

PHENOLOGICAL ARCHIVE SURVEY AND THE USAGE OF PHENOLOGICAL DATA IN SLOVENIA

FENOLOŠKI ARHIV IN UPORABA FENOLOŠKIH PODATKOV V SLOVENIJI

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POVZETEK

V prispevku smo predstavili fenološki arhiv na Hidrometeorološkem zavodu Republike Slovenije. Fenološki arhiv zajema podatke o datumih pojava fenoloških faz opazovanih gojenih in negojenih vrst rastlin v obdobju od 1951 do 1998. Fenološki arhiv je do leta 1980 v klasični, od tega leta dalje pa v elektronski obliki. Elektronsko arhivirane datoteke so v ASCII zapisu, po letu 1995 pa z uvajanjem DBase datotek pripravljamo arhiv za delo z programom Oracle.

Trenutna fenološka mreža obsega 60 postaj. Opazujemo 38 negojenih in 23 gojenih rastlinskih vrst. Seznam opazovanih gojenih rastlinskih vrst dopolnjujejo še številne sorte. Podatki o enoletnih gojenih vrstah rastlin imajo krajše nize, v zgodnjem obdobju sorte niso definirane. Te podatke danes uporabljamo za agrometeorološke analize in ocene vpliva vremena na kmetijske rastline.

Podatki negojenih rastlinskih vrst so kvalitetnejši, zajemajo daljše nize, normalno porazdeljeni in zato primerni za statistično obdelavo. So dobro zastopani po celi Sloveniji. Problem predstavljajo manjkajoči podatki v izbranem nizu, čemur je potrebno prilagoditi postopek obdelave podatkov.

Fenološki podatki iz našega arhiva so bili osnova za mnoge raziskovalne in uporabne naloge. Trenutno v največji meri služijo raziskavam in uporabnim agrotehničnim namenom.

Ključne besede: fenološki podatki, fenološka opazovanja, fenološki arhiv

ABSTRACT

In the article we represent the Phenological archive of Hydrometeorological Institute of Slovenia. It comprises the data about the phenological phenomena of cultivated and uncultivated plants during the period 1951 to 1998. The data from 1951 to 1980 are

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deposited in classical archive, the data, following the year 1980, are kept in electronic archive. The data records are in ASCII forms after the year 1995, *DBase* data forms were a step to maintain the archive in Oracle.

The recent phenological networks consist of 60 phenological stations. The observations are carried on 38 species of not cultivated plants and on 23 species of cultivated plants. Observations on cultivated species are furthermore extended on various varieties. The data records of cultivated annual plants mainly comprise a few years' periods, in the early stage of phenological observations the varieties were not determined. Those data are mostly used in agriculture surveys.

The data series of uncultivated plants are longer and prove a good quality. The phenological data of uncultivated plants adjust the normal distribution, therefore are suitable for statistical processing. They are mainly well distributed over the whole territory of Slovenia. The phenological data of our archive were data base for numerous investigations. The recent usage of phenological data is devoted to research and applicable agriculture purposes.

Key words: phenological data, phenological observation, phenological archive

1 INTRODUCTION

The phenological archive comprises the data of phenological phenomena of cultivated and uncultivated plants. Recently, the abundant bank of phenological data is unique in the country. The phenological data are devoted to various purposes: the documentation of annual phenological development of observed cultivated and uncultivated plants. In statistical processed forms manifest the phenological variation of plant growing upon the defined area. One of the aim of phenological data bank is devoted also to research purposes. The phenological data are particularly profitable when serve to agriculture purposes, when the growth development of productive agriculture plants is related to weather parameters. The phenological data of our archive were data base for numerous investigations.

2 ARCHIVE PROCESSING

Recently the phenological archive comprises the data of 206 phenological stations. In early fifties, phenological observations started on 30 phenological stations, later the number increased over 100 and ceased again to 60 stations in the last ten years. There are 51 stations with continuous data records even from the early beginning of observations, and another 39 stations with 30 year period of observations, but do not operate any more. Numerous other stations have shorter periods of data records.

The phenological observations are carried out on 38 not cultivated and 23 cultivated plant species (see APPENDIX and Figure 1). The list of cultivated plant species is extended by various varieties.

The observing area comprises the wide surroundings of the phenological station. Observations of forest trees, shrubs, fruit trees and vine are made permanently on one marked specimen. Herbaceous uncultivated plants are observed predominately on constantly location, while agricultural annual crops, especially those in rotation, are observed in the near surroundings.

