

OBSERVATIONS ON THE PHENOPHASES OF FLOWERING AND THE INFLUENCE OF ENVIRONMENTAL FACTORS ON CHERRY TREE

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INTRODUCTION

Cherries are the favorite fruits for consumption in summer, Romania occupying the 5th place in the production of cherries in the EU, after countries like Poland, Spain, Italy and Hungary (Eurostat, 2021).

In the context of current climate change, the knowledge of the fruiting phases and their evolution is of major importance for fruit growing.

Among the studies published in Romania, the most current phenological observations regarding phenophases: budding, leafing, flowering, seed ripening, coloring and leaf falling were published about chestnut (*Castanea sativa* L.) (Bud 1973; Teodosiu 2015) and 13 other species of forest trees and shrubs by Marius Teodosiu et al., from the Institute of Forestry Marin Dracea, Suceava in the paper "Climatic determinism of the production of phenophases in forest species with maximum series in Romania", published in Bucovina Forestieră magazine, in 2015.

The National Meteorological Institute (ANM) aims to provide farmers with estimates of vegetation periods and effects on agricultural productivity, in the form of Agrometeorological Bulletins (1980-2005). These agro-meteorological bulletins target the main field crops and our vine-fruit species in different pedoclimatic conditions.

The main phenological phases and stages of growth and development of the species of interest in relation to the evolution of the climatic factors from an agricultural year are being followed.

Although they have a tradition in our country, the phenology observations have been resumed and implemented at national level, primarily for forest species since 2003, on five permanent monitoring areas (Cenusa, 2003, Teodosiu M., Mateescu E., 2004).

Since 2004, the foundations of a FENOFOR phenology network have been laid, on a number of 8 forest species with observations carried out in 22 phenological resorts made by the specialists within ICAS and those of the ROMSILVA National Forests Authority.

At European level, such phenological studies are of great interest and relevance due to the climatic determinism of the production of phenophases, especially those that occur in spring due to the increase in global temperature (Cook B. I., et al. 2012, Menzel et al. 2008, Delpierre et al. 2015).

The knowledge of the physiological mechanisms of the phenophases, their correlation with the environmental factors and the elaboration of some predictive models as well as the establishment of some species with bioindicator value shows interest for biologists not only for agronomists.

Knowing the evolution of fruiting phases depending on the evolution of environmental factors in fruit growing, offers the possibility for specialists to establish treatment and fertilization programs to support the most important phenological moment that determines the production per tree. In this way the most important phenological moment is identified.

The phenophase of cherry blossoming includes 3 important moments: the beginning of flowering, the maximum flowering and the end of flowering preceded by the beginning of bud swelling, according to the BBCH classification, which includes the phenological phases of growth and development for stone fruits (Meier et al., 1994, Rati I.V., et al., 2008).

This study represents the team work carried out by biology students during 2 years 2021, 2022 coordinated by PhD Professor Rati Ioan Viorel, idea that started during the COVID pandemic due to the need to be in communion with nature and to implement the information into practice.

The students recorded the phenological observations according to the specialized methodological norms together with the beginning of bud swelling of the flowers in 2 species: apple and cherry tree. In this paper we'll analyze the particularities and evolution of phenophases in cherry trees.

The research on this study was carried out by: accessing specialized information on fruiting phases, daily photos of phenophases, recordings of temperature and precipitation provided by the Bacău weather station.

Geographic coordinates were recorded taking into account the GPS coordinates of each tree tracked.

MATERIAL AND METHODS

The methods used in this study were: direct daily observation of fruiting phases and phenophases by taking daily photos of trees for observation;

Statistical methods of information processing and methods of analyzing the variation diagrams of temperature and amount of precipitation were used.

The following equipment was used: camera, strips for marking the trees and observation sheets.

The trees selected for the study were marked with colored strips placed on branches on every 100 flower buds, determining this way the natural fertility. Natural fertility is the percentage ratio between the number of resulting fruits and the number of flower buds.

Using observation sheets, the calendar dates for the onset of the phenophases were identified: the swelling of the flower buds, the beginning of flowering, the maximum flowering, the end of flowering.

