COST Action 1404, Snow field campaign in Slovakia, 15-16 February 2016

Influence of snow cover on the spring phenological phases of European hazel (*Corylus avellana* (L.) in Central Slovakia

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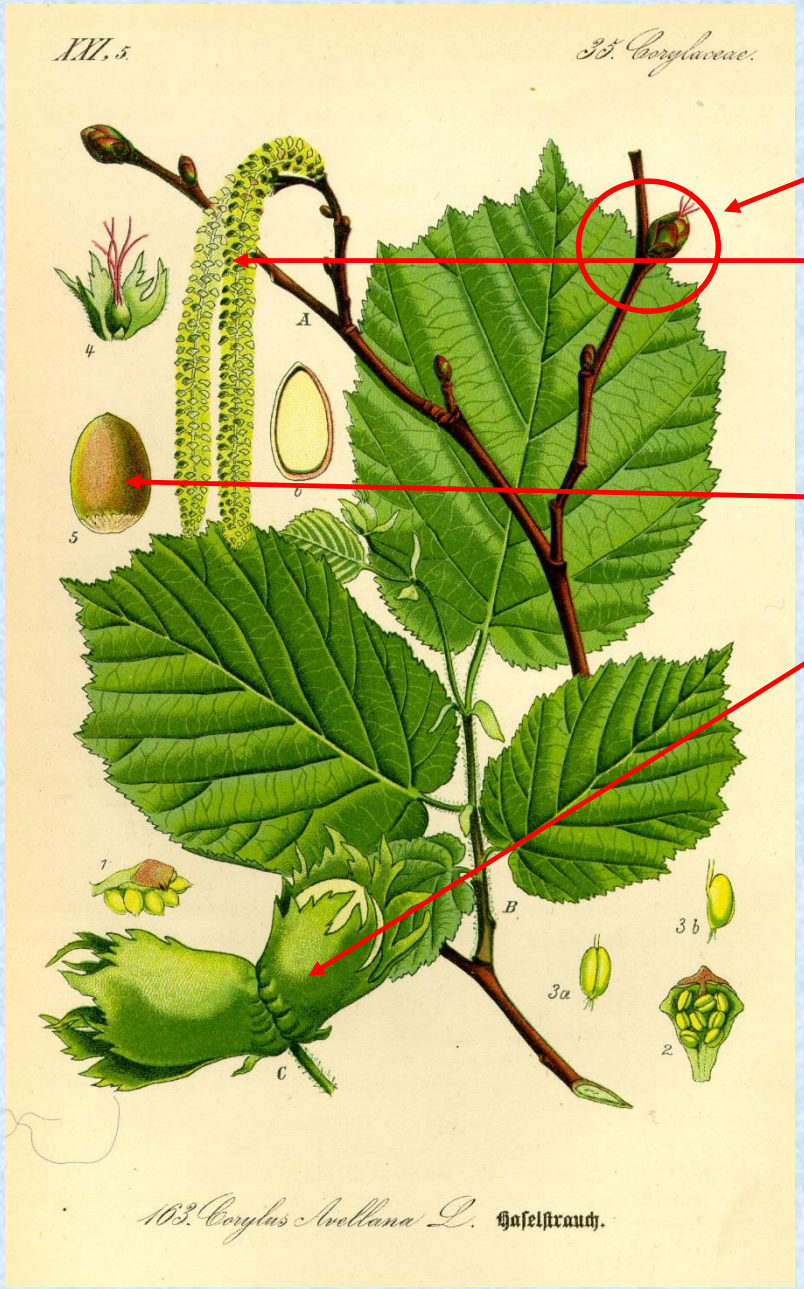
Introduction

- ***Plants*** are shaped by interactions with their surroundings. ***Environmental conditions*** control the length of the ***growing season***, and plant growth and developmental stages are tightly linked to characteristics of the ***physical environment.***
- ***„Phenology*** *is the study of periodic plant and animal life cycle events and how these are influenced by seasonal and interannual variations in climate, as well as habitat factors (such as elevation)*“. The word is derived from the Greek *φαίνω* (*phainō*), "to show, to bring to light, make to appear"+ *λόγος* (*logos*), amongst others "study, discourse, reasoning„ and indicates that ***phenology has been principally concerned with the dates of first occurrence of biological events in their annual cycle***.
- In the scientific literature on ecology, the term is used more generally to indicate the time frame for any ***seasonal biological phenomena***, including the ***dates of last appearance*** (e.g., the seasonal phenology of a species may be from April through September)

