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GROWTH OF THE DOMINANT WOODY PLANTS OF FLOODPLAIN COMMUNITIES IN THE CHANGING HYDROLOGICAL AND CLIMATIC CONDITIONS

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ABSTRACT

Poplars and willows growing in fragments of Váh river floodplain communities were analysed on two stands with different dynamics of the hydrologic regime. There was confirmed statistically significant influence of several hydrologic and climatic characteristics on radial increment of poplars and willows. On both analysed stands, decrease of radial increment of willows was found out from the beginning of eighties, which is statistically significant in some years. Evident decrease of radial increment of poplars on locality Ďulov Dvor began only after year 2000. On locality Čalovec, this woody plant showed more or less positive increment response. According to the obtained data, poplar appears to be more adaptable woody plant under conditions of long-term trend of groundwater level decrease.

KEY WORDS: growth, radial increment, hydrologic regime, willow, poplar

INTRODUCTION

Natural communities of the Váh river bottomland were originally created by floodplain forests with high biodiversity. Due to intensive transpiration and huge growth rate of biomass increment, the soft-wood species of floodplain forests are very significant for utilization of groundwater reserves. This way groundwater enters the hydrologic cycle and it is not lost through underground outflow. Currently there is preserved approximately 1% of the original klimax willow-poplar floodplain forests and bank alder forests (Jureková et al. 2008). In the softwood floodplain forests the dominant woody polants are poplar and willow. The limiting ecological

factor is groundwater level, regular floodings in growing season and climatic characteristics. According to Fritts (1976), Vojtuš (1978) Larcher (1988), the growth and diameter increment of woody plants is synchronised with the ecological stand conditions. The dependence of diameter increment on sum of precipitation in growing season was confirmed also by dendrochronologic analysis (Šomšák et al. 1995).

Study of tree growth is metodically difficult especially due to their dimensions and high degree of variability. The quantitative analysis uses phenometry procedures which enable to determine the influence of environmental factors on cambium activity and diameter growth. More detailed analyses confirmed that precipitation and temperature have the highest influence on diameter increment of woody plants via impact on cambium activity. In the beginning of growing season, Cambium creates earlywood (spring wood), it consists of thin-walled tracheides with big diameter. In summer, cambium creates well-differentiated late wood (summer wood) with thick-walled tracheides.

It is confirmed (Larcher 1988), that spring temperatures and other stimulating factors of bud sprouting and twig elongation are in positive correlation with production of spring wood. Factors which hasten ageing of the leaves support production of the summer wood. Precipitation has low importance in spring, because after winter, there is nearly often sufficient supply of water in soil and trees use supply of water accumulated during winter season (Svoboda 1952). In June, temperature and precipitation are equally important. Later, in July and August, the influence of temperature is lower and importance of precipitation increases. The precipitation is important exceptionally in August, because groundwater reserves are probably drained and trees depend on supply of surface water. According to Fiedler and Wenk (1973), period at the end of August and in the beginning of September is important, because in this time the majority of woody plants terminate diameter growth

The paper presents study of diameter growth interactions of two fast-growing woody plants willow (*Salix*) and poplar (*Populus*) to selected climatic-hydrological factors of floodplain forest in alluvia of the Váh river.

MATERIAL AND METHODS

Characteristics of experimental stands

The experiment was performed on two localities with fragments of floodplain forests: in land register of town Komárno, part Ďulov Dvor-Zámocká Pusta, between elevation points 107,09 and 108,60 metres and in land register of village Čalovec, elevation points 109,30 and 108,30 metres. The climatic conditions were following (according to data from Slovak hydro-meteorological institute): average annual air temperature 11,0°C, average annual precipitation 520,28 mm, sunlight 2100 hours. Groundwater level under surface was 2,20 m on locality Ďulov Dvor and 1,82 m on locality Čalovec. Soil conditions represent Calcaric Fluvisols. From point of view of syntaxonomical structure, localities can be classified as *Salici-Populetum fac. Fraxinetosum*.

The description of dominant woody plants and dendrometric characteristics

The subject of analysis were individuals of the grey poplar (*Populus canescens* (Ait).J.E Sm) and white willow (*Salix alba* L.) growing in the first and second forest storey according to Kraft (Šebík and Polák 1990). Selected trees had straight trunk and regularly developed crown, their position in spatial structure of the stand was more-less the same.

