

VARIABILITY OF PHENOLOGICAL PHASE FIRST LEAVES OF THE BEECH (*FAGUS SYLVATICA L.*) IN SLOVAKIA DURING THE PERIOD 1996 - 2015

HANA PAVLEDOVÁ², ZORA SNOPKOVÁ¹, KATEŘINA HRUŠKOVÁ¹, ZUZANA SITKOVÁ²

¹National Forest Centre – Forest Research Institute, T. G. Masaryka 22, 960 92 Zvolen, Slovakia

²Slovak Hydrometeorological Institute, Regional Center Banská Bystrica, Zelená 5, 974 04 Banská Bystrica, Slovakia

*This paper looks at the beginning of first leaves of common beech (*Fagus sylvatica L.*) on the territory of Slovakia during the period 1995 – 2014. We have discovered that during evaluated 20-year period, there occurs a shift in 7 days to earlier dates in onset of first leaves pheno-phase of beech. Average onset date of first leaves pheno-phase in Slovakia during the evaluated period is from 16th April to 4th of May. The beginning of first leaves of beech in Slovakia begins in Podunajská lowland. The latest onset of this phenological phase is observed in sub-mountainous localities of northern Slovakia, in Orava, Liptov, Spiš and Kysuce.*

Keywords: pheno-phase, first leaves, beech

INTRODUCTION

At the end of 20th century, adverse changes of climate began to reflect following air pollution. (Braslavská, 2000). These changes of environmental conditions significantly influenced onset and length of single pheno-phases, which certainly reflects the actual position of phenology. It has gained importance during the observation of the effect of possible climate change on the spatial distribution of trees and shrubs and also time changes at the onset of phenological phases during the growing season (Snopková, Braslavská, 2004). Phenological observations are a precious source of information during the monitoring and clarifying the course of life manifestations of wood plants. They serve to take the time course of the phenological phases in given area (Hájková, Voženílek, Tolasz, 2012).

MATERIALS AND METHODS

Variability of onset of first leaves pheno-phase of beech (*Fagus sylvatica L.*) in the territory of Slovakia was further evaluated for the period 1996 – 2015. We used data from 44 stations of special forest phenology. Phenological observations on SHMI are performed according to the methodological subscription (Braslavská, Kamenský, 1996). Geographical location of phenological stations is stated in the table 1.

First leaves pheno-phase belongs to vegetal pheno-phases. It begins when first leaves (fig. 1), which are light green coloured and smaller than in maturity, emerged at least on the half of individuals in observed group.

During the procession and evaluation we used revised data from databank of Climate and Meteorological Information System of Slovak Hydrometeorological Institute. Phenological observation of beech was interrupted during evaluated 20-year period on stations Muráň (1996-97), Oravská Polhora (1997), Oščadnica (2000, 2006, 2008), Nové Mesto nad Váhom (2005), Stakčín (2005), Veľký Folkmar (2009), Stupava (2014), Liptovská Teplička (2014) and Slovenská Ľupča (2015). Data were used without preliminary homogenization and missing data were not supplemented.

Data were evaluated from stations from different altitudinal zones using Microsoft Excel programme (basic statistic methods) and geoinformation system ArcView. The map of onset of the first leaves pheno-phase in Slovakia was created using linear regression with altitude.

Table 1: List of chosen phenological stations

Name of the station	Latitude	Longitude	Altitude
Železná Studienka, Bratislava	48° 10'	17° 07'	220
Stupava	48° 16'	17° 02'	177
Hvezdáreň, Modra Harmónia	48° 22'	17° 17'	531
Nové Mesto nad Váhom	48° 46'	17° 50'	196
Myjava	48° 46'	17° 35'	383
Kšinná	48° 48'	18° 21'	314
Opatová	48° 55'	18° 06'	380
Hajnáčka	48° 13'	19° 57'	220
Kysihýbeľ	48° 26'	18° 58'	565
Kokava nad Rimavicou	48° 34'	19° 51'	325
Zvolen	48° 34'	19° 10'	300
Ždaňa	48° 34'	18° 45'	300
Pofana	48° 30'	19° 30'	1265
Slovenská Ľupča	48° 46'	19° 17'	375
Čierny Balog Šaling	48° 45'	19° 42'	560
Brusno	48° 50'	19° 22'	535
Hronec	48° 47'	19° 35'	500
Staré Hory	48° 54'	19° 42'	485
Červená Skala	48° 49'	20° 08'	825
Závadka	48° 51'	19° 55'	625
Bacúch	48° 51'	19° 48'	625
Kláštôr pod Znievom	48° 58'	18° 49'	480
Malužiná	48° 58'	19° 46'	725
Liptovský Ján	49° 30'	19° 41'	630
Turie	49° 09'	18° 45'	435
Bytča - Starovec	49° 14'	18° 33'	305
Oravice	49° 17'	19° 45'	855
Oščadnica	49° 26'	18° 53'	490
Slaná Voda - Oravská Polhora	49° 31'	19° 27'	700
Liptovská Teplička	48° 58'	20° 05'	940
Muráň	48° 44'	20° 02'	400
Svinica	48° 44'	21° 28'	272
Jasov	48° 40'	20° 58'	280
Poruba pod Vihorlatom	48° 49'	22° 08'	193
Mníšek nad Hnilcom	48° 48'	20° 48'	471
Kecerovce	48° 49'	21° 24'	328
Dobšinská Ľadová Jaskyňa	48° 52'	20° 17'	875
Veľký Folkmar	48° 51'	21° 00'	420
Smižany	48° 57'	20° 31'	487
Prešov-Cemjata	48° 58'	21° 10'	388
Stakčín	49° 00'	22° 13'	256
Giraltovce	49° 07'	21° 31'	240
Krajná Pofana	49° 23'	21° 40'	387
Zborov	49° 22'	21° 18'	325