The spatial distribution of the studied trees includes Bacău and Neamț counties. The area in which the observations were made is between the following GPS geographical coordinates: Latitude: 45.9167000N / 46.9289890 N and Longitude: 26.2621000 E / 27.0955660 E.

The data recorded for each cherry tree studied were quantified to observe the evolution of fruiting phases, phenophases depending on the calendar data, following the variation of temperature and the amount of precipitation.

The aim of the study is to identify the influence of climatic factors on the duration of flowering phenophases, fruiting stages and natural fertility.

RESULTS AND DISCUSSIONS

The variation of environmental factors and their influence on cherry tree flowering phenophases

The spatial distribution of the tracked trees includes Bacău and Neamț counties (Fig.1-3).

The area in which the observations were made is between the following GPS geographical coordinates: Latitude: 45.9167000N / 46.9289890 N and Longitude: 26.2621000 E / 27.0955660 E.

In the cherry species in 2021 (Table 1) it was found that the swelling of flower buds (BBCH 51) ranged in average time between 7 days and 12 days, with two exceptions: Zemeș (18 days) where very low daytime temperatures were recorded in relation to the calendar period and the village of Țefan Vodă (16 days) where other environmental factors intervened, possibly the lack of precipitation for too long or certain characteristics of the soil. In 2022, on the analyzed trees, it was found that the swelling of the flower buds started much earlier on April 26 to May 7 (Table 2).

The flowering phenophase includes 3 very important moments according to the BBCH classification in the evolution of trees, namely: the beginning of flowering (BBCH 55-59), full flowering (BBCH 65) and the end of flowering when all petals are fallen (BBCH 69) (Fig 4 a-e).