Average age of the willows on locality Ďulov Dvor is 43 years, average age of the poplars is 31 years. On locality Čalovec, the average age of analysed willows is 20 years and average age of the poplars is 26 years. However, real age of the willows on Čalovec is higher, because these individuals

were often pruned and cut. They regenerated on tree stumps in height about 1 m above surface of the soil profile.

On investigated stands, the following dendromeric characteristics of the dominant woody plants were measured: height with accuracy 1 m, diameter at breast height (dbh) with accuracy 10 mm and perimeter of trunk with accuracy 10 mm.

More detailed analysis of diameter growth was performed according to annual radial diameter increment. Increment cores (woody cylinders) were sampled from trunks at height 1,3 m for analysis of the radial diameter increments. Procedure and sampling position was done according to Šmelko (2000).

Sampled increment cores were pasted into woody frames and smoothed. The widths of annual growth rings were measured in CorelDraw 11 (Fig. 1).

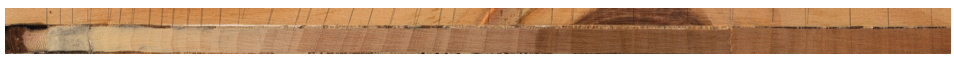

Fig. 1: Analysis of the diameter increment image of white willow Salix alba

Synchronization of the annual ring diagrams

Synchronization of the annual rings is essential methodical step, which ensures correct chronological assessment of the individual annual rings. Existence of defects in annual ring creation and also metrical errors within measurement of the width of annual rings requires verification and synchronization.

The basic synchronization curve for evaluated area was constructed from average standardized values of diameter increment per group of trees with the similar increment reaction (result of the regression and cluster analysis). Synchronization curve was afterwards compared with course of the climatic data (temperatures and precipitation) which significantly influence diameter increment during year. Final synchronization curve was compared with the annual ring diagrams of the particular trees. Their synchronization was done by method of the distinctive annual rings (Šebík and Polák 1990).

Fig. 2: Synchronized diagram of the radial diameter increment for localities Ďulov Dvor and Čalovec with 95% confidence interval

Climatic-hydrological characteristics of the analysed areas

Climatic-hydrological data from several stations, which are situated the nearest to investigated localities, were utilized for analysis. Evaluated climatic data (station Hurbanovo) include average daily minimal and maximum temperatures and monthly sum of precipitation. The course of these climatic characteristics has shown generally known long-term increasing trend of air temperatures (Fig. 3A). The course of precipitation amount indicates decreasing trend of precipitation sums in summer period and their increase in spring (Fig. 3B).

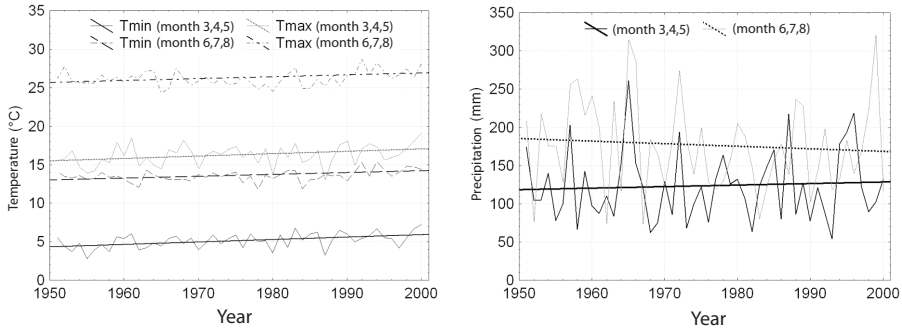

Fig. 3: The course of average of temperature sums (A) and sum of precipitation (B) full lines represent data for March April and May, dotted lines represent data for June July and August

Hydrological data originate from 5 various hydrological stations (Čalovec 2659, Mužla Kendeles 2514, 514 and Komárno – Zámocká Pusta 537, 2537), from which the depth of groundwater level was calculated. There were analysed arithmetic mean, minimum and maximum values of groundwater depth during defined period.

The longest time series comes from station Mužla Kendeles 514, where more conspicuous decrease of groundwater level occurred in years 1981-1982. The course of groundwater level depth has similar tendencies and trends on all hydrologic stations (Fig. 4). Due to analysis of the hydrologic regime changes on radial increment of trees there was accepted a hypothesis about equivalency of the log-term tendencies of groundwater level depth on station Mužla Kendeles 514 and on analysed localities (where increment cores were sampled). Data (Fig. 4) have shown the significant increase of groundwater level depth.

