

Features of the passage of main phenological phases of common cherry cultivars in the conditions of the Orel region

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Abstract. This article presents the results of studying the features of main phenological phases passage by varieties, selected and elite seedlings of common cherry in the conditions of the Orel region. The research was carried out on the basis of stone crops plantings of the Russian Research Institute of Fruit Crop Selection in 2018-2020. The purpose of the research was to study the peculiarities of phenological phases passage by common cherry cultivars from the VNIISPK gene pool. During the studies it was found that Turgenevka, Businka and Kapelka varieties are early-ripening, in conditions of the Orel region, and forms 84847, 84595 and 84854, Putinka, Umanskaya Skorospelka are late-ripening. The duration of cherry cultivars vegetation season was determined at the level of 175-194 days. The sum of active temperatures during the vegetation season of cherry cultivation was 2592.4-2650.9 °C. The variance analysis allowed to determine a certain influence degree of the year conditions on vegetation season duration and sum of active temperatures necessary for the varieties to pass the phenological phases successfully.

1 Introduction

One of the basic factors of plant adaptation is the timely passage of phenological phases of development in various soil and climatic conditions. The phenological rhythms of plants take place in various temperature conditions, to which they are adapted in the course of evolution and which are largely under genetic control [1].

Traditionally, phenological data is used to plan the timing of agricultural work, but recently, historical phenological observations are increasingly used in climatology, since plants can be very sensitive to changes in their environment [2]. The phenology of perennial fruit crops, such as cherry, is an ideal bio-indicator of climate change due to its long-term characteristics [3].

Air temperature increased by 0.07 °C per decade in Europe and Asia between 1850 and 2005, and future scenarios show an increase by 0.08-0.72 °C per decade between 2006 and 2100 [4]. If the warming trend continues and the maximum temperatures increase in the

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future, then these two types of fruit trees may require important changes in garden management [5].

Studies in other countries have shown that the overall climate warming can have unexpected consequences, such as an increased risk of damage from frost in the spring. For example, it was found that in recent decades, frost damage to forest species and fruit trees in Switzerland has increased in places at an altitude of more than 800 m above sea level [6; 7]. Therefore, knowledge of the temperature requirements of the variety can be useful for producers to anticipate the future performance of their gardens and design new gardens taking into account the projected global warming [8].

The purpose of this study was to study the features of the passage of phenological phases by cultivars of common cherry from the VNIISPK gene pool.

2 Materials and methods of research

The study was conducted in 2018-2020 on the basis of stone crops VNIISPK plantings (Orel region). The objects of the study are represented by varieties, selected and elite seedlings of different ecological and geographical origin in the amount of 12 pieces. The distance between the trees is 5x2 m. The Turgenevka variety was the control one. The study of the features of cherry phenological phases passage was carried out in accordance with [9]. Statistical processing of experimental data was carried out by variance analysis method [10], as well as with the use of "Excel" computer program. The objects of research are presented in Table 1.

Table 1. Research objects

№	Variety sample	Genetic origin
1	Turgenevka (control) (r)	Free pollination of the Zhukovskaya variety
2	Businka (r)	Shokoladnitsa x Novella
3	Vereya (GSI)	Anratsitovaya (k) x Prevoskhodnaya Venyaminova
4	Griot Ostgeymysky (r)	Starinny sort iz Ispanii
5	Kapelka (r)	Rovesnitsa x Novella
6	Prevoskhodnaya Venyaminova (r)	Selection from seedlings of Drogana Zheltaya free pollination
7	Putinka (r)	Anratsitovaya x Prevoskhodnaya Venyaminova
8	Umanskaya Skorospelka (r)	Drogana Zheltaya x Griot Ostgeymysky
9	OS 84735	Shokoladnitsa (k) x Novella
10	OS 84595	Zolushka (k) x Shokoladnitsa №51
11	ELS 84847	Rovesnitsa x Novella
12	OS 84854	Rovesnitsa x Novella

*(r) - zoned variety

*(GSI) - a variety submitted for State Variety Testing

The onset of early phenological phases is determined by the following indicators:

Beginning of budding (NPR) - the first dehisce flower or leaf buds appeared on a tree or shrub.