In spite of unique form, there are no unique list of observations. On the Littoral, at forest locations and those over 800 meters above the sea level, the plant assortment distinguishes from the ordinary predominate stations.

There are 30 phenological phases, mostly easy to determinate even if the observer is unprofessional. Data are collected in the manner of monthly reports by mail. *On line* connection exists only for a limited number of phenological stations. Some stations give a note also about some field operations (hay making, sowing) and bees keeping. Those data are not archived and mostly serve in agriculture purposes.

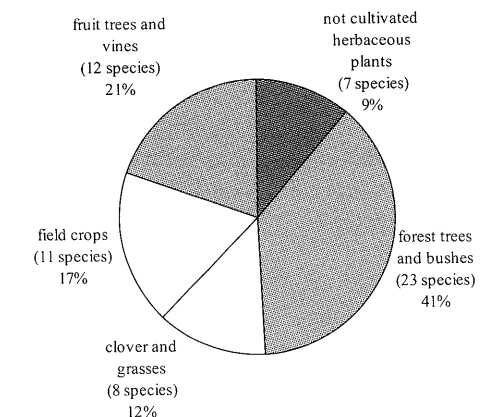


Figure 1: Share of plants in the assortment of phenological observations.

3 ARCHIVE

The sufficiently established archive makes phenological data - row or statistical processed - easy accessible. Establishing of archive was an extensive work with an aim to transfer classic form of archive to an electronic ones'. Electronic records of data

comprise codes for phenological station, year of observation, phenological object, variety and phenological phase. Until 1995 the data records are in ASCII form, after the year 1995 in *DBase* data forms, in the future we intend to maintain the phenological archive in Oracle. Electronic archive comprises data following the year 1980, the data from the previous period are mostly in classical form (phenological books). Phenological data bank comprises 5MB of the storage space. The storage space is increasing by archiving the current phenological data.

Before the archiving the current phenological data, the logical control eliminates the rough errors in registration of observation. Critical control is carried out next to process of the data using some simple graphical and statistical methods to examine the accuracy of the data. Questionable data are once again examined by analyzing the weather situation and eliminated if not reflect the real situation.

4 QUALITY OF THE DATA

Quality data is the most important characteristic of structured archive. Organizing the contents of the archive we confront with the impediments mostly the consequences of subjective and objective reasons. The subjective ones base upon subjective estimation of the phenological phase appearance and the objective ones originate from removal or cancellation of the phenological stations, or withering of plants in observation (frost, hail etc.).

In the early period of phenological observations until 1970, the annual cultivated plants were not determined by varieties. Some phenological stages of annual cultivated plants have a considerable involvement of a man (sowing, planting, harvesting). In that reason the observations of annual cultivated agricultural plants are carried on predominantly in agricultural purposes.

On the contrary the data records of uncultivated and cultivated perennial plants prove good quality, the data records are longer (numerous stations more than 30 years), the data are mostly adjusted to the normal distribution. They are mainly well distributed over the whole territory of Slovenia.

5 GAPS

The weak point of phenological archive are gaps. The problem of gaps fairly arises in every statistical data processing. Consequently we can allow gaps and therefore risk bad results. Another way is to use proportionately shorter periods of data records or to fill the gaps with data from a cognate phenological station. For that kind of intervention a very good judgment of macro and micro location of observed phenological objects is needed. Any such interventions is reasonable only before the

statistical data processing. On basis of our phenological data some studies gave statistically confirmed relationships between the phenological phenomena and weather elements. The elevation is the another parameter which influences the vertical variability of climate elements influencing the plant development. Zrnc (1994) confirmed the close relationship between the phenological phenomena and the elevation and suggested the applicability of this relationship in filling gaps.

The relationships between the subsequent phenological phases of one variety or between phenological phase appearances of various plants or varieties gave firmly confirmation that the relation could be applicable also in filling gaps in the data records (Strajnar, 1997).

The figures 2 and 3 represent the graphical survey of the relationship between the flowering start for two varieties of vine (šipon and riesling blanc) in the vine growing region of Gornja Radgona in the north east of Slovenia. Figure 2 represents the regression line between flowering start of two vine varieties. Figure 3 represents the comparison of the data recorded in the period 1961 - 1990 compared to the serie of data quantified by the regression analysis.