Consecutively, daily or monthly values of climatic and hydrologic data were summarized or averaged for two periods. The first period are months March, April and May, the second period represents following three months June, July and August. These months decisively influence growth and radial increment of woody plants.

The dimension of radial increment depends also on previous growing season. Therefore (climatic and hydrologic) data moved against values of radial increment by one year, were prepared for evaluation as well.

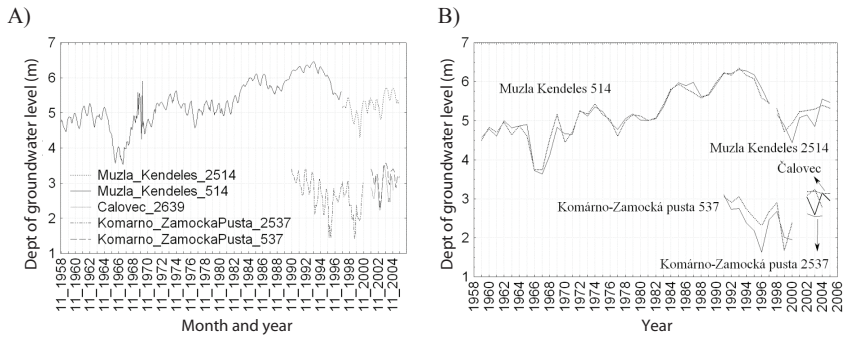

Fig. 4: The course of average monthly (A) and average summarised values of groundwater level (B) full line represents data for March April and May, dotted line represens data for June July and August

Quantification of increment changes

Quantification of increment changes is based on and modified according to dendrochronological model. The method was successfully applied by several authors (Vinš 1961, Pollanschütz 1967, Petráš et al. 1993, Riemer et al. 1997, Šmelko and Ďurský 1999).

As a first step, there is necessary to exclude the influence of age trend from course of time series of radial increments. The age trend is eliminated from increment course by calculation of annual rings indexes as ratio real increment / model increment.

Regarding the fact that radial increments are sampled from differently old trees, creation of increment model in dependence on year required transformation of data in relation to age. The equalization of relation between width of radial increment (y) and age (x) as well as for creation of increment model was calculated using equation according to Korsuň:

$$y = a_0 \cdot x^{a_1 + a_2 \cdot \log(x)}$$

The course of derived model increments for poplar (*Populus*) and willow (*Salix*) on localities Ďulov Dvor and Čalovec is shown on Fig.5. The real radial increments were indexed towards these models and their course during calendar years was obtained by backward transformation.

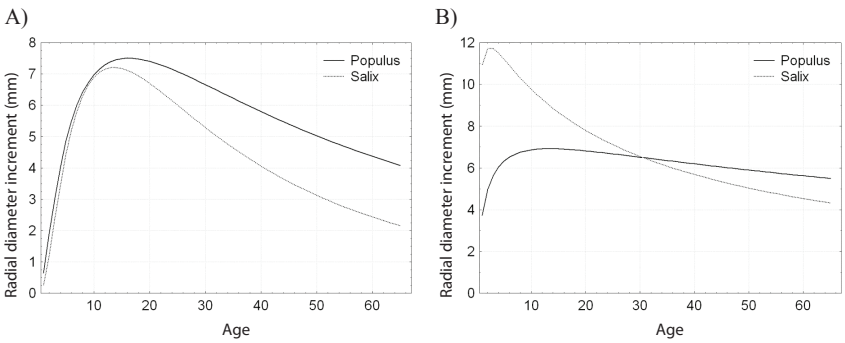

Fig. 5: Model of the radial diameter increment for Populus and Salix on locality Ďulov Dvor (A) and Čalovec (B)

RESULTS AND DISCUSSION

Relationship between height and stem girth

Willows and poplars reached higher dimensions on locality Ďulov Dvor, whilst dendrometric characteristics of some willows (stem girth and height) are influenced by their vegetative regeneration (stump sprouting) on locality Čalovec. Quite high variability of the stem girth values ($S_{x\%}$ > 30%). was recorded within analysed woody plants on both analysed stands. The differences between stands are evident from diagram of the relationship between heights and stem girth values of the studied woody plants (Fig. 6 and 7).

