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HERB LAYER PRODUCTION IN THE POPLAR MONOCULTURES ON THE DANUBIAN SOFT-WOOD FLOODPLAIN FOREST SITES

FERDINAND KUBÍČEK, VOJTECH ŠIMONOVIČ, JOZEF KOLLÁR

Institute of Landscape Ecology of the Slovak Academy of Sciences, Štefánikova 3, P.O.BOX 254, 814 99 Bratislava, The Slovak Republic, e-mail: Ferdinand.Kubíček@savba.sk

Abstract

Kubíček, F., Šimonovič, V., Kollár, J.: Herb layer production in poplar monocultures of the soft-wood floodplain forests (various types) on the Danubian soft-wood floodplain forest sites. Ekológia (Bratislava), Vol. 28, No. 2, p. 152–157, 2009.

The paper is focused upon detail production-ecological analysis of the total herb layer biomass (above-and belowground) in the various types of the soft floodplain forests on the Danube river. The basic results varied between 1 and 5.5 $t.ha^{-1}$ according to the herb layer cover. At all forest types, aboveground biomass is essentially higher than the belowground one (2.52–3.11). The results are compared with other ones obtained from the Danube and Morava river alluvium.

Key words: herb layer production, poplar monoculture, floodplain forests, Danube

Introduction

The herb layer is an important indicator of any changes and negative impact and interferences to plant (forest) community. From this point of view, production-ecological characteristics of the plant community are very important – they provide more information on its structure, productivity and stability. The aim of this contribution is a detailed herb layer biomass analysis of the various types of poplar monocultures planted on the sites of the Danubian soft-wood floodplain forests.

Methods

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). More detailed information on the applied method may also be found elsewhere (e.g. Kubíček, Šomšák, 1982). Phytocoenological

characteristics of the soft-wood floodplain forests and phytocoenological relevés in the field were made on the principle of the Zurich-Montpellier school, the names of plants are according to Dostál, Červenka (1991, 1992). More detailed information on the flora and vegetation is to be found in some previous papers (Šomšák, Kubíček, 1995a, b; Šomšák et al., 2002).

Description of the selected sample sites

Forest ecosystems in the Danube river watershed are an important landscape-ecological element forming the whole character of the landscape. There are mainly floodplain forests, which are typical dominants of this region and represent a scarce complex both within Slovakia and Central Europe. Nowadays, there is only a rest of them and their largest extent is in the area of direct inundation – interdike space.

Regarding the fact that soft-wood floodplain forests cover relatively large area in interdike space of the Danube river, our research was focused on the association *Salici-Populetum* (Tx. 1931) Meier-Dies 1936 – willow-poplar forests.

The tree layer of original phytocoenoses was created by willows (*Salix alba, S. fragilis)* and domestic poplars (*Populus nigra, P. alba, P. x canescens).* At the present, tree composition is formed, besides of original tree species, prevailingly by cultivated poplars – mainly clone I-214, and rarely also *Populus robusta*, *P. monilifera* and in last ten years also *P. panonia*. The shrub layer is built by *Sambucus nigra, Swida sanguinea,* rarely *Salix caprea, S. triandra* and *Crataegus monogyna*. The herb layer consists of hygro- and nitrophilous species. Of these, *Urtica dioica, Phalaroides arundinacea* and *Rubus caesius* are to be mentioned first of all. In many stands (especially in open ones), the dominance of some neophytes is typical (*Impatiens glandulifera, Aster novi-belgii* agg.*, Solidago canadensis, S. gigantea).*

The *Salici-Populetum* association was divided into three subassociations (see Šomšák et al., 2002):

Subassociation: *phragmito-caricetosum* Jurko 1958
Subassociation: *myosotidetosum* Jurko 1958
Subassociation: *typicum* Oberdorfer 1953
Variant: with *Urtica dioica*
with *Rubus caesius*
with *Swida sanguinea*

Following this classification, three different sample sites of the soft-wood floodplain forests (poplar monocultures) of different age were selected, which are characterized by following relevés:

1. *Salici-Populetum myosotidetosum* (T_1):

Forest department of Gabčíkovo, stand 194 a, moderate depression, E_3 90%, E_2 0%, E_1 80%, height of the tree layer 12 m, age 10 years.