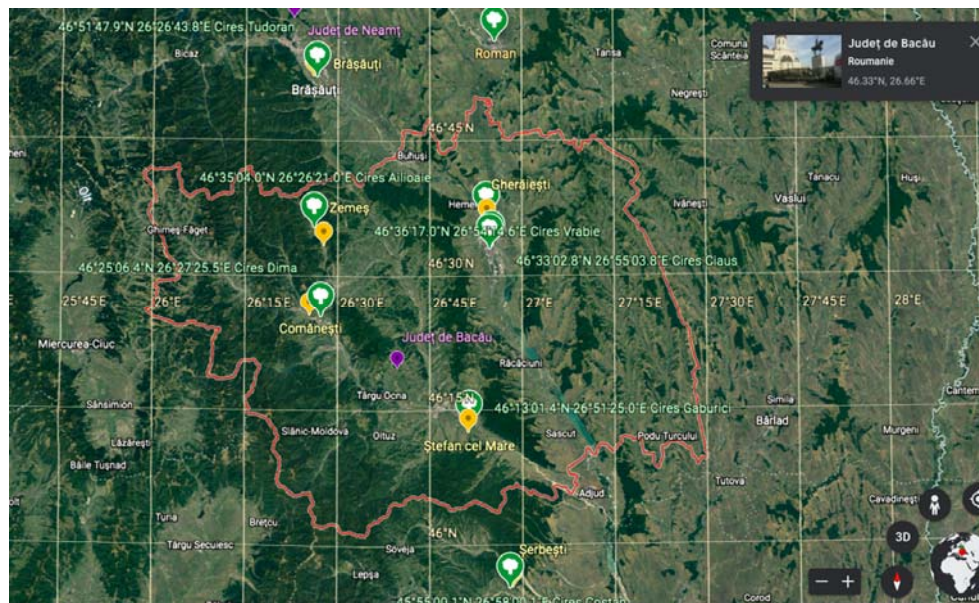


Fig. 1. Spatial distribution of monitored cherry trees in Bacau County

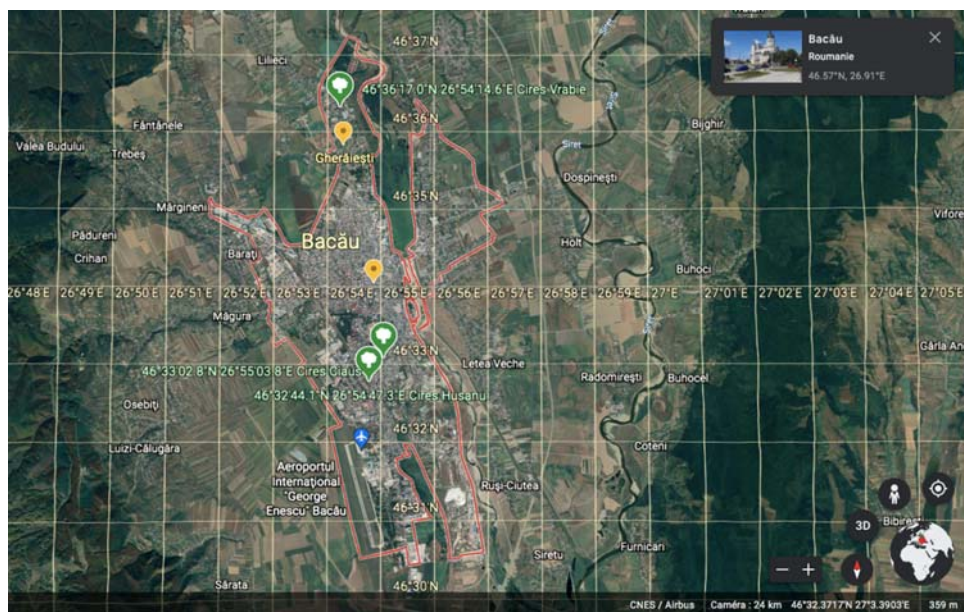


Fig. 2. Spatial distribution of monitored cherry trees in the city of Bacău

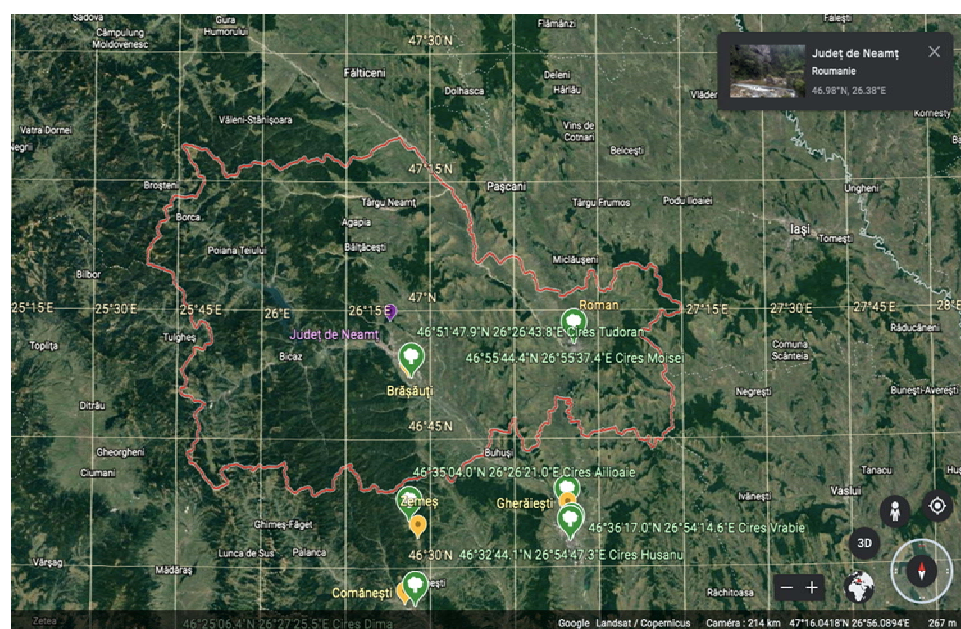


Fig. 3. Spatial distribution of monitored cherry trees in Neamț County

The variation of the diurnal temperature for the cherry tree species during the fruiting phases, the swelling of flower buds and the phenophase of flowering, is characterized by a minimum of 11°C (12.04.2021-Zemeș), a maximum of 21.1°C (01.05.2021-Bacău) and an average temperature of 16,09°C.