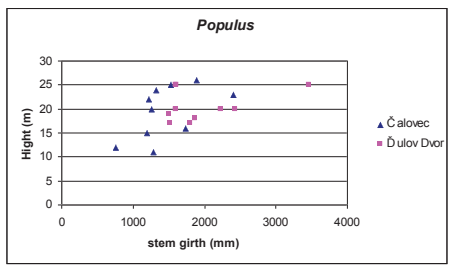

Fig. 6: Relationship between height and stem girth of the poplars on analysed stands

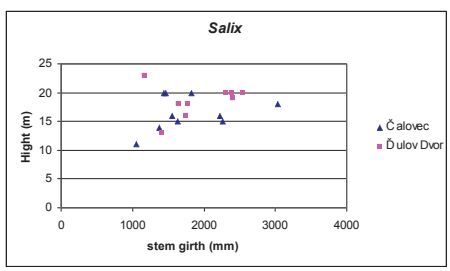

Fig. 7: Relationship between height and stem girth of the willows on analysed stands

Poplars on locality Čalovec have quite high variance of the dendrometric parameters in comparison with individuals on locality Ďulov Dvor, what indicates variable stand conditions and possible differences in the age structure of their population. The population density of poplars on locality Čalovec is 2-3 trees per 10m^2. It is a sparsely stocked stand with broken topography. Poplars grow on elevated parts of the terrain mostly in little groups (2-3 individuals) or as solitary trees. Their dendrometric parameters are quite low, with average value of height 9,5m and average value of stem girth 1458 mm. The differences in dendrometric characteristics of poplars on analyzed stands are evident also on diagram (Fig. 6).

The girth increment is limited rather by hydrologic regime of the stand, than by sunlight access, because poplar reached higher values of stem girth (1510 – 3460 mm) on locality with higher stand density (Ďulov Dvor).

On locality Ďulov Dvor poplars grow in more abundant groups (5-7 trees) on elevated parts of the terrain. The population density is 8-10 trees per 10 m^2.

The differences of the willow dendrometric parameters have similar pattern as for poplar

between analyzed stands (Fig. 7). On locality Čalovec, willows reached lower height values (16,5 m) and in average lower values of stem girth (1789 mm). The population density is 4-5 individuals per 10 $m^{2.}$ Willows grow mostly in the terrain depressions. Their tree habit is deformed by pruning and cutting. Trees grow in small groups and stand has open canopy.

On locality Ďulov Dvor, willows reached higher height values as well as better dimensions of the stem girth. Several individuals grow in the main forest storey and influence growth conditions of the other woody plants by upper shading. The population density is 3-4 individuals per 10 m^2. Stand has variable density, the internal part with terrain depression and long-lasting water-logging is quite sparse without evident vegetative or generative regeneration of the woody plants. Stand density is higher at the elevated terrain margins. Individuals on marginal parts of the terrain regenerate vegetatively.

Because of limited number of trees that was possible to evaluate on the analyzed stands, the growth characteristics were evaluated for genus *Salix* and *Populus*, not for particular species. There were found differences between stands. On the locality Ďulov Dvor willow and poplar reached higher dimensions of height and stem girth, than on locality Čalovec. However, found differences are not statistically significant (probably because of the age differences between analyzed trees and their limited number).

On both localities, autochthonous poplars have diameter dimensions comparable with bred clones of poplars. Only vertical growth of autochthonous poplars is slower which can be influenced by woody plant species, individual predisposition of growth rhythm but also by light conditions of stands (Jureková et al. 2008).

Radial diameter increment

Analyses of the radial width increment (Fig. 8A-D) have show that course of increment corresponds to theoretical assumptions (left-skewed curve). The diameter increment of the fast-growing trees culminates quite early. On locality Ďulov Dvor, the diameter increment of the poplars (*Populus*) culminated approximately in the age 25 years (22 + 3 years to grow up to breast height 1,3m) (Fig. 8A). The increment of willows (*Salix*) culminated earlier, approximately in the age 15 years (Fig. 8B).

On locality Čalovec, the course of radial diameter increment is specific in such way, that there is missing distinctive culmination point (Fig. 8C), what can be influenced by very early or slightly recorded culmination. Situation with increment of willows is similar to locality Ďulov Dvor. However, radial increment culminates in the age 10 years (Fig. 8D). All diagrams show several evident changes in the course of the radial increment during life cycle of both analysed woody plants. It is so called seasonal periodicity of the increment changes.

