

Influence of unstable weather conditions on the passage time of phenological phases of black currant in the Middle Urals

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Abstract. Purpose. The research is aimed at studying the influence of weather conditions on the timing of the phenological phases of black currant in the Middle Urals. **Methods.** The study is based on methods of phenological observations in accordance with generally accepted methods. **Results and practical significance.** It was found that black currant adapts well to unstable weather conditions in recent years in the Middle Urals, during the research period, budding was observed in the period from April 12 to May 4; the dates of the beginning of flowering were marked from May 10 to May 28; maturation dates are marked from July 16 to August 10. The shift in the dates of onset of the main phases of vegetation from the average long-term can reach 14 days. Industrial plantings should consist of varieties of different flowering and maturation periods, to avoid the spring frosts of the main part of the plantation, as well as to form a conveyor for the arrival of fresh berries. The experiment identified five early-flowering cultivars in the Middle Urals: Zabava, Fortuna, 1-3-010-13, 3-2-010-13, 6-44-00-03; four late-flowering: Gerkules, Slavyanka, 5-1-010-13, 8-2-010-13; the remaining 28 cultivars are of the average flowering period. Five varieties of early maturation are identified: Zabava, 2-1-010-13, 2-4-010-13, 3-1-010-13, 5-1-010-15; four late maturation: Zaglyaden'e, Kipiana, Chudnoe mgnovenie, Slavyanka; the remaining 28 varieties are of average maturation. Not all early-flowering cultivars are early-maturing, and not all late-flowering cultivars are late-maturing. **The scientific novelty** consists in the study of phenological rhythms of black currant varieties of various genetic origin in unstable weather conditions of recent years in the Middle Urals.

Keywords: black currant, introduced varieties, local varieties, phenology, Middle Urals, unstable weather conditions, adaptation.

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Introduction

Black currant is one of the leading small-fruit crops grown in the Middle Urals [1, p. 166]. The timing of the onset of the main phenological phases in black currant, as well as in other crops, is genetically determined and is directly dependent on the sum of effective and active temperatures [2, p. 147], [3, p. 29], [4, p. 14], [5, p. 35], [6, p. 96], [7, p. 55], [8, p. 234]. In the conditions of the Middle Urals, for the beginning of the growing season (vegetation), the sum of effective temperatures of 41.0–115.0 °C is required, for flowering – 207.0–368.5 °C, for ripening – the sum of active temperatures is 1246.0–1539.0 °C, the end of the growing season – 1993.5–2363.0 °C. The growing season is 153–195 days [9, p. 53]. In the initial growing season of black currant, weather conditions in the Middle Urals are unstable, accompanied by sharp fluctuations in temperature. The flowering phase of black currant often coincides with the period of return frosts. The growing seasons of the last three years sharply differed among themselves in temperature indicators and the amount of precipitation, which affected the timing of the onset of the phenological phases of black currant over the years. The cultivars included in the study were introduced from other natural

and climatic zones or were selected in the conditions of the Middle Urals and have different genetic origins [10]. Phenological observations have both scientific and practical value, highly adaptive varieties are able to most fully reveal their potential and ensure high productivity [11, p. 233], [12, p. 225], [13, p. 228], [14, p. 66], [15, p. 178], [16, p. 31], [17, p. 117], [18, p. 2]. In connection with the above, a study was carried out of the passage of phenological phases of vegetation by black currant varieties during 2017–2019. at the Sverdlovsk gardening selection station.

The aim of the research is to study the influence of weather conditions on the timing of the phenological phases of black currant in the conditions of the Middle Urals.

Research methods

Place of work – Sverdlovsk selection station of gardening – a structural subdivision of the Federal State Budgetary Scientific Institution “Ural Federal Agrarian Research Center of the Ural Branch of the Russian Academy of Sciences” on a unique scientific installation of the collection of living plants in open ground “Gene pool of fruit, berry and ornamental crops in the Middle Urals” (Ekaterinburg).

Observations of varieties and selected forms in phenology were carried out according to the generally accepted methods of variety study of fruit, berry and nut crops [19, p. 351], [20, p. 158]. When carrying out phenological observations, the timing of the onset of phenophases was determined visually in general by replicates. Accounting for the beginning of budding and the timing of flowering was carried out every other day, the timing of ripening – in two days.

The beginning of the growing season (vegetation). Weather conditions in the second – third decade of April have a great influence on the beginning of the growing season, when the average daily temperature in our zone goes over $+5^{\circ}\text{C}$ and, as a rule, buds begin to bloom. Over the years of observation, bud opening was noted in mid-April – early May.

Flowering. On average it started 3–4 weeks after the beginning of the budding phase. Over the years of research, flowering was observed in the second – third decade of May.

Maturation. The ripening of berries in the studied varieties was noted in mid-July – early August, depending on the weather conditions prevailing during the years of observation.

Weather conditions for the period of research are shown in Fig. 1 and 2.