The precipitation recorded during the study was reduced in terms of quantity. During the observation days between 03.04.2021-16.04.2021, the period in which the flower buds swelled, the recorded precipitations did not exceed 4 mm / 24 h,

and between 14.04.2021-17.05. 2021, in which the flowering phenophase took place, the precipitations did not exceed 4 mm / 24h, except for April 21, 2021 when in Chiticieni was registered a quantity of precipitations of 15 mm / 24h.

Assessing the degree of natural fertility on the cherry trees observed, it was found that the natural fertility had an average of around 57%, with a maximum of 70% (Chiticieni) and a minimum of 20% (Comănești). Natural fertility is an indicator that increases if there are pollinating varieties in the plantation or in the monitored area.

Table 1. Observations of the cherry tree phenophases in 2021

Nr	March		April																														May		
	30	31	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01	02	03
1.													X												X										
2.								X							X						X												X		
3.																							X												
4.								X											X					X											
5.				X																X						X							X		
6.	X																			X						X								X	
7.													X								X					X									
8.													X													X							X		
9.																	X			X					X										

■ the swelling of the flower buds
■ the beginning of flowering
■ the maximum flowering
■ the end of flowering

Table 2. Observations of the cherry tree phenophases in 2022

Nr	March				April																													May				
	26	27	30	31	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	01	02	03	
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the swelling of the flower buds

the beginning of flowering

the maximum flowering

the end of flowering



a.BBCH 51



b.BBCH 55-56



c. BBCH 57-59



d. BBCH 65



e. BBCH 69



a. BBCH 51



c. BBCH 57



e. BBCH 69



d. BBCH 65

Fig. 4. Cherry tree phenophases: a. BBCH 51 – inflorescence buds swelling; b. BBCH 55-56 – single flower buds visible (still closed) borne on short stalks, green scales slightly open; c. BBCH 57-59 – sepals open: petal tips visible; single flowers with white petals (still closed), d. BBCH 65 – full flowering, e. BBCH 69 – end of flower

CONCLUSIONS

The results revealed that:

The low temperature correlated with the increase of latitude and a reduced amount of precipitation generates a significant time lag compared to the calendar period specific to the fruiting phases, and also an extension of the time intervals in which these processes take place.

The lack or very low amount of precipitation, extended the time for the swelling phase of flower buds. Productivity per tree is influenced by both temperature and precipitation.

Low temperature or too much precipitation for a longer period, especially during the flowering phenophase, makes it difficult for pollinators to access flowering trees, leading to a decrease in productivity per tree.

A sufficiently long time interval between the beginning of flowering and the end of flowering allows pollination of as many flowers as possible to bind fruit, considering that the temperature and precipitation are favorable for pollinators access to flowering trees.

A tree has a very good production if, out of 100% of existing flowers on the tree, it binds about 13-14%. The natural fertility of the trees subjected to phenological observations in this study was very good for both species, the average value being over 40%.

We mention that although the influence of temperature and precipitation is major on the evolution of fruiting phases and productivity per tree, in reality there is a complex of factors that as a whole we call environmental conditions that significantly influence these processes.

The proximity of each location of the tree, the characteristics of the soil and landscape, the air pollution and the particularities of the local climate.

In conclusion, knowing the evolution of the fruiting phases according to the evolution of environmental factors and their graphic highlighting, offers the possibility for specialists to establish treatment and fertilization programs that support the most important phenological moment that determines the cherry tree production.

ABSTRACT

This study represents the team work carried out by biology students during 2 years 2021, 2022 coordinated by PhD Professor Rati Ioan Viorel, idea that started during the COVID pandemic due to the need to be in communion with nature and to implement the information into practice.

The objectives of the study were: to make observations regarding the development of cherry fruiting phases starting with the swelling of flower buds, the beginning of flowering, the maximum and the end of flowering.

By establishing the influence of climatic factors (temperature, humidity, precipitation) on the fruiting phenophases of cherry species in the evaluated area, we can find optimal solutions to increase the degree of natural fertility and avoid pests.

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