Values of the indexes above 1 signify that real increment is higher than model increment and values under 1 signify lower real increment than model increment. On the locality Ďulov Dvor, the radial increment indexes of *Poplar* have even course up to year 2000, later there is evident decrease of the radial increment (Fig.9A). Similar, even more distinctive trend of the increment course is described for willow (*Salix*), whilst period of the increment fall starts approximately in 1980. Decrease of increment is in several years statistically significant. About year 1995, increment achieved some increase, but in the next years increment again gets negative trend (Fig. 9B)

On locality Čalovec, the increment of poplars (*Populus*) has rather positive response (Fig. 9C), while increment of willows (*Salix*) has decreasing tendency, similarly as on locality Ďulov Dvor (Fig. 9D).

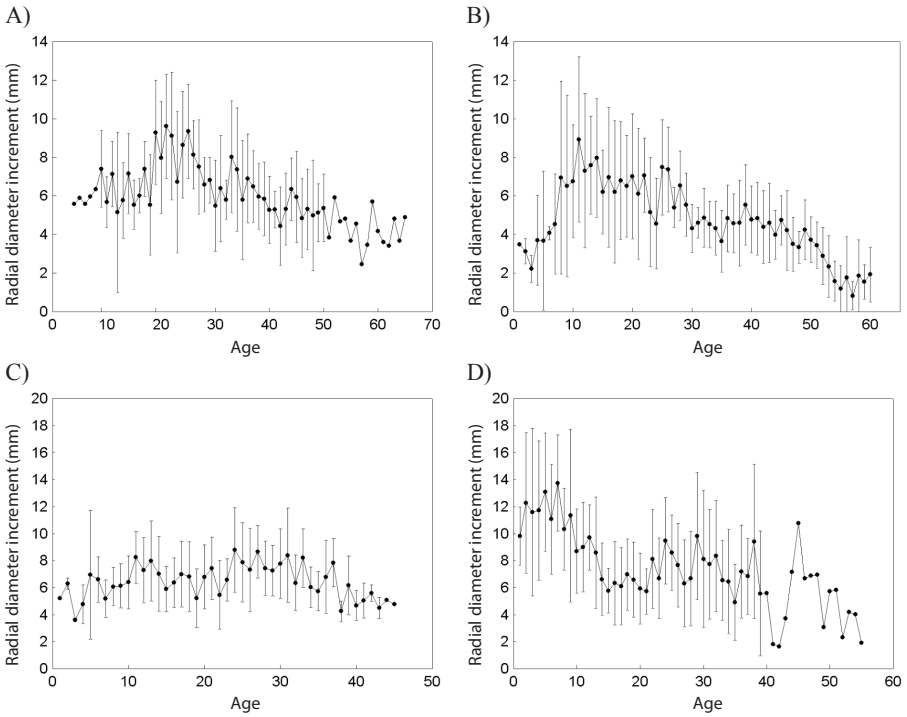

Fig. 8: Course of the average radial diameter increment in relation to age of the trees on position (point) where increment core was sampled. Diagrams A) B) represent locality Ďulov Dvor - Zámocká Pusta. Diagrams C) D) represent locality Čalovec. Diagram A) C) describes poplar (Populus). Diagram B) D) describes willow (Salix). Abscissa in the shape of inverse letter "H" represents 95% confidence interval, where should appear the real value of the radial increment

On locality Ďulov Dvor the statistically significant relation between index of radial increment of the poplar and course of almost all hydrologic indicators on station Mužla Kendeles 514 and in one case also on station Komárno-Zámocká Pusta 537.

The most fitted relations were found out between course of the radial increment indexes and course of maximum values of the groundwater level during period June-August in foregoing year on station 537 (quite fitted relation with value 0,73), as well as on station 514. They are followed by relation between increment and average depth of groundwater level on station 514 during the same period. However, correlation indexes (coefficients) have quite low values in the range 0,35-0,43 (Tab. 1)