- **Because many such phenomena are very sensitive to small variations in climate, especially to temperature**, ***phenological records*** can be a useful **proxy for** temperature in historical climatology, especially in the study of ***climate change*** and global warming.
- The Slovak ***climate*** lies between the ***temperate*** and **continental** climate zones with relatively warm summers and cold, cloudy and humid winters. Temperature extremes are between −41 to 40.3 °C although temperatures below −30 °C are rare. The weather differs from the mountainous North to the plain South.
- ***Winter*** weather is usually changeable. With alternating warm - temperate and humid ***Atlantic cyclonal period*** (in mountain with ***snow***), with cold and ***frosty periods*** under the influence of ***continental anticyclones***.
- ***Winter*** is characterized in terms of climatology in particular: air temperature (especially ***minimum temperature***) and precipitation (mostly ***snow***)

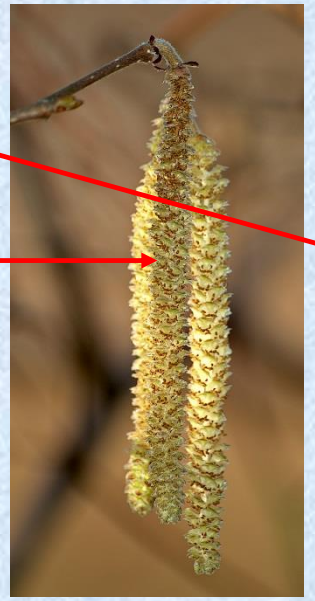
- ***Corylus avellana***, the ***Common hazel***, or ***European hazel*** is a species of hazel native to Europe and western Asia, from the British Isles south to Iberia, Greece, Turkey and Cyprus, north to central Scandinavia, and east to the central Ural Mountains, the Caucasus, and northwestern Iran.
- Hazel is typically a ***shrub*** reaching 3–8 m tall, but can reach 15 m.
- The ***leaves are deciduous***, rounded, 6–12 cm long and across.
- The ***flowers*** are produced ***very early in spring, before the leaves***.
- ***Hazel is the first phenological active tree species in our country.***
- ***Male catkins*** are pale yellow and 5–12 cm long, while ***female catkins*** are very small and largely concealed in the buds with only the bright red 1–3 mm long styles visible.
- The ***fruit*** is a ***nut***, produced in clusters of one to five together



Female flower

Male flower

Nut



Data and Methods

- Phenological data has been observed in the **Arboretum Borová hora** – ***Botanical garden*** of Technical University in Zvolen.
- Onsets of phenological phases of European hazel (*Corylus avellana* L.) were recorded on habitats of original spread in Central Slovakia (south west part of the Zvolen basin) during years ***1987–2015***.
- Altitudinal profile of the area ranged from 290 to 377 m a. s. l., (48°35'N 19°09'E).
- Meteorological data used for analyses were observed on the meteorological station Sliač (314 m a. s. l., 48°39´N, 19°09'E). Yearly mean ***air temperature*** was ***8,2 °C***, mean annual ***precipitation*** total ***757 mm***.

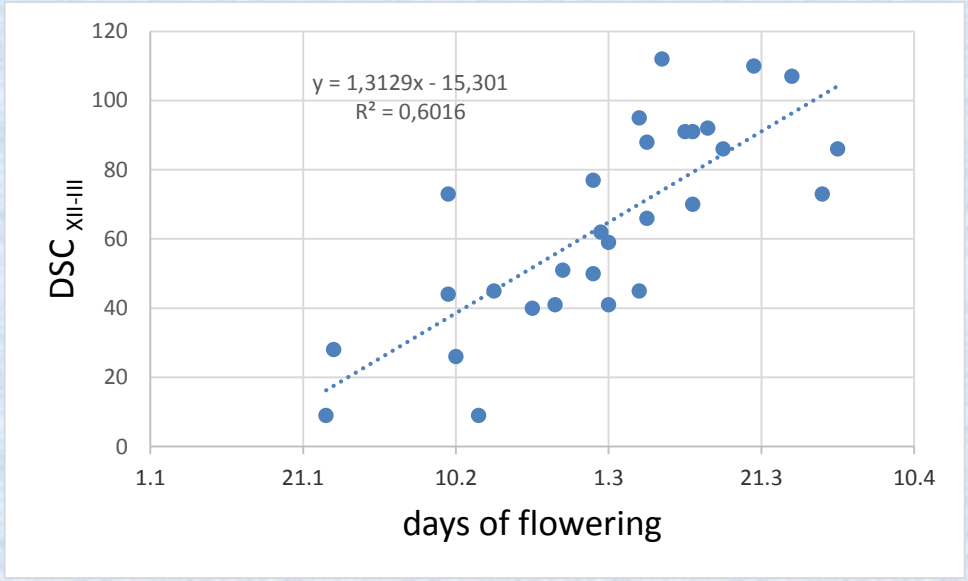
- Phenological phases of European hazel were evaluated according to ***methodology of Slovak Hydrometeorological Institute*** in Bratislava (SHMI). This methodology is standard one for observation of woody plants in Slovakia.
- ***Flowering - FW*** (male flower pollen grains are recorded in air). Dates of ***10% onset*** (phenophases is observed on 10 % of plants). Consequently dates were transformed on ***days of the years*** (Julian days) that were used for statistical analyses.
- We evaluate the ***first spring phenological phase***: FW – ***Flowering 10 % onset***