Figure 1: First leaves of beech

RESULTS

Beech (*Fagus sylvatica* L.) is a hefty deciduous tree that grows to a height of 40 m. Its crone is ovoid to widely distributed, of variable shape. The branches are mostly obliquely diverted from the trunk. In Slovakia it is one of the most important economic species. It can endure large climatic extremes. In our territory it grows, except lowlands, from the lowest positions on average to 1 260 (max 1 480) m. a. s. l. (Pagan, Randuška, 1987).

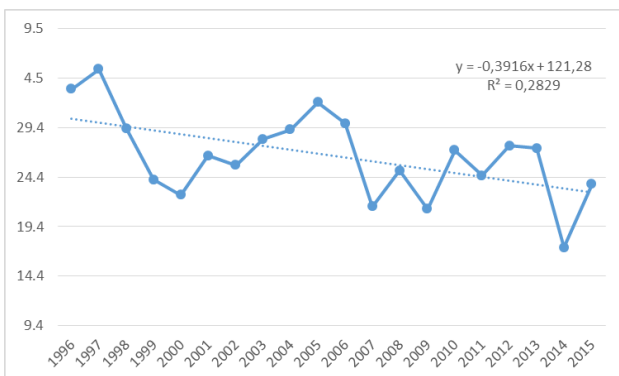


Figure 2: Average onset of the first leaves pheno-phase of beech in Slovakia during the period 1996-2015

Beech (*Fagus sylvatica* L.) shows huge variability of onset of the first leaves pheno-phase during the observed period. On average the earliest onsets were recorded in year 2014, following very warm winter (early onset of spring phenophases) and latest onsets were recorded in year 1997 (fig. 2). The first leaves pheno-phase in Slovakia during the period 1996-2015 onsets on average from 16th April to 4th May. We have discovered that during evaluated period, there occurs a shift in 7 days to earlier dates. The decrease was evaluated as statistically significant at the $\alpha = 0.01$. The earliest onset date of the first leaves pheno-phase was observed in Hajnáčka at 28th March 2014 and latest near Dobšinská Ice Cave at 24. May 2005 (fig. 3). The beginning of first leaves of beech in Slovakia begins in Podunajska lowland. The latest onset of this phenological phase is observed in sub-mountainous localities of northern Slovakia, in Orava, Liptov, Spiš and Kysuce.

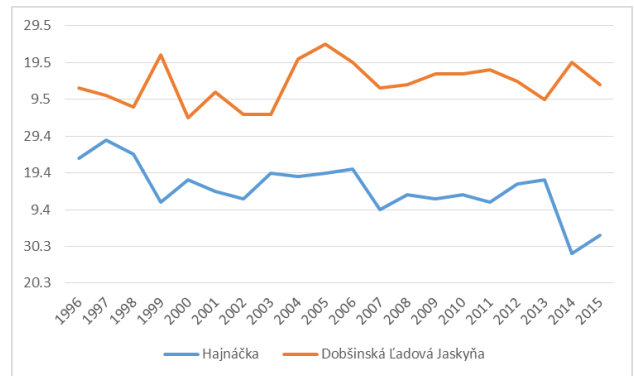


Figure 3: Variability of onset of the first leaves pheno-phase of beech in chosen phenological stations during the period 1996-2015

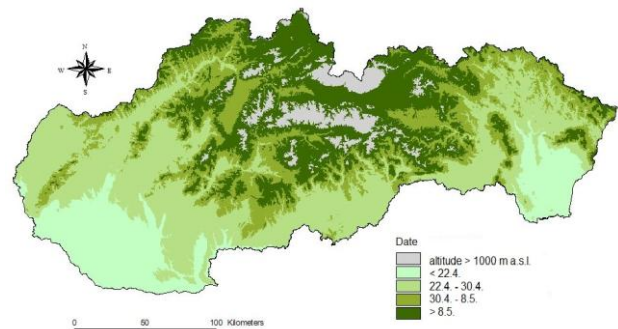


Figure 4: Map of first leaves pheno-phase of beech in Slovakia during the period 1996-2015

CONCLUSION

The onset of phenophases following considering external factors best correlated with air temperature and therefore, more generally also with altitude. By the various stations of plant species on the slopes is also important their orientation relative to the cardinal, the shape of the terrain and soil types. Phenological observations are an important part of climatological monitoring. Their results help in the investigation and assessment of natural conditions and its peculiarities in different regions of Slovakia.

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