$E_{3:}$ *Populus (clone* I 214) 5

$E_{1:}$ *Urtica dioica* 3*, Phalaroides arundinacea* 2*, Solidago canadensis* 1*, Glechoma hederacea* 1*, Carex acutiformis* +*, Galium aparine* (1-2)*, Impatiens glandulifera* +*, Myosotis palustris* agg. +*, Myosoton aquaticium* +*, Persicaria mitis* +*, Poa palustris* +*, Phragmites*

australis +, *Rubus caesius* +, *Rumex conglomeratus* +, *Symphytum officinale* +, *Angelica sylvestris* r, *Arctium lappa* r, *Calystegia sepium* r,

2. *Salici-Populetum typicum* , variant with *Swida sanguinea* (T_2)

Forest department of Gabčíkovo, stand 192 a, drier site, E_3 80%, E_2 40%, E_1 60%, height of the tree layer 15 m, age 15 years

E_3: *Populus* (clone I 214) 4, *Fraxinus americana* +

E_2: *Swida sanguinea* 3, *Fraxinus americana* 1-2, *Ulmus minor* +

E_1: *Urtica dioica* 2-3, *Glechoma hederacea* 2-3, *Galium aparine* (2), *Rubus caesius* 1, *Swida sanguinea* 1, *Carduus crispus* +, *Carex acutiformis* +, +, *Fraxinus americana* +, *Galeopsis speciosa* +, *Impatiens glandulifera* +, *Moehringia trinervia* +, *Negundo aceroides* +, *Phalaroides arundinacea* +, *Poa palustris* +, *Rumex conglomeratus* +, *Solidago canadensis* +, *Ulmus minor* +, *Arctium lappa* r, *Angelica sylvestris* r, *Iris pseudacorus* r, *Symphytum officinale* r

3. *Salici-Populetum typicum,* variant with *Urtica dioica* (T_3)

Forest department of Gabčíkovo, stand 159 f, E_3 70%, E_2 1%, E_1 100%, height of tree layer 22 m, age 23 years

E_3: *Populus robusta* 4

E_2: *Swida sanguinea* +

E_1: *Impatiens glandulifera* 4-5, *Urtica dioica* 3, *Galium aparine* (2), *Carduus crispus* +, *Cirsium arvense* +, *Humulus lupulus* +, *Rubus caesius* +, *Phragmites australis* +, *Solidago canadensis* +, *Symphytum officinale* +, *Swida sanguinea* +

Results and discussion

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

The floristic structure of all three selected communities is relatively pure, but regarding to biomass values, there are six expressive dominants – *Urtica dioica, Impatiens glandulifera, Solidago canadensis, Rubus caesius,* and in two sample areas (T_1 and T_2) also *Phalaroides arundinacea* and *Glechoma hederacea.* Other species have a small share on the total biomass values. The highest biomass values we observed for *Urtica dioica* in T_1 and T_3 sample areas, aboveground biomass between 2–3 t.ha^{-1}, less – only 350 kg. ha^{-1} – in T_2 (reflecting a high cover of the shrub layer). Belowground biomass varied in both sample plots between 736–764 kg. ha^{-1}, while in T_2 it reached 165 kg. ha^{-1}. As for *Impatiens glandulifera,* in both sample plots (T_1 ,T_3), aboveground biomass ranged from 0.6 to 0.7 t.ha^{-1} and belowground biomass 66–422 kg.ha^{-1}. Only at sample area T_1 we observed also high values of both biomass particles – aboveground 934 and belowground 438 kg. ha^{-1}. In all cases, there was aboveground biomass higher than belowground one – ratio is ranged from 2.86 to 10.79.

T a b l e 1. Herb layer biomass of poplar monocultures [kg.ha-1] (various types the soft – wood floodplain forests).

Community	*Salici – Populetum myosotidetosum* (T1)				*Salici – Populetum typicum* variant with *Swida sanguinea*				*Salici – Populetum typicum* variant with *Urtica dioica*			
Species	A	B	C	A/B	A	B	C	A/B	A	B	C	A/B
Dominant species												
Urtica dioica	2111	764	2875	2.76	350	165	521	2.12	3239	736	3975	4.40
Impatiens glandulifera	711	66	777	10.79	106	8	114	14.63	591	422	1013	1.40
Solidago canadensis	87	25	112	3.43	13	3	16	4.13	31	3	34	11.28
Rubus caesius	29	42	71	0.67	32	35	67	0.91	245	156	401	1.57
Phalaroides arundinacea	934	438	1372	2.13	11	4	15	2.86	-	-	-	-
Glechoma hederacea	120	22	142	5.55	89	9	98	9.92	-	-	-	-
Other species												
Symphytum officinalis	17	3	20	5.06	48	13	61	3.57	-	-	-	-
Myosotis palustris agg.	7	1	8	7.00	-	-	-	-	-	-	-	-
Poa palustris	4	1	5	4.00	-	-	-	-	-	-	-	-
Persicaria mitis	40	7	47	5.54	-	-	-	-	-	-	-	-
Swida sanguinea	-	-	-	-	82	54	136	1.53	-	-	-	-
Carex acutiformis	-	-	-	-	9	3	12	3.00	-	-	-	-
Total	**3960**	**1369**	**5329**	**2.86**	**740**	**294**	**1034**	**2.52**	**4106**	**1317**	**5423**	**3.11**