We evaluated these winter ***meteorological characteristics***:

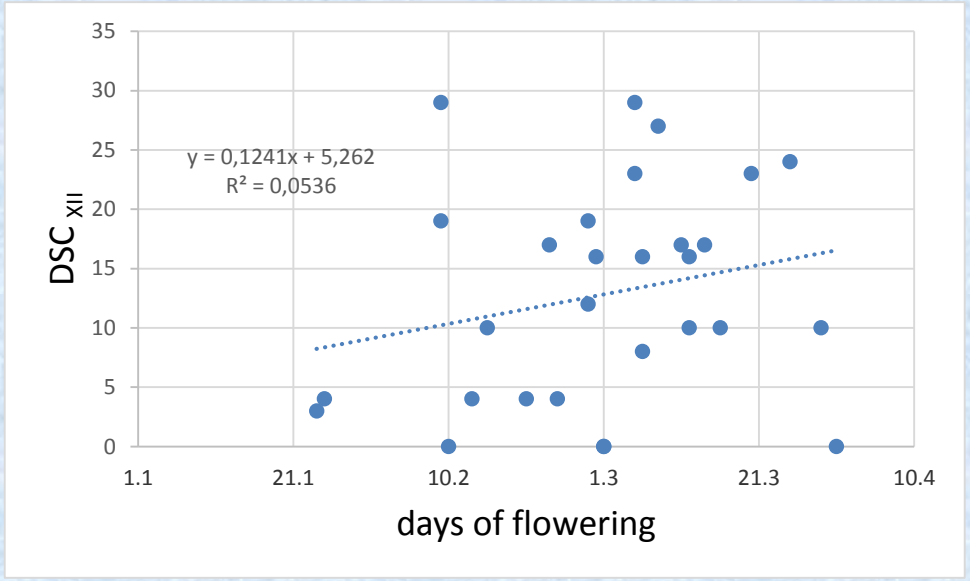
- **Snow:**
  - **DSC** - Number of days with snow cower
  - **SD** - Depth of snow cover (cm)
  - **SC ≥1** - Number of days with snow cower ≥ 1 cm
  - **SC ≥5 -** Number of days with snow cower ≥ 5 cm
  - **SC ≥10 -** Number of days with snow cower ≥ 10 cm

- **Air Temperature**:
  - $\mathbf{T_{min}}$ - Mean minimal temperature (°C)
  - **T mean** – mean monthly temperatute (°C)
  - **Tabs max -** Abs. Maximal daily temperature (°C)
  - **FD** - Number of Frost days (*days when the daily minimum temperature is less than 0°C*)
  - **ID** - Number of Icing Days (*days when the daily maximum temperature is less than 0°C*)