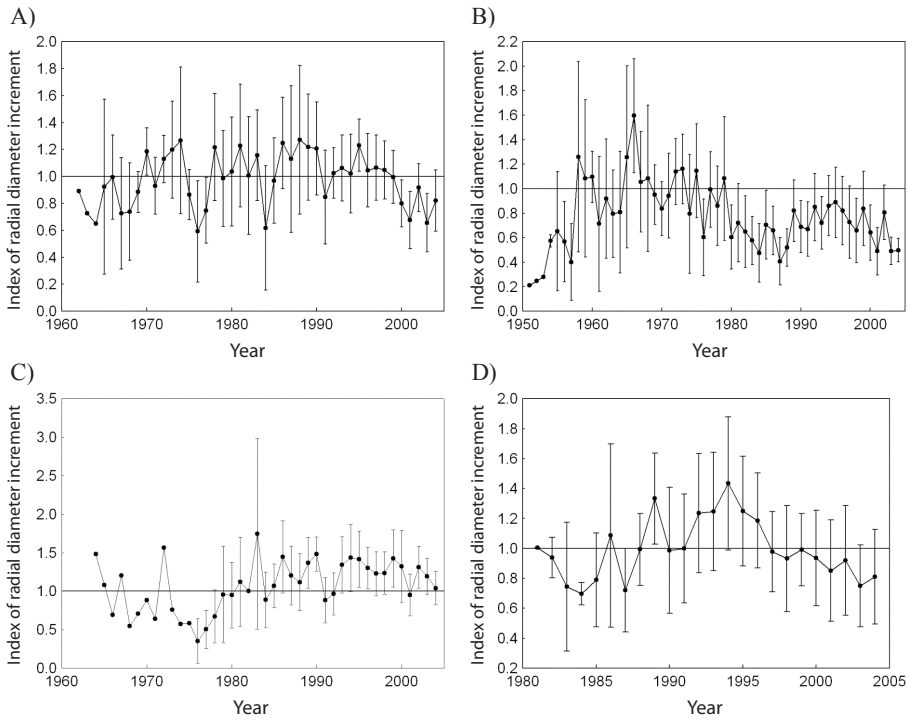

Fig. 9: Course of the average index of radial diameter increment in relation to year. Diagrams A) B) represent locality Ďulov Dvor Zámocká Pusta, diagrams C) D) locality Čalovec. Diagrams A) C) characterise poplar (Populus) and diagrams B) D) characterize willow (Salix). Abscissa in the shape of inverse letter "H" represents 95% confidence interval, where should appear the real value of the radial increment

Relation between hydrologic characteristics and indexes of the radial increment of willow (*Salix*) on locality Ďulov Dvor is more fitted. In contrast with poplar, the correlation coefficients have minus sign, it means that increment decreased with drop of the groundwater level. The values of correlation coefficients for this station ranged from -0,42 to -0,57. The most fitted relation was recorded between radial increment and course of minimum values of groundwater level during period June - August in the year of increment production. Relatively strong relation was proved towards course of minimum values of groundwater level in the year of increment production during months June – August on station 537 Komárno – Zámocká pusta (R = 0,72). Significant relations were recorded also towards course of precipitation sums during mentioned three months in the year of increment production as well as in foregoing year (R = 0,32 a 0,29).

On locality Čalovec, there was recorded the most fitted relation (R=0,72) between indexes of radial increment of poplars and course of minimum values of groundwater level during period June – August in the year of increment production on station 537 Komárno – Zámocká pusta. The significant relation was also found out towards minimal daily averages T_{max} for the same period (R=0,36). Concerning willows (*Salix*), the most fitted correlation was determined between radial increment and course of minimum and average values of groundwater level during period June – August in the year foregoing the increment production (R= 0,60–0,62).

Tab. 1: Regression analysis of relation between the index of radial increment and climatic-hydrological characteristics

