SELECTED FACTORS INFLUENCING AUTUMN PHENOLOGY OF CHOSEN FOREST TREE SPECIES

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Abstract. Changes in autumn phenology are less studied than changes in spring phenology and therefore poorly understood. They are influenced by huge amount of factors which can be hardly explained. We focused particularly on air temperature, amounts of rainfall and water balance. We examined spatial patterns (across sites) and temporal patterns (across years). Between years 2009 and 2010 we had monitored autumn vegetative phenological phases on three sites which are located in the south part of Kremnické vrchy mountains and in Zvolenská kotlina basin (Arborétum, Bukovina, Boky). We have monitored coloring of leaves and leaves falling on *Corylus avellana* L. and *Carpinus betulus* L..

Introduction

Analysis of the timing of phenological phases (especially the autumn phenophases) and the influence of meteorological factors on their timing and duration is so far little explored area. Most of the papers deal "only" with the comparison of phenophases timing in the past and present time (Menzel, Fabian, 1999; Menzel, 2000; Jaagu, Ahas, 2000; Chmielewski, Rőtzer, 2001). Research of this part of phenology is needed to detect responses to questions related to issues such as how phenology affect other organisms, or how it affects the cycle of water, energy and chemical elements in nature and also how potential climate change could affect these relationships. Many authors studies influence of the various factors individually (Škvareninová et al. 2007; Štefančík, 1995), but only the small group of scientists deals with them comprehensively. And just phenological observations are very important part of the identification of climate change and the growing number of studies shows that the flora and fauna begin to react intensively on increasing temperature (Scheifinger et al., 2007; Badeck et al., 2004).

Obtained information can be used in future for development of models that can help us understand and adapt to changing climate conditions.

Data and methods

In the period 2009-2010, we did phenological observations of European hazel - *Corylus avellana* L. and European hornbeam - *Carpinus betulus* L. on 3 sites in Zvolenska kotlina and the southern part of Kremnicke vrchy (Arboretum, Bukovina, Boky) in the middle of Slovakia, with different altitude and exposure.

Phenological observations were written down according to the guideline (Kolektív 1984) prepared by SHMU. This is currently used for monitoring forest tree species in Slovakia. We observed autumn vegetative phenological phases: colouring of the leaves (10, 50 and 100%), leaves falling (10, 50 and 100%).

In addition, with phenological observations at those locations we continuously recorded weather data with using a digital weather station.

To calculate the daily climate water balance (KVB), we used the difference of the cumulative daily precipitation P (in the last 10 days) and cumulative potential evapotranspiration PE (for the last 10 days), calculated by Haude (1955).

From the measured meteorological data and calculated data on the climate water balance, we evaluated the dependence of the onset of phenological phases and the mean air temperature and the availability of water in the system obtained from rainfall.

Results and disscussion

Evaluated years 2009 and 2010 were significantly different, particularly as regards the amount of precipitation and values of water balance in the months from July to November (months important in evaluating of their impact on the autumn phenophases).

Mean monthly air temperature on the locations were in the autumn months in 2009 higher (September 16 ° C, October: 12 ° C) than in 2010 (September 8 ° C, October: 7 ° C). Many authors have presented (e.g. Štefančík 1995), that lower temperatures indicate the onset of autumn phenological phases. This fact can not be according to our evaluation confirm or refute. In 2009 (warmer autumn), leaves falling phenophase 100% occurred in both of the plants earlier than in 2010, but the colouring of leaves phenophase 10% occurred in the one before and the other one later than in the following year 2010 (cooler autumn).

The values of water balance in 2009 were negative from the first third of July until the first third of October, while in 2010 the same period of the year had significantly positive values. Škvareninová (2007) presents that in the year with less amount of rainfall autumn phenophases are earlier than in a year with its normal amount. In 2009, leaves falling phenophase actually occurred earlier in both plants, than in 2010 (sufficient amount of rainfall). Graphical representation of phenological phases timing and duration, water balance, precipitation and temperature is shown in Figure 1.