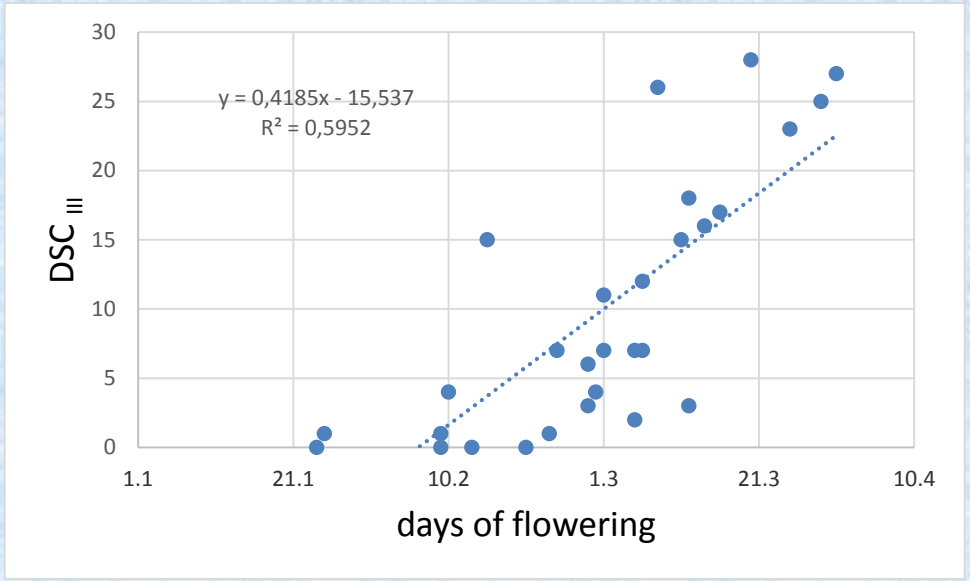
DSC - Days with snow cower



R^2=0,602 *December – March* ***p<0.001**

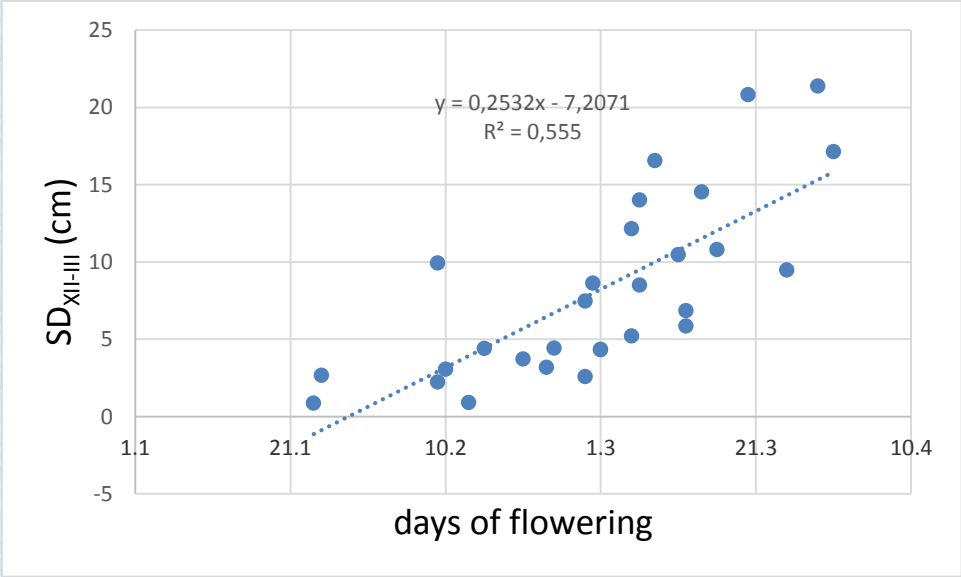


December ***n.s.***

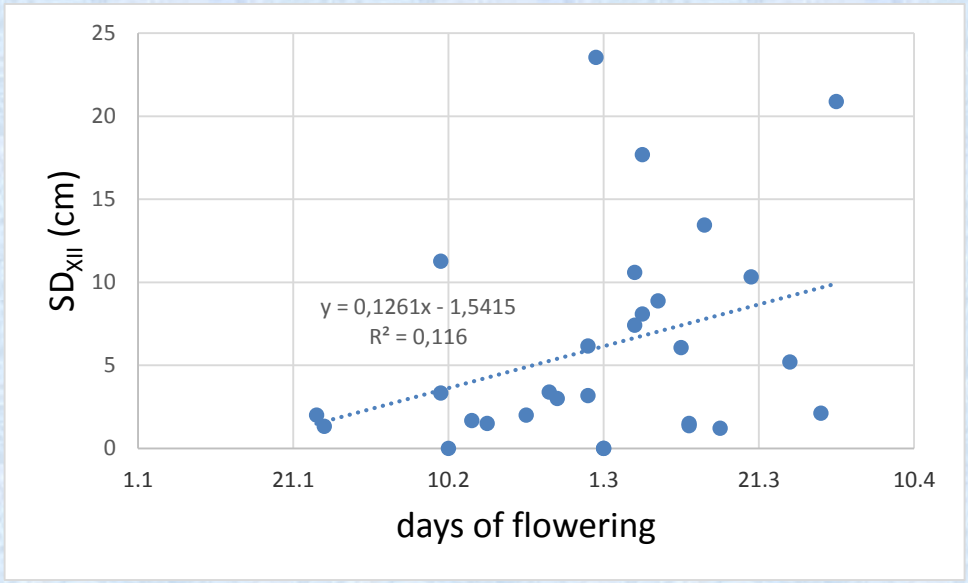


*March****p<0.001**

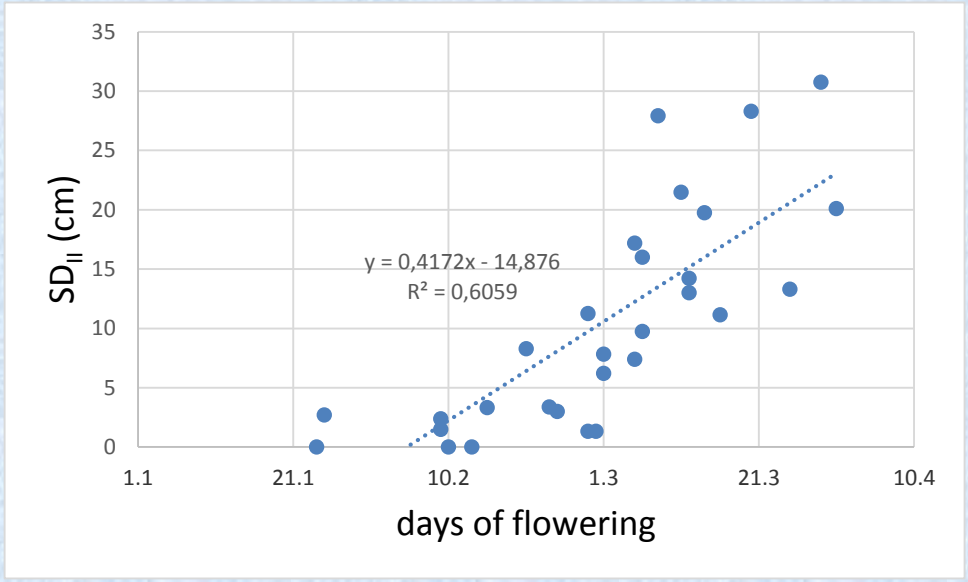
SD - Depth of snow cover (cm)