	Populus						*Salix*					
	Ďulov Dvor			Čalovec			Ďulov Dvor			Čalovec		
Characteristics	R	p	n	R	p	n	R	p	n	R	p	n
MinOfDailyAverageTmin_C_678	0.141	0.390	39	0.319	0.051	38	0.100	0.491	50	0.353	0.127	20
MinOfDailyAverageTmax_C_678	-0.174	0.288	39	0.360	0.026	38	-0.096	0.509	50	0.280	0.231	20
SumOfMonthlyAveragePrecipitation_mm_678	0.174	0.291	39	0.085	0.613	38	0.329	0.020	50	0.211	0.373	20
MinOfDailyAverageTmin_C	0.186	0.257	39	-0.233	0.160	38	0.192	0.182	50	0.330	0.155	20
MinOfDailyAverageTmax_C	0.220	0.178	39	-0.130	0.436	38	0.190	0.185	50	0.281	0.230	20
SumOfMonthlyAveragePrecipitation_mm	0.046	0.781	39	-0.128	0.443	38	0.022	0.881	50	-0.036	0.881	20
PMinOfDailyAverageTmin_C_678	-0.012	0.943	40	-0.046	0.780	39	-0.141	0.329	50	0.162	0.483	21
PMinOfDailyAverageTmax_C_678	-0.271	0.091	40	-0.013	0.939	39	-0.013	0.929	50	-0.021	0.927	21
PSumOfMonthlyAveragePrecipitation_mm_678	0.128	0.432	40	-0.077	0.640	39	0.297	0.036	50	0.137	0.553	21
PMinOfDailyAverageTmin_C	-0.022	0.894	40	-0.128	0.438	39	0.076	0.599	50	0.142	0.538	21
PMinOfDailyAverageTmax_C	-0.086	0.597	40	-0.181	0.271	39	0.127	0.378	50	-0.045	0.846	21
PSumOfMonthlyAveragePrecipitation_mm	0.170	0.294	40	-0.097	0.558	39	0.252	0.078	50	-0.002	0.993	21
MK_514HI_345_Avgm	0.375	0.024	36	0.044	0.803	35	-0.557	0.000	39	0.398	0.114	17
MK_514HI_345_Minm	0.342	0.041	36	0.055	0.752	35	-0.543	0.000	39	0.400	0.112	17
MK_514HI_345_Maxm	0.392	0.018	36	0.052	0.766	35	-0.555	0.000	39	0.400	0.111	17
MK_514HI_678_Avgm	0.352	0.035	36	-0.001	0.998	35	-0.571	0.000	39	0.388	0.124	17
MK_514HI_678_Minm	0.352	0.035	36	0.008	0.964	35	-0.569	0.000	39	0.382	0.131	17
MK_514HI_678_Maxm	0.320	0.057	36	-0.027	0.877	35	-0.550	0.000	39	0.404	0.108	17
PMK_514HI_345_Avgm	0.402	0.014	37	0.053	0.757	36	-0.438	0.005	39	0.600	0.008	18
PMK_514HI_345_Minm	0.372	0.023	37	0.076	0.659	36	-0.426	0.007	39	0.614	0.007	18
PMK_514HI_345_Maxm	0.396	0.015	37	0.066	0.701	36	-0.449	0.004	39	0.578	0.012	18
PMK_514HI_678_Avgm	0.403	0.014	37	0.042	0.808	36	-0.461	0.003	39	0.622	0.006	18
PMK_514HI_678_Minm	0.393	0.016	37	0.061	0.724	36	-0.461	0.003	39	0.623	0.006	18
PMK_514HI_678_Maxm	0.431	0.008	37	0.017	0.924	36	-0.461	0.003	39	0.610	0.007	18
KZP_537HI_345_Avgm	0.649	0.059	9	0.591	0.094	9	0.564	0.114	9	0.568	0.111	9
KZP_537HI_345_Minm	0.640	0.064	9	0.596	0.090	9	0.548	0.126	9	0.501	0.170	9
KZP_537HI_345_Maxm	0.657	0.054	9	0.588	0.096	9	0.539	0.135	9	0.601	0.087	9
KZP_537HI_678_Avgm	0.483	0.188	9	0.592	0.093	9	0.543	0.131	9	0.495	0.175	9
KZP_537HI_678_Minm	0.658	0.054	9	0.722	0.028	9	0.702	0.035	9	0.620	0.075	9
KZP_537HI_678_Maxm	0.478	0.193	9	0.511	0.159	9	0.467	0.206	9	0.465	0.208	9
PKZP_537HI_345_Avgm	0.446	0.268	8	0.053	0.900	8	-0.014	0.974	8	0.235	0.576	8
PKZP_537HI_345_Minm	0.353	0.391	8	0.015	0.972	8	-0.101	0.811	8	0.143	0.736	8
PKZP_537HI_345_Maxm	0.480	0.229	8	-0.008	0.986	8	0.009	0.983	8	0.302	0.468	8
PKZP_537HI_678_Avgm	0.539	0.168	8	0.230	0.583	8	0.157	0.711	8	0.361	0.379	8
PKZP_537HI_678_Minm	0.374	0.361	8	0.153	0.718	8	0.005	0.991	8	0.243	0.562	8
PKZP_537HI_678_Maxm	0.730	0.040	8	0.316	0.446	8	0.346	0.401	8	0.624	0.098	8

On both investigated localities (Čalovec and Ďulov Dvor), willows showed the tendency of decrease of radial increment production. We assume that it is connected with changes of hydrologic regime (long-term trend of groundwater level drop). It was confirmed also by statistically significant correlations among radial increment and several hydrologic indicators within the investigated area. The values of correlation coefficient document various degree of fitting in described relation between radial increment and hydrologic regime of groundwater. According to Šomšák et al. (1995), the changes of groundwater level are considered to be a limiting (however not alone factor) influencing the radial increment of woody plants in floodplain ecosystems. The second limiting factor is temperature. Confirmed increasing values of the air temperature, especially in summer season (June, July, August) and decrease of precipitation sum can significantly overheat the forest stand. Our assumption is in accordance with findings of Woodward a Diament (1991), who confirmed negative correlation between rate of cambium growth and high values of the air temperature.