However phenophase colouring of leaves showed different results between observed species. In 2009 it occured on hazel earlier than in 2010; in contrast on hornbeam it occured later. And because of lack of observed years and sites, it is very difficult to evaluate valuable conclusions.

Conclusions

On site Arboretum Borová hora in Zvolenska kotlina and sites Bukovina and Boky in southern side of the Kremnicke vrchy we observed in 2009 and 2010 autumn vegetative phenological phases colouring of leaves and leaves falling on tree species Corylus avellana L. and Carpinus betulus L. growing in native forest ecosystems.

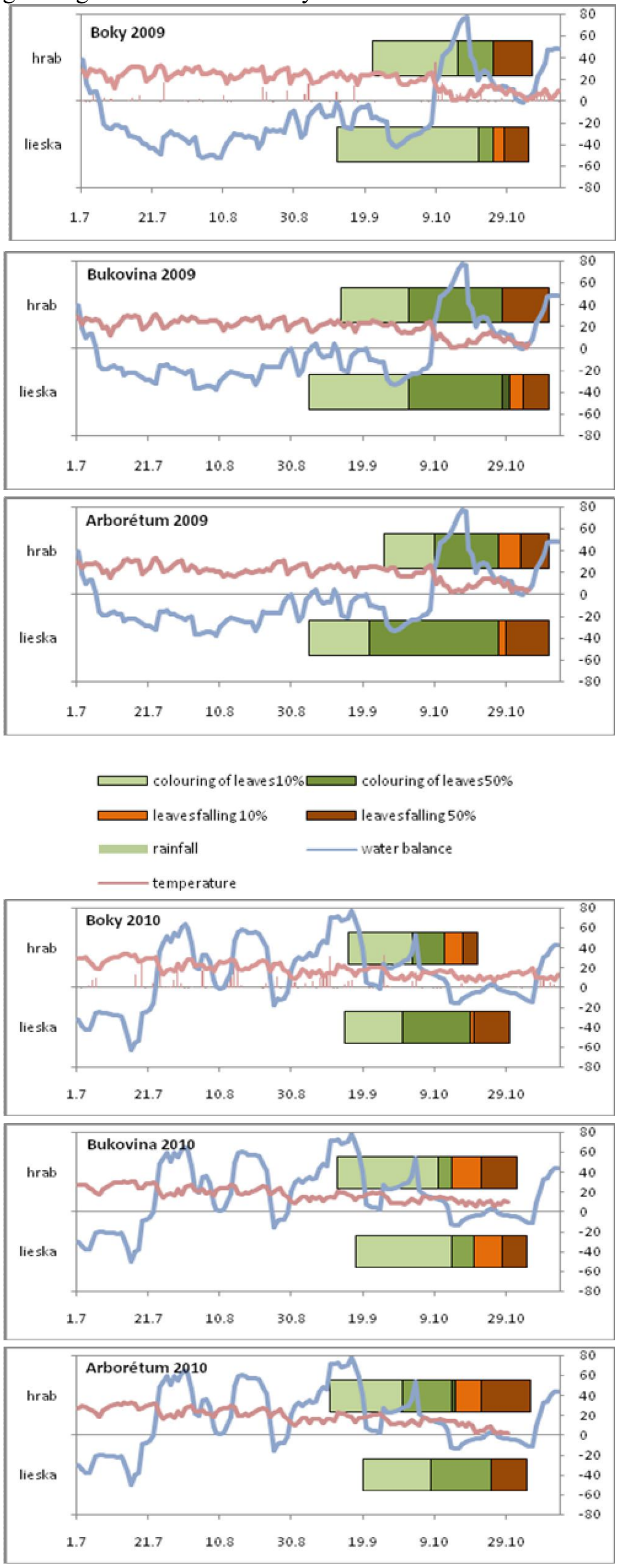

Figure 1. Timing of the autumn phenological phases of hornbeam (hrab) and hazel (lieska) in 2009 and 2010 (X axis – date in year; Y axis – rainfall(mm)/temperature (°C)

Based on observed phenophases and measured meteorological variables, we processed the data graphically. However, for statistical significance of the work it will be neccessary to supplement observations by additional years, or other locations.

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