December – March ******p<0.001***

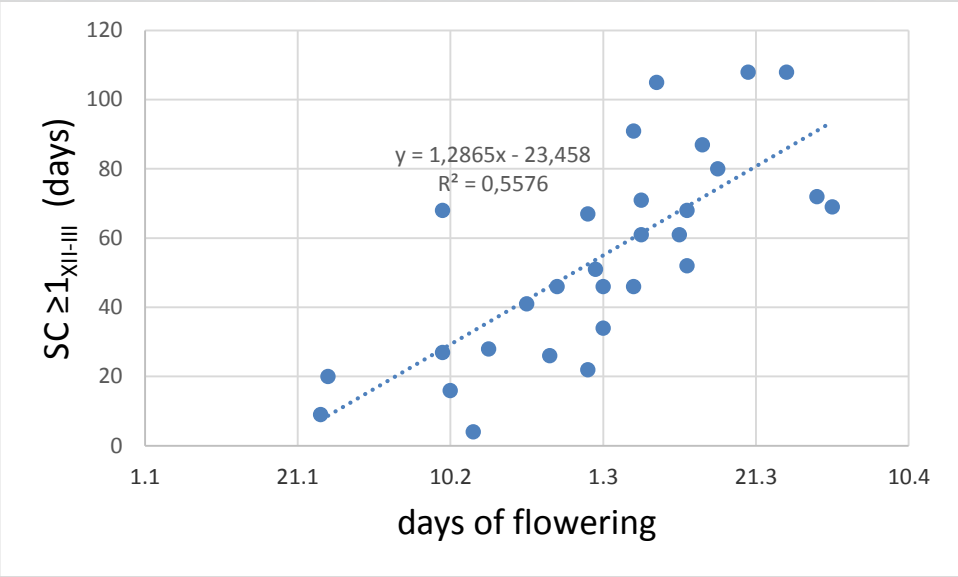


December ***n.s. p<0.1***



R^2=0,606 *February* ******p<0.001***

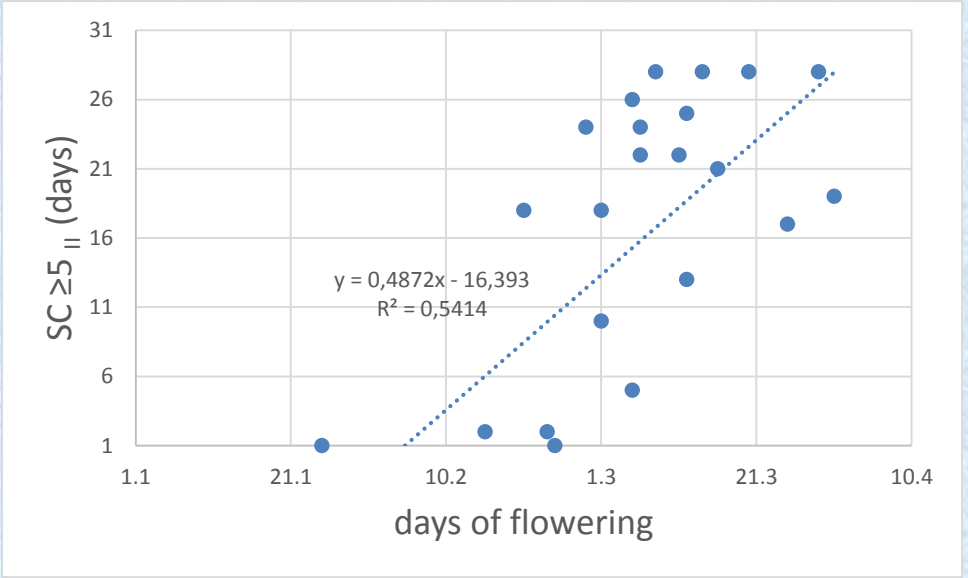
SC - Number of days with snow cower



Number of days with snow cower ≥ 1 cm, sum XII. – III.

