slovensku.

Quercus rubra L. pri veku 34 rokov v skupine lesných typov *Carpineto-Quercetum* dosahuje v rovnorodých porastoch zásobu objemu 292,48 m³.ha⁻¹ a zásobu nadzemnej biomasy 199,93 t.ha⁻¹.

Juglans nigra L. pri veku 32 rokov v skupine lesných typov *Ulmeto-Fraxinetum* dosahuje v nezmiešaných porastoch objemovú zásobu 343,02 m³.ha⁻¹ a zásobu nadzemnej biomasy 134,52 t.ha⁻¹.

Pinus nigra Arnold pri veku 100 rokov v zmiešaných porastoch pri zastúpení do 30 % v oblasti Malých Karpát dosahuje objemovú zásobu v skupine lesných typov *Querceto-Fagetum* 464 m³.ha⁻¹.

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