Introduced varieties were used as objects of research: selections of FGBNU VNIISPK (Orel) – Zaglyadienie, Kipiana, Wonderful moment; selection of FGBNU FANTSA (Barnaul) – Hercules, Zabava; varieties and selected seedlings of the selection of the Sverdlovsk selection station of horticulture (32 varieties) of various origins (table 1).

Results

During the study period, bud breaking was observed in the period from April 12 to May 4; blooming dates are marked from May 10 to 28; ripening period – from July 16 to August 10. The results of phenological observations in this experiment are presented in table 2.

In 2017, the passage of all phenological phases took place in the usual terms according to long-term average data. Dissolution of buds was observed from 17 to 20 April. Flowering dates are marked May 12–17. Ripening dates are marked from 24 to 29 July.

In 2018, all phenological phases took place at a later date according to long-term average data (shift by 10 days) due to the late melting of the snow cover (April 22) and cold May. In 2018, budding was noted in the period from 1 to 4 May. The beginning of flowering was observed from 23 to 28 May. Ripening was noted from 2 to 10 August. In 2019, budding was observed between April 12 and 17. At this time, there was a sharp cooling down to -11°C with precipitation in the form of snow (on April 16–17, there was noted temporary snow cover) after warm weather (the air temperature during the day rose to $+18.5^{\circ}\text{C}$). The dates of the beginning of flowering are marked from May 10 to 14; the flowering period was very tight due to the fact that at this time there was hot weather, the air temperature during the day rose to $+28^{\circ}\text{C}$. The frost was recorded during the formation of the ovary on May 24–26 to -1.7°C . Ripening dates are marked from July 16 to 25 (which is 14 days earlier than in 2018 and 7 days earlier than in 2017).

When growing black currants in the Middle Urals in industrial plantations, in order to select a varietal composition, it is especially necessary to take into account the timing of the flowering and ripening phases. The plantings should consist of varieties of different flowering and ripening periods, to avoid spring frosts in the main part of the plantation, as well as to form a conveyor for the supply of fresh berries. In the experiment were identified stable early flowering varieties in the conditions of the Middle Urals: Zabava, Fortuna, 1-3-010-13, 3-2-010-13, 6-44-00-03; stably late flowering: Hercules, Slavyanka, 5-1-010-13, 8-2-010-13; the rest of the varieties – the average flowering period. Varieties of stably early ripening: Zabava, 2-1-010-13, 2-4-010-13, 3-1-010-13, 5-1-010-15; consistently late ripening: Zaglyadienie, Kipiana, Chudnoe mgnovenie, Slavyanka; the rest of the varieties – the average ripening period.

Not all early flowering cultivars proved to be early maturing, not all late flowering varieties were late maturing. So, only the variety Zabava is early both in terms of flowering and ripening of berries; only the Slavyanka variety is late both in flowering and ripening. Variety 5-1-010-15 late flowering but early ripening.

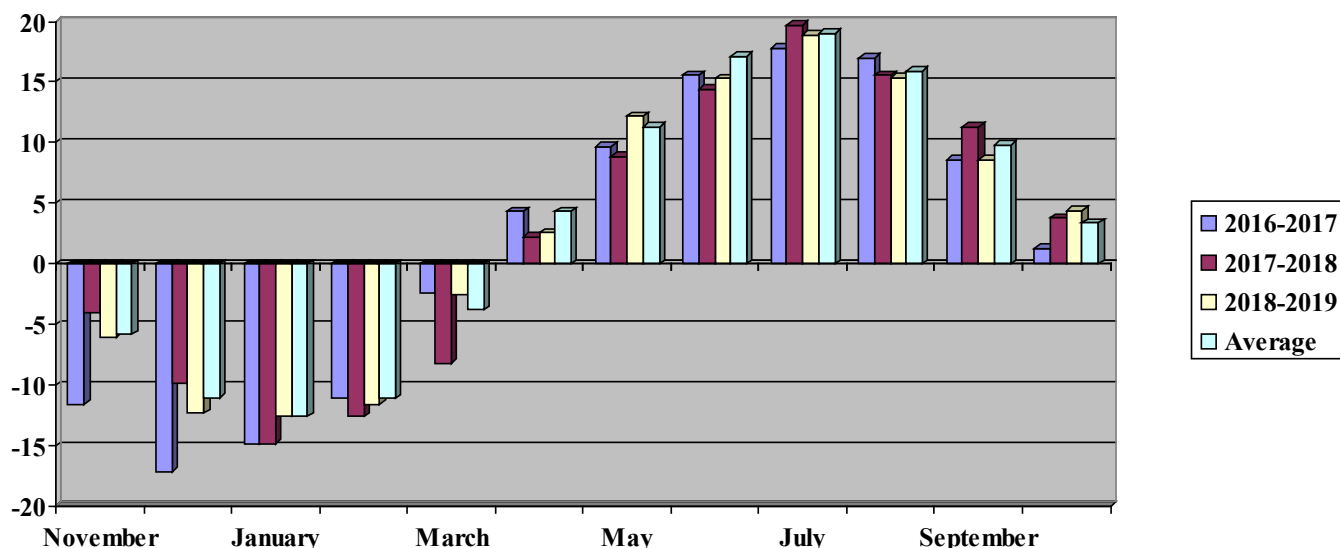


Fig. 1. Temperature regime of overwintering and vegetation period of plants in comparison with the average long-term data