R^2=0,556

***p<0.001**

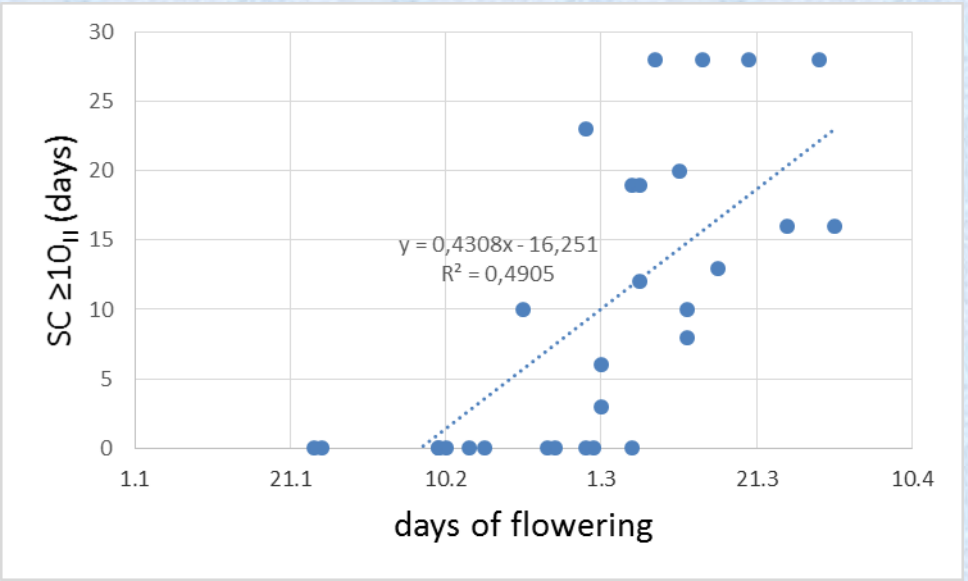


Number of days with snow cower ≥ 5 cm, february

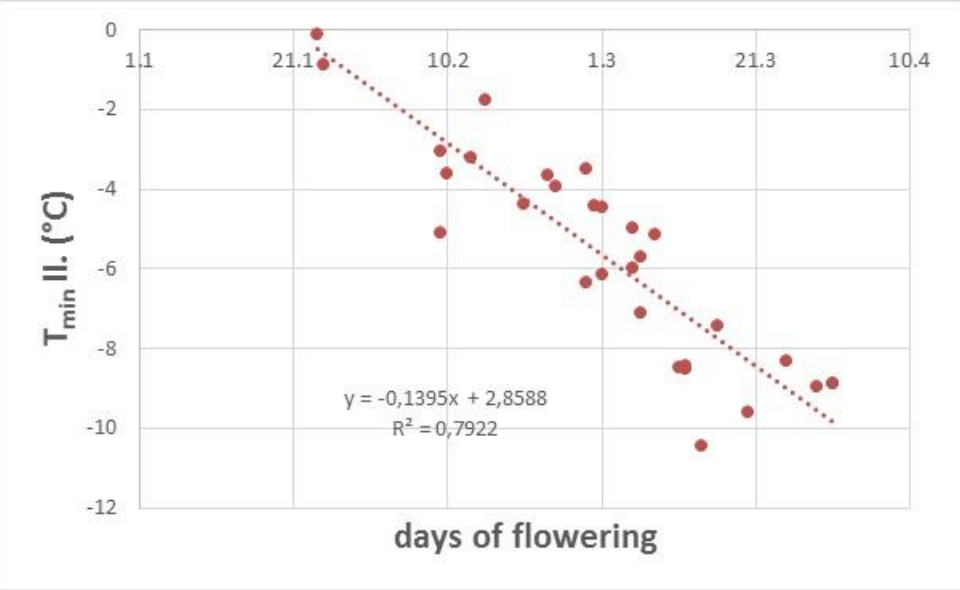
***p<0.001**

Number of days with snow cower ≥ 10 cm, february

***p<0.001**

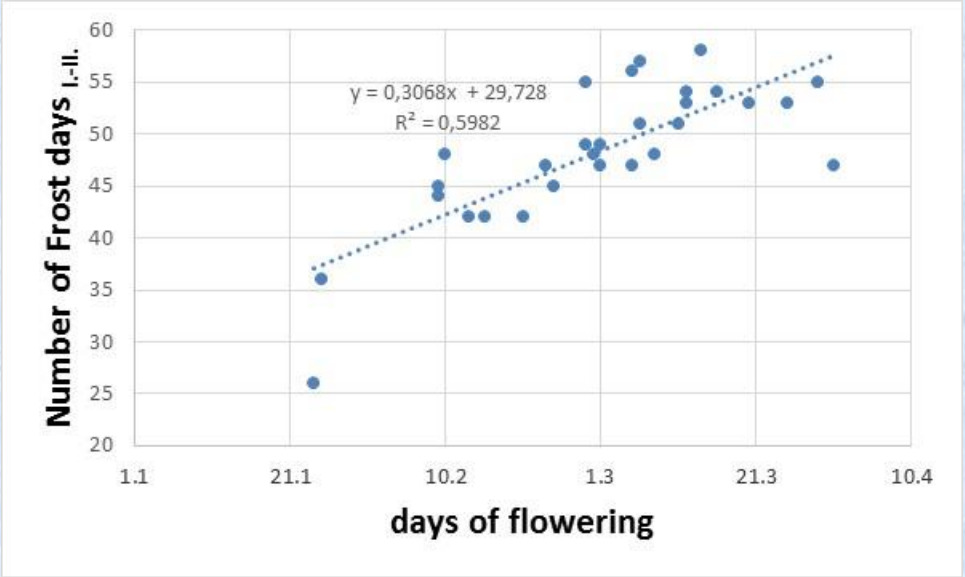


Air Temperature



Mean minimal temperature (°C), february

R^2=0,792 ***p<0.001

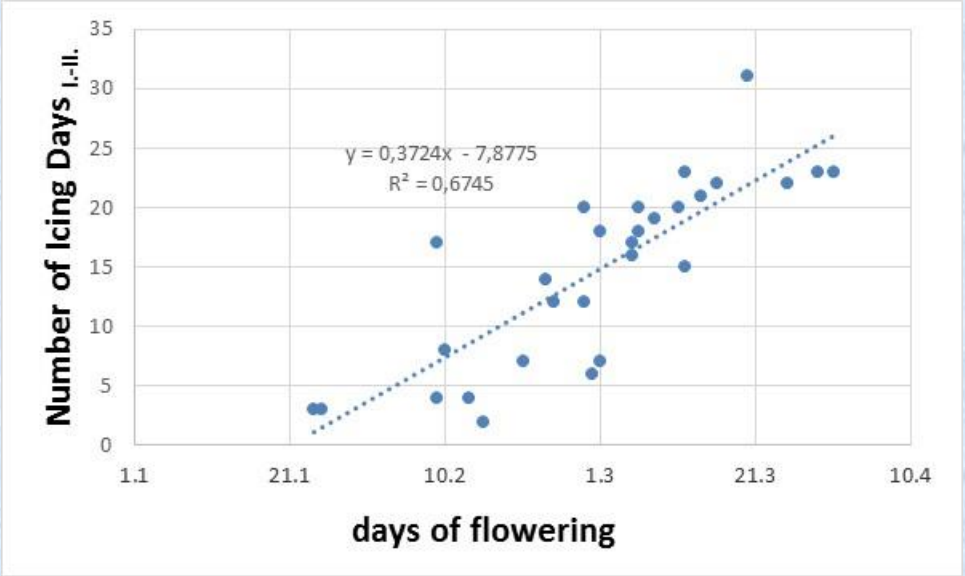


Number of Frost days,january - february

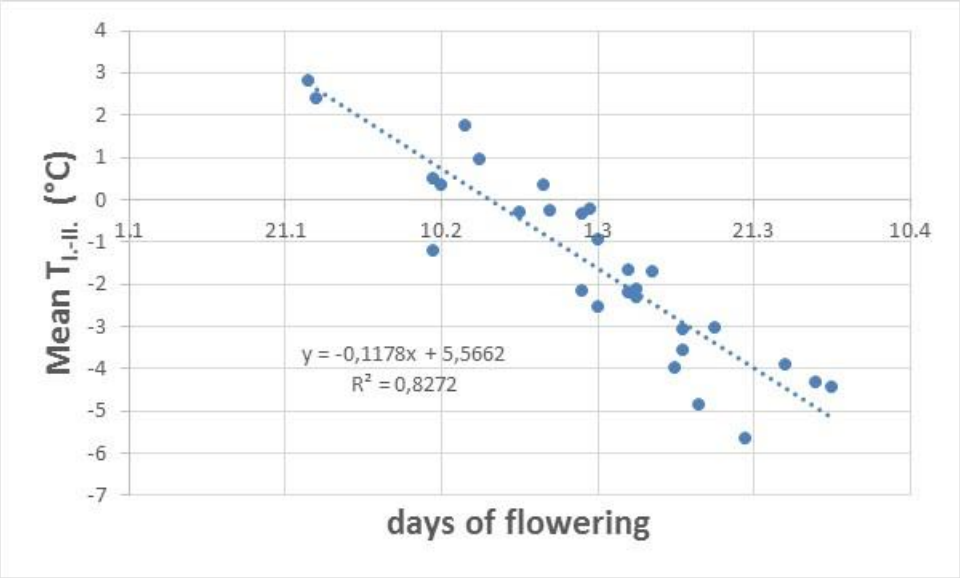
***p<0.001

Number of Icing Days, january - february