Beginning of flowering (NC) – about 25% of the flowers have opened on trees or shrubs.

End of flowering (KC) - the petals fell off most of the flowers (25% of the flowers remained).

Fruit maturation (SP) – when variety fruits have reached picking maturity and can be harvested.

End of shoot growth (KRP) is noted when the apical buds have formed in most shoots located at the ends of branches, mainly in the upper part of the crown, where shoot growth ends last.

Beginning of leaf fall (NL) is noted when the natural leaf abscission began (about 25% of the leaves fell off)

End of leaf fall (KL) - about 75% of the leaves have fallen.

3 Results and discussion

The study period was distinguished by special weather and climatic conditions (Fig. 1-2). April-November 2018-2020 period was warmer compared to long-term data. The average sum of temperatures for months and years of studies was +12.6 °C, which is +1.9°C higher than the annual average.

Analysis of Figure 2 shows that 2018-2020 were drier compared to long-term indicators. On average, only in May and July there was more precipitation than according to the average statistical data. The average amount of precipitation for months and years of studies was 323.7 mm, while the annual average for these months is 394 mm. All these parameters of weather conditions are of great importance when observing the seasonal development of plants.

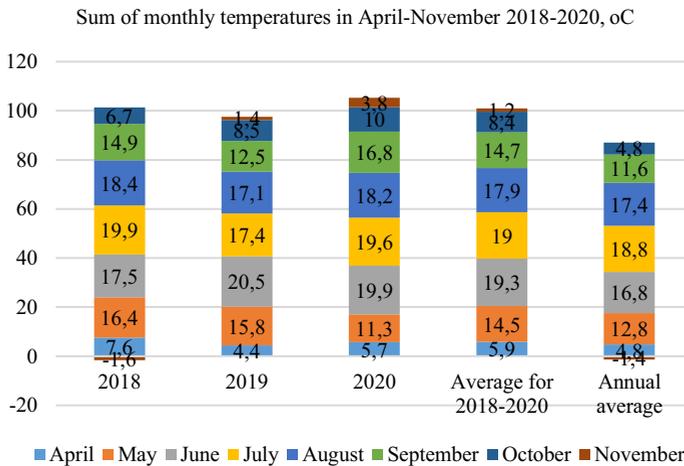


Fig. 1. Sum of monthly temperatures during the study period, °C

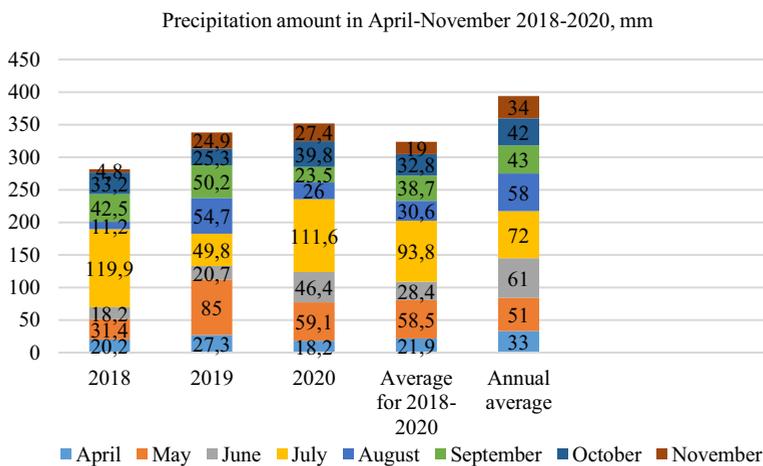


Fig. 2. Precipitation amount during the study period, mm

The study of cherry phenological phases revealed some varietal features. In most varieties, budding began in the middle of the third decade of April, on April 24-26. Earlier than this period, on April 21-23, the buds bloomed in the varieties Businka, Prevoskhodnaya Venyaminova, Griot Ostgeymsky. Later, on April 27-28, budding was observed in Putinka and form 84847.