On locality Ďulov Dvor, the same tendencies of the diameter increment drop as for willow were found out also for poplar. However, decrease of the radial increment of poplar has some time drift (appears approximately in 2000), while for willows the decrease of the radial increment started already from 1980. The increment drop is in several years statistically significant

The tendency of gradual decrease of groundwater level on investigated stands negatively influenced predominantly willows which create relatively shallow widely expanded root system. On both analysed stands, the reduction of regeneration was found out (there is a lack of generative reproduction and vegetative regeneration is very rare), what also indicates that woody plants are weakened by water deficit in the soil.

Poplars responded slowly on changes of the stand hydrologic regime. On locality Čalovec a positive increment reaction of the poplars was detected.

Poplars in contrast with willows are tolerant to stronger changes of hydrologic regime including reduction of the regular flooding and drip of the groundwater level depth. On stands with higher groundwater level poplars create large root system. Under surface of the soil profile create polycormons, where big numbers of individuals are connected with root systems. Tap root system of poplars is huge and with slow decrease of the groundwater level creates lower root storeys in deeper soil layers. Such model of adaptation was probably used by analysed poplars on investigated localities.

Analysis of hydrologic and climatic characteristics in studied area showed that the impact of stronger dynamics of hydrological regime on locality Čalovec is evident on growth processes of investigated woody plants. The groundwater level on station Čalovec has, in comparison with station 537 Komárno-Zámocká Pusta, interesting course. In summer, groundwater level steeply drops and in September, when rain and snowfall begin, it quickly increases. In early spring and after abundant rains, local surface soaking of stand appeared on locality Čalovec. There is probable that the level of groundwater on this locality is markedly influenced by climate or subsoil. The less significant results were achieved on this locality. The reasons are either differences of hydrologic trends or it is evidence of woody plants adaptability on strong fluctuation of hydrologic regime.

CONCLUSIONS

Presented paper evaluates poplars (*Populus*) and willows (*Salix)* growing in fragments of Váh river floodplain communities. Trees were analysed on two stands (Čalovec a Ďulov Dvor) with different dynamics of the hydrologic regime. Locality Čalovec is characteristic by long-term strong fluctuation of hydrologic regime, which negatively influenced dendrometric characteristics of the woody plants.

Poplars and willows reached bigger dimensions on locality Ďulov Dvor, where also higher population density of investigated woody plants was found out. Registered differences indicate dissimilarities in ecological characteristics of the stands and differences of their hydrologic regime.

On both analysed stands, decrease of radial increment of willows was found out from the beginning of eighties which is statistically significant in some years.

Evident decrease of radial increment of poplars on locality Ďulov Dvor began only after year 2000. On locality Čalovec, this woody plant showed more or less positive increment response.

The analyses confirmed statistically significant influence of several hydrologic and climatic characteristics on radial increment of poplars and willows. On locality Ďulov Dvor, the radial increment of poplars was the most influenced by the extremes of groundwater level depth (especially decrease) in period June - August in the year foregoing analysis of radial increment. On locality Čalovec, the impact of extremes of higher temperatures during the period June-August in the year of radial increment production was confirmed as significant, besides the influence of groundwater depth.

The diameter increment of willows on locality Ďulov Dvor is the most significantly influenced by groundwater level depth in the period June-August in the year of increment production. On this locality, the sum of precipitation in mentioned period has also significant impact on diameter increment. On locality Čalovec, groundwater level depth during whole growing season of the year foregoing production of radial increment was confirmed as the strongest factor influencing the radial increment.

The experimental study confirmed significant influence of hydrologic regime changes on diameter growth of investigated woody plants. The poplar appears to be more adaptable woody plant under conditions of long-term trend of groundwater level decrease, as a consequence of its eco-physiological characteristics.

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