***p<0.001



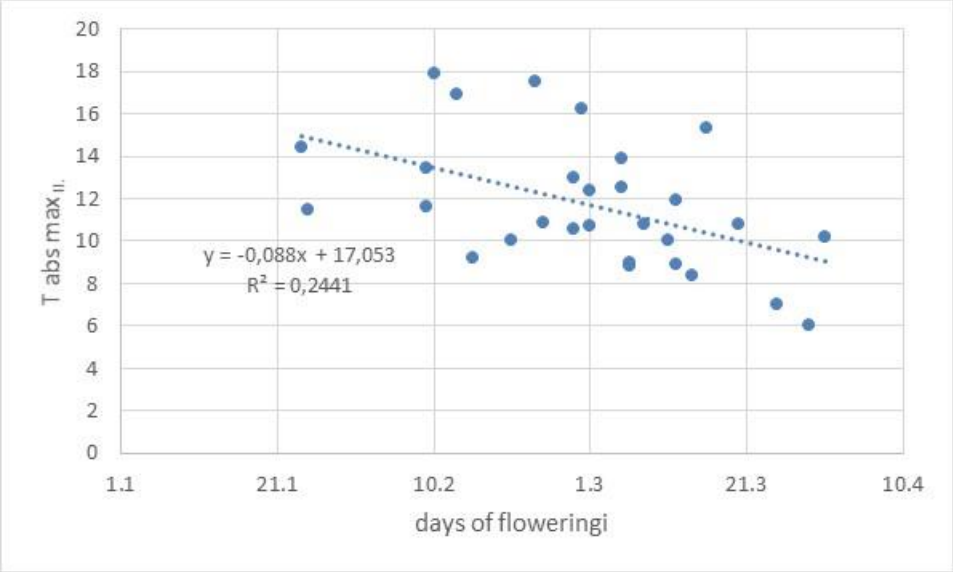
Air Temperature



Monthly Mean temperature (°C), january - february

******p<0.001***

R^2=0,827 ***r =0.9095***



Abs. Daily Maximal temperature (°C), february

*****p<0.01 r =0.4945***

Conclusions

- ***Hazel sensitively responds to winter snow conditions:***
  - Most sensitive to the onset of flowering hazel influences snow depth in February **(r=0.778**)
  - Sum of Days with snow cower – December-March (**r=0.776**)
  - Number of days with snow cower ≥ 1 cm, sum XII. – III. (**r=0,747**)

- ***The response to the temperature is stronger than to the snow conditions***
  - the greatest impact has the average minimum of air temperature in February (r=0.892)
  - the number of Icing Days in January and February has an important influence (r=0.821)
  - Phenological data series were strongly correlated to the mean temperatures of the months (r=0.9095) than to daily maximum temperatures (r = 0.206 – 0.4945)

„New“ research program **Phenological cameras**


THANK YOU !