Almost all cherry varieties under study began to bloom within a short time, on May 5-8. The prevoskhodnaya Venyaminova variety was the exception, which blooms on average on May 4. The end of flowering turned out to be more extended in time. Most varieties ended flowering on May 16-18. Earlier, on May 13-14, the varieties Prevoskhodnaya Venyaminova, Griot Ostgeymsky, 84735 finished flowering. Later than the others, on May 20, the form 84595 finished flowering.

Fruit ripening also turned to be time-consuming. First of all, ready-to-eat fruits were formed on June 26-July 1 in the varieties Turgenevka, Businka and Kapelka. The varieties that began to bear fruit on July 5-8 – Vereya, Griot Ostgeymsky, Prevoskhodnaya Venyaminova, 84735 - became the average by the date of maturation. The late cultivars that began to form fruit on July 13-19 were Putinka, Umanskaya Skorospelka, 84847, 84595, 84854.

The shoot growth in most of the studied varieties was ended in the first half of July. Most varieties completed shoot growth in mid-July, on July 12-17. These are the varieties Putinka, 84847, 84854, Turgenevka, Kapelka, Umanskaya Skorospelka, 84735. Earlier than this period, on July 2-8, the growth was completed in the varieties Vereya, Prevoskhodnaya Venyaminova, Businka, Griot Ostgeymsky. On July 24, the shoot growth stopped in the form 84595, the latest.

Leaf fall began in the second decade of October (October 14-19). Varieties Turgenevka, Kapelka and 84854 became an exception, from which the phenological phase began on October 20-22. The bulk of the varieties completed leaf fall on October 29-November 1, with the exception of the varieties Putinka and 84735 (October 19 and 25, respectively) and Griot Ostgeymsky and 84854 (November 3 and 6, respectively). The onset of all these phenological phases generally corresponds to the weather and climatic conditions of the Orel region.

Table 2. Average phenological phases of cherry cultivars of 2011 planting

Variety	NRP	NC	KC	SP	KRP	NL	KL
Turgenevka (k)	24.04	7.05	16.05	26.06	15.07	20.10	31.10
Businka	21.04	6.05	16.05	30.06	7.07	15.10	1.11
Vereya	25.04	6.05	16.05	5.07	2.07	15.10	29.10
Griot Ostgeymsky	23.04	5.05	14.05	5.07	8.07	17.10	3.11
Kapelka	25.04	5.05	16.05	1.07	15.07	22.10	30.10
Prevoskhodnaya Venyaminova	22.04	4.05	13.05	8.07	2.07	17.10	1.11
Putinka	27.04	7.05	17.05	13.07	12.07	14.10	19.10
Umanskaya Skorospelka	24.04	6.05	18.05	15.07	15.07	19.10	1.11
OS 84735	25.04	6.05	14.05	8.07	17.07	14.10	25.10
OS 84595	26.04	8.05	20.05	18.07	24.07	14.10	30.10
ELS 84847	28.04	8.05	18.05	17.07	13.07	14.10	30.10
OS 84854	26.04	7.05	18.05	19.07	13.07	20.10	6.11

The study of the average date of the onset of the fruit maturation phenological phase allows to distinguish a number of early and late varieties. The first ones include Turgenevka, Businka, and Kapelka (date of fruit ripening is June 26-July 1). Forms 84847, 84595 and 84854, which began to bear fruit on July 17-19, are assigned to the group of late-maturing varieties.

When characterizing agroclimatic resources, special attention is paid to the vegetation (growing) season. The vegetation season is the period of the year during which the growth and active development of plants (vegetation) are possible under these climatic conditions [11]. For the territory with a moderate climate, the vegetation season corresponds to a segment of the calendar year during which the average daily air temperature exceeds 10°C [12]. Our studies showed that the average length of the vegetation season varied from 175 days in the Putinka variety to 194 days in the Businka, Griot Ostgeymsky, 84854 (Fig. 3).

