Ekológia (Bratislava) Vol. 29, No. 1, p. 15–19, 2010
doi:10.4149/ekol_2010_01_15

HERB LAYER PRODUCTION IN THE WILLOW stands ON THE DANUBIAN SOFT-WOOD FLOODPLAIN FOREST SITES

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Abstract

Kollár J., Šimonovič V., Kubíček F.: Herb layer production in the willow stands on the Danubian soft-wood floodplain forest sites. Ekológia (Bratislava), Vol. 29, No. 1, p. 15–19, 2010.

The contribution is focused upon detail production-ecological analysis of the total herb layer biomass (above-belowground) in the different age stages of the willow stands (soft-wood floodplain forest of the *Salici-Populetum* association) in the Danube river inundation. The basic results vary between 1.3 to 3.1 t. ha^{-1} according to the age structure and herb layer cover. At all studied forest types, aboveground biomass is higher than belowground one (1.60–7.00 t. ha^{-1}). The results are compared with those obtained from the Danube and Morava river alluvium.

Key words: herb layer production, willow community, *Salici-Populetum*, floodplain forests, Danube river

Introduction

Production-ecological characteristic of the plant (forest) community is very important as it provides more information on its structure, productivity and stability (Kubíček, Šomšák, 1982). Within our systematic research of both phytocoenological and production-ecological characteristics of the Danubian floodplain forests (e.g. Kubíček, Šomšák, 1982; Šomšák, Kubíček, 1995 a, b; Šomšák et al., 2002; Kubíček, Oszlányi, 2006) we paid some attention also to the willow communities. The stands were selected to sample various age stages of same ecological conditions (*Salici-Populetum myosotidetosum* subassociation) partly also representing the succession stages differed by floristic composition as well as biomass production.

Methods

Phytocoenological characteristic of the soft-wood floodplain forests and phytocoenological relevés in the field were carried out on the principle of the Zurich-Montpellier School, the names of plants are according to Dostál, Červenka (1991, 1992). For estimation of the herb layer biomass we used the principles of the indirect sampling method (Kubíček, Brechtl, 1970) modified for field measurements in summer seasonal maximum (Kubíček, Jurko, 1975; Kubíček, Šimonovič, 1975). Geographical coordinates are listed in the WGS 84 system.

Description of the selected sample sites

All the sampled sites represent conditions of the soft-wood floodplain forest of the *Salici-Populetum myosotidetosum* J u r k o 1958 subassociation (i.e. hygrophilous type of soft-wood floodplain forest) typical by regular and relatively long-lasting floods and gleyic soils. The floristic composition is shown in Table 1.

V_1: Monoculture of cultivated willow
The stand, aged about 15, is formed by a willow cultivated from *Salix fragilis*. Despite it is not a natural stand, it can partly simulate its early succession stage, which are absent in the area in the principle. The undergrowth is made of hygrophilous species. Of these, *Galium palustre* is the most abundant accompanied by e.g. *Leucojum aestivum, Rumex sanguineus, Persicaria mitis, Urtica dioica* etc.

V_2: Monoculture of cultivated willow
Floristic and site characteristic is more-less same as in the previous type except for its age (about 25 years)

V_3: Natural willow forest in the disintegration stage
The open stand of *Salix fragilis* presents natural forest being in a final succession stage (aged about 60–70 years), which is only seldom to find in the region. Contrary to the previous stands, there is a high light income in the undergrowth resulting in *Urtica dioica* invasion. Its prevailing causes distinct changes both in floristic composition and biomass production (see Table 1, Table 2).

Results and discussion

The basic results of the biomass measurements obtained from three types of willow stands (V_1, V_2, V_3) are summarized in Table 2. It contains the following information: type of forest community, herb layer biomass values (above-below-total – A, B, T) in kg.ha^{-1}, dry weight and ratio aboveground/belowground biomass (A/B).

The selected three willow stands occupy same soil-hydrological conditions. They are differed by age and partly by leading tree, but the latter is not considered to be a crucial ecological factor.

Their floristic structure is relatively pure and also regarding to biomass values, there are only three or four dominant species. At the first monoculture site (V_1) they are mainly the following ones: *Galium palustre, Leucojum aestivum* and also *Rumex sanguinea*. As for the older monoculture (V_2), there are mainly these four species: *Galium aparine, Rubus*

caesius, Urtica dioica and *Solidago canadensis.* Other species have a small share on the total biomass values. The highest aboveground biomass values at V_1 site we recorded for *Galium palustre* (0.6 t.ha^{-1}), while the belowground for *Leucojum aestivum* (0.3 t.h^{-1}). V_1 site's total biomass reached 1.26 t.ha^{-1}. The dominant species at V_2 site were the following ones: *Galium aparine, Rubus caesius, Galeopsis speciosa, Urtica dioica,* the total aboveground biomass was 1.13 t.ha^{-1} and belowground one only 0.16t. ha^{-1}, the total biomass values we recorded about 1.3t.ha^{-1}. In the both sites, aboveground biomass was found to be higher than belowground one – ratio is ranged from 2.28 t 7.00.

The highest biomass values we recorded at V_3 site, which represents the old willow forest (aged 60–70 years) close to the natural conditions. Five species act as expressive dominants here – *Urtica dioica, Leucojum aestivum, Solidago canadensis, Galium palustre* and *Rumex sanguinea*. The highest aboveground biomass we obtained for species *Urtica dioica* (0.84 t.ha-1), while that of belowground again for *Leucojum aestivum* (0.76 t.ha^{-1}). The total biomass values were as follows: aboveground 1.9 t.ha^{-1}, belowground 1.2 t.ha^{-1}, total 3.1 t.ha^{-1}. The ratio between aboveground-belowground biomass was in favour of the aboveground biomass (1.60).