Table 1: Regression relationship of blossoming start for various cultivars of vine and apples.

plant	plant	period	regression	R ²	region
Sauvignon (S)	Riesling Blanc (RB)	1961 - 1990	$Y = 0.8617 * RB + 21.976$	0.82	Slap pri Vipavi
Šipon (Š)	Riesling Blanc (RB)	1961 - 1990	$Y = 0,8761 * RB + 18.866$	0.75	Gornja Radgona
apple cv. Jonathan (J)	apple cv. Bobovec (B)	1961 - 1990	$Y = 0.7394 * B + 28.663$	0.70	Slovenske Konjice

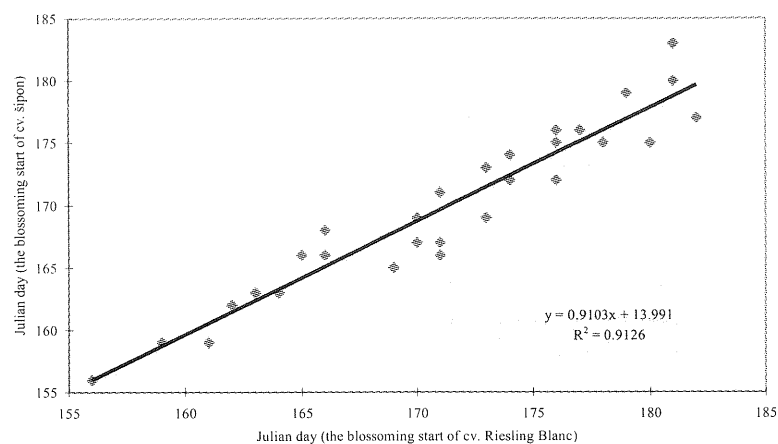


Figure 2: Regression line of the day of blossoming start of vine varieties laški Riesling and šipon in vine growing area of Gornja Radgona (period of reference: 1961 - 1990).

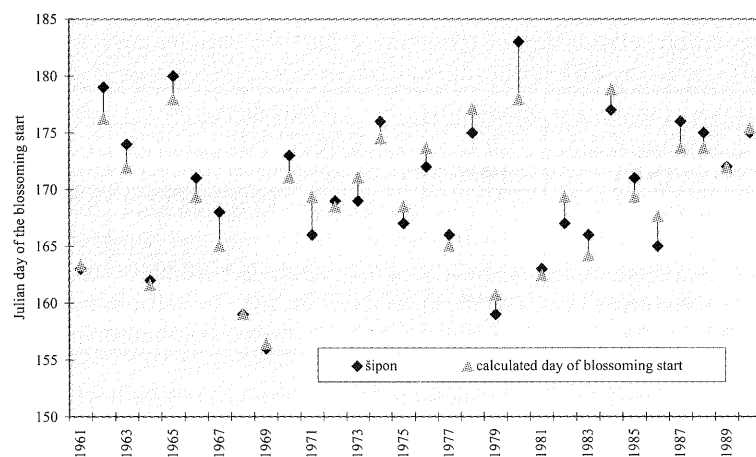


Figure 3: Blossoming start of vine cv. šipon (in Julian days) compared to the serie of data quantified by the regression relationship in the vine growing area of Gornja Radgona (reference of period: 1961 - 1990).

Firmly relationship was confirmed also between the beginning of flowering for two varieties of apple cv. Bobovec - an old and well distributed variety - is very related to cv. Jonathan in the fruit growing area of Slovenske Konjice in north east of Slovenia. The results are presented in Table 1.

6 THE RECENT USAGE OF PHENOLOGICAL ARCHIVE IN SLOVENIA

- documentation of annual phenological development of the observed plants on the territory of Slovenia, comparison to the average and extreme values with the purpose of agrometeorological analysis which are published in public media;
- testing of models where the phenological data records serve as the main or among the others input parameters;
- studying of climate influence on plant development resulting in trends of phenological phenomena;
- evaluation of agricultural area suitable for plant production with special temperature properties
- phenological maps prepared on the basis of methods of spatial interpolation and distribution of phenological data (allergenic plants)
- evaluation of crop coefficients applied in irrigation forecast models, indispensable for Slovene irrigation forecast model IRRFIB-2 elaborated at HMI. Adopted coefficients are based on phenological phases observed in different climate regions of Slovenia during the last 15 years.

REFERENCES

- Strajnar, (por. Lajevec) K., 1997: Prostorska in časovna analiza pojava fenoloških faz nekaterih samoniklih in sadnih rastlinskih vrst v Sloveniji v odvisnosti od vremena, *diplomsko delo*, BF, Ljubljana, Oddelek za agronomijo.
- Zrnec, C., 1994: Značilnosti cvetenja nekaterih vrst rastlin in njihova uporabnost v agrometeorologiji. *Razprave - Papers Slo. meteo. soc.* 31, 51-60. *Arhiv HMZ.*