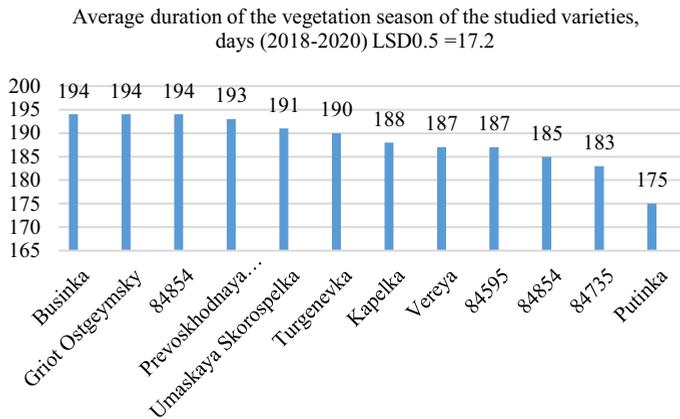


Fig. 3. Average duration of the vegetation season of the studied varieties in days

The variance analysis of the vegetation season duration makes it clear that the share of the year conditions influence on this indicator was 21.8% (Table 4).

Table 4. Variance analysis of the vegetation season duration

Variation source	F	P-Value	F crit.	Share of influence, %
Genotype	1.366041	0.256055	2.258518	F<F crit.
Year conditions	5.157655	0.01456	3.443357	21.8

For successful cherry growth and fruiting, a sum of active temperatures (above 10°C) equal to 2000°C is required [13]. Figure 4 shows the sum of active temperatures in April-November 2018. Its analysis suggests that 2018-2020 was mostly favorable for cherry cultivation in the conditions of the Orel region. The greatest sum of active temperatures for the passage of all phenological phases was required for the varieties Prevoskhodnaya Venyaminovka, Umanskaya Skorospelka, form 84854 and the control variety Turgenevka (2650.8°C). The lowest value for this indicator is in the Putinka variety (2592.4°C).

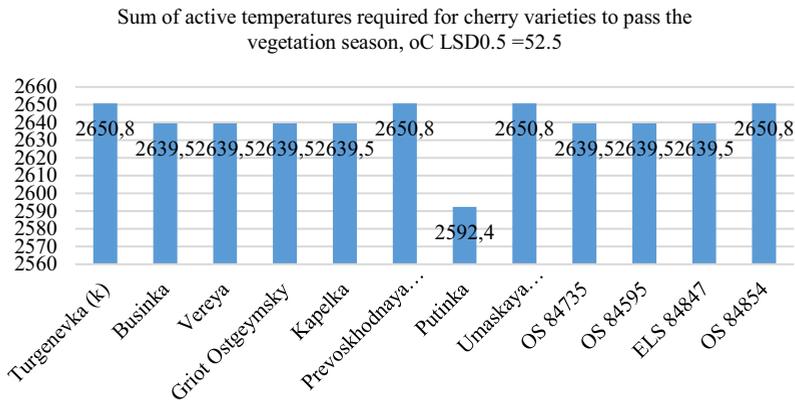


Fig. 4. Sum of active temperatures required for cherry varieties to pass the vegetation season, °C

The variance analysis of the sum of active temperatures required for cherry cultivars to pass the vegetation season allows to understand that the share of the influence of year conditions on this indicator was 50% (Table 5).

Table 5. Variance analysis of the vegetation season duration.

Variation source	F	P-Value	F crit.	Share of influence, %
Genotype	1.242975	0.318085	2.258518	F<F crit.
Year conditions	286.0848	1.79E-16	3.443357	50%

4 Conclusions

As a result of studying the features of phenological phases observation, a number of early (Turgenevka, Businka, Kapelka) and late (84854, 84595, 84847, Putinka, Umanskaya Skorospelka) varieties of common cherry were identified by the fruiting period. The onset of the studied phenological phases corresponds to the weather and climatic conditions of the Orel region.

The average duration of the vegetation season for all the studied cultivars varied from 175 to 194 days. The shortest vegetation season was noted in the variety Putinka, and the longest one - in the cultivars of 84854, Businka, Griot Ostgeymysky.

The sum of active temperatures required for the variety samples to pass the vegetation season varied from 2592.4°C for the Putinka variety to 2650.8°C for the Prevoskhodnaya Venyaminova, Umanskaya Skorospelka, 84854 and the control Turgenevka variety.

The variance analysis allowed to determine a certain influence degree of the year conditions on vegetation season duration and sum of active temperatures to pass it.

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