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

Comparing the total biomass values of selected forest communities, we can see some differences. Poplar monocultures with low cover of the shrub layer have relatively high total biomass values (T_1 and T_3) – both about 5 t.ha $^{-1}$, meanwhile if the shrub layer cover is high (e.g. sample area T_2) total biomass is only sbout 1 t.ha^{-1}. In this case it also concerns drier type of the community *Salici-Populetum typicum* variant with *Swida sanguinea.*

The herb layer biomass values obtained from Danubian soft-wood floodplain forests are quite comparable with our previous results from the Danube river and Morava river floodplain forests. Kubíček, Šomšák (1985) found out the following aboveground biomass values for hard-wood floodplain forest: Danube river area (*Fraxino–Ulmetum aegopodietosum)* – 539 kg.ha $^{-1}$, Morava river area (*Fraxino–Ulmetum typicum)* – 1.5 t.ha^{-1}. Šimonovič et al. (1996) obtained total biomass values (A+B) from the Morava river secondary willow-poplar forests about 4 t.ha^{-1} and Šimonovič, Šimonovičová (1999) also from the Morava river obtained total biomass of hard-wood floodplain forests (*Fraxino-Ulmetum)* about 2.7 t.ha^{-1}. Kubíček (1999) observed the following aboveground biomass values from the Danubian floodplain forests:

1. original hard-wood floodplain forests between 0.32–0.77 t.ha^{-1}, poplar monoculture (I 214) almost 6 t.ha^{-1} and *Fraxinus americana* monoculture 4 t.ha^{-1}
2. transitional floodplain forests monoculture (clone I 214) between 3.5–6t.ha^{-1}
3. soft-wood floodplain forests willow monocultures (*Salix alba x S. fragilis*) between 3.5–4.5 t.ha^{-1}.

For the Morava river transitional (ash-poplar) floodplain forests, Kubíček et al. (mscr) found out the total values of the herb layer biomass (A+B) between 0.9–1.6 t.ha^{-1} and for hard-wood (ash-elm) floodplain forests between 0.8–1.3 t.ha^{-1}.

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References

Dostál, J., Červenka, M., 1991: The great key for determination of plants (in Slovak). Part I. SPN, Bratislava, 775 pp.

Dostál, J., Červenka, M., 1992: The great key for determination of plants (in Slovak). Part II. SPN, Bratislava, p. 787–1561.

Kubíček, F., Brechtl, J., 1970: Production and phenology of the herb layer in an oak-hornbeam forest. Biológia (Bratislava), *25*: 651–666.

Kubíček, F., Jurko, A., 1975: Estimation of above-ground biomass of the herb layer in forest communities. Folia Geobot. Phytotax., *10*: 113–129.

Kubíček, F., Šomšák, L., 1982: The herb layer production of fir forests in the eastern part of the Slovenské rudohorie Mts. Biologické Práce, *28*: 59–180.

Kubíček, F., Šomšák, L., 1985: Production analysis of the herbaceous layer in floodplain forests (Subaliance *Ulmenion* Oberd. 1953) of western Slovakia. Ekológia (ČSSR), *4*: 347–365.

Kubíček, F., 1999: Production of the herb layer in the Danubian lowland floodplain forests. Ekológia (Bratislava), *18*: 301–309.
Kubíček, F., Šimonovič, V., Kollár, J., Kanka, R., 2008: Herb layer biomass of the Morava river floodplain forests. Ekológia (Bratislava), *27*: 23–30.
Šimonovič, V., Šomšák, L., Kubíček, F., Mičuda, R., 1996: Comparison of the herb layer biomass of an original and secondary willow-poplar forests of the Morava river. Ekológia (Bratislava), *15*: 321–329.
Šimonovič, V., Šimonovičová, A., 1999: Some production-ecological and microbiological characteristics of floodplain forests in the Morava river inundation area. Ekológia (Bratislava), *18*: 341–349.
Šomšák, L., Kubíček, F., 1995a: Genesis of flora and vegetation of the Danubian lowland in relation to the hydroelectric power structures Gabčíkovo-Nagymaros. In Mucha, I. (ed.), Gabčíkovo part of the hydroelectric power project environmental impact. Faculty of Natural Science, Comenius University, Bratislava, p. 165–174.
Šomšák, L., Kubíček, F., 1995b: Flora and vegetation of the Danubian lowland within the impact of the Gabčíkovo project. Counter-Memorial of the Slovak Republic, Vol. 4, Ministry of Foreign Affairs, Bratislava, p. 73–90.
Šomšák, L., Šimonovič, V., Kollár, J., Lakatošová, E., 2002: Elaboration of phytocoenological map of the left-side inundation of the Danube river in the stretch Dobrohošť-Sap (in Slovak). GROUNDWATER consulting group, Bratislava, 37 pp.