The herb layer biomass values obtained from the Danubian soft-wood floodplain forests are quite comparable with our previous results from the Danube and Morava river floodplain forests. Kubíček, Šomšák (1985) found out the following aboveground biomass values for hard-wood floodplain forests: the

T a b l e 1. Phytocoenological relevés of the sampled sites.

Site	V_1	V_2	V_3
Tree layer			
Salix fragilis	.	.	4
Salix sp.	4	4	.
Shrub layer			
Negundo aceroides	.	+	.
Herb layer			
Negundo aceroides	r	r	r
Carex acutiformis	+	+	+
Galium palustre	4	1	1
Leucojum aestivum	2	1	4
Poa palustris	+	1	1
Rumex sanguineus	1	+	2
Solidago canadensis	+	+	2
Symphytum officinale	+	+	1
Barbarea vulgaris	r	.	+
Galium aparine	.	4	1
Humulus lupulus	r	+	.
Iris pseudacorus	+	.	+
Lysimachia nummularia	2	+	.
Lysimachia vulgaris	.	+	+
Myosotis palustris agg.	1	.	+
Persicaria mitis	1	+	.
Ranunculus repens	+	.	+
Rubus caesius	r	3	.
Stachys palustris	r	.	+
Urtica dioica	.	1	4
Caltha palustris	+	.	.
Conyza canadensis	+	.	.
Galeopsis speciosa	.	2	.
Glechoma hederacea	.	+	.
Lactuca serriola	r	.	.
Myosoton aquaticum	.	+	.
Phalaroides arundinacea	.	+	.
Quercus robur	.	r	.
Sonchus arvensis	.	.	r
Sonchus oleraceus	r	.	.

Head to the table:
V_1: 12.06. 2007, Riečina locality (southward of Dedinský ostrov settlement), 47°49´55,8´´ N, 17°35´13,5´´ E, covers: E3 70%, E1 75%, age 15 years, tree height 16 m
V_2: date and locality as the previous, 47°50´51,8´´ N, 17°33´31,1´´ E, covers: E3 75%, E2 3%, E1 98%, age 25 years, tree height 16 m
V_3: date and locality as the previous, 47°49´56,9´´ N, 17°35´10,5´´ E, covers: E3 60%, E1 100%, age 60–70 years, tree height 12 m

T a b l e 2. Herb layer biomass of the differently aged and structured Danubian willow stands.

Community	*Salici-Populetum* (V1)				*Salici-Populetum* (V2)				*Salici-Populetum* (V3)			
Species	A	B	C	A/B	A	B	C	A/B	A	B	C	A/B
Dominant species												
Galium palustre	600	53	653	11.40	14	7	21	2.00	70	9	79	7.76
Leucojum aestivum	97	302	302	0.32	6	14	20	0.44	461	760	1221	0.60
Rumex sanguineus	55	15	15	3.62					42	16	58	2.57
Galium aparine					468	29	497	16.30				
Rubus caesius					305	48	353	2.87				
Galeopsis speciosa					168	23	191	7.35				
Urtica dioica	37	4	41	9.75	90	29	119	3.08	835	300	1135	2.78
Solidago canadensis	24	4	28	5.85	2	1	3	2.00	385	82	467	4.70
Other species												
Ranunculus repens	14	1	15	14.25								
Lysimachia nummularia	30	4	34	6.54								
Myosotis palustris agg.	20	2	22	10.39								
Persicaria mitis					2	1	3	2.00				
Poa palustris					48	6	54	8.15	15	2	17	7.50
Myosoton aquaticum					22	3	25	6.92				
Phalaroides arundinacea					4	2	6	2.00				
Glechoma hederacea					2	1	3	2.00				
Barbarea vulgaris									34	1	35	34.00
Symphytum officinale									16	6	22	2.60
Stachys palustris									37	7	44	5.36
Total	877	385	1262	2.28	1131	164	1295	7.00	1895	1183	3.078	1.60

Abbreviations: A – aboveground biomass, B – belowground biomass, C – total biomass, A/B – aboveground and belowground ratio.

Danube river area (*Fraxino–Ulmetum aegopodietosum)* 0.54 t.ha^{-1}, the Morava river area (*Fraxino–Ulmetum typicum)* 1.5 t.ha^{-1}. Kubíček (1999) observed the following aboveground biomass values from the Danubian floodplain forests: original hard–wood floodplain forests between 0.32–0.77 t.ha^{-1}, poplar monocultures (clone I 214) almost 6 t.ha^{-1} and *Fraxinus americana* monoculture 4 t.ha^{-1}, transitional floodplain forests monocultures (clone I 214), between 3.5–6 t.ha^{-1}, soft-wood floodplain forests willow monocultures (*Salix alba, S. fragilis)* between 3.5–4.5 t.ha^{-1}. Šimonovič et al. (1996) obtained total biomass values from the Morava river secondary willow–poplar forests about 4 t.ha^{-1}. Kubíček et al. (2008) found out the total values of the herb layer biomass for transitional (ash–poplar) floodplain forests between 0.9–1.6 t.ha^{-1} and for hard-wood (ash–elm) floodplain forests between 0.8–1.3 t.ha^{1} on the Morava river alluvium.

Translated by F. Kubíček and J. Kollár

Acknowledgements

The authors are grateful to the Slovak Grant Agency for Science (VEGA) – grant No. 2/027/08 for partial supporting this work.

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