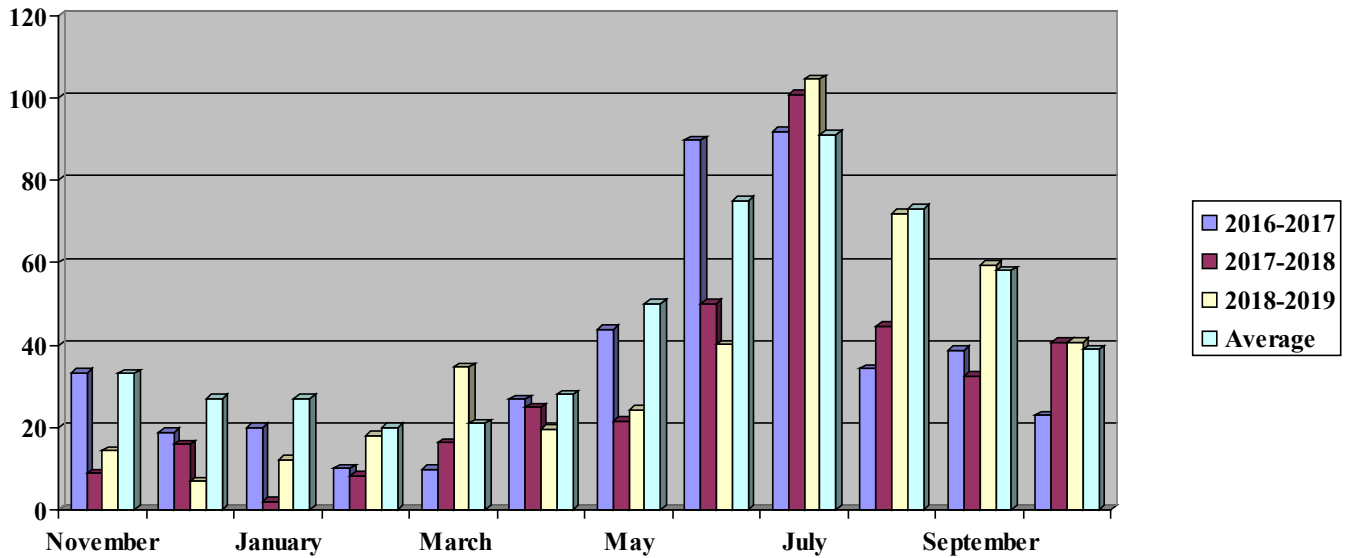


Fig. 2. The amount of precipitation during the research period in comparison with the average long-term data

Table 1
The origin of the variety form in the experiment

No.	Hybrid family	Variety form
Introduced		
1	(27-3-63 × Sunderbyun II) × Orlovskiy val's	Zaglyaden'e
2	Ekzotika × 762-5-82	Kipiana
3	(Bredtorp – open pollination) × Samoplodnaya	Chudnoe mgnovenie
4	Plotnokistnaya × selected form	Gerkules
5	Bredtorp × (Zoya × Pushistaya)	Zabava
Breeding Sverdlovsk selection gardening station		
6	No. 147-1/182 (Naslednitsa × Bredtorp) × Globus	1-1-010-13
7	Valovaya × Dobryy Dzhinn	1-2-010-13, 1-3-010-13, 1-4-010-13
8	Dobryy Dzhinn × Globus + Dobryy Dzhinn	2-1-010-13, 2-2-010-13, 2-3-010-13, 2-4-010-13, 2-5-010-13
9	Globus × No. 147-1/182 (Naslednitsa × Bredtorp)	3-1-010-13
10	Valovaya × No. 147-1/182 (Naslednitsa × Bredtorp)	3-2-010-13, 3-3-010-13, 6-37-00-03, 7-52-00-03, 7-63-00-03
11	Pilot × No. 147-1/182 (Naslednitsa × Bredtorp)	3-4-010-13
12	Pilot × Dobryy Dzhinn	4-1-010-13
13	Krasa L'vova × Globus	5-1-010-13, 5-2-010-13
14	No. 147-1/182 (Naslednitsa × Bredtorp) × Valovaya	6-44-00-03
15	Krasa L'vova × Dobryy Dzhinn	8-1-010-13, 8-2-010-13
16	Valovaya – open pollination	Ataman, Voevoda, Dobrokhhot, Pilot, Fortuna
17	Khabarovskaya × Bredtorp	Vasilisa
18	31-4-a (39-19-61 × GAZ-1-45) × Akkord	Kornet
19	Fertodi × Zelenaya dymka	Slavyanka
20	Slavyanka × Valovaya	Udalets
21	Globus × Valovaya	Shaman

Table 2

Timing of phenological phases of black currant varieties in the 2014 experiment

No.	Variety form	2017			2018			2019		
		Start date			Start date			Start date		
		budding	flowering	ripening	budding	flowering	ripening	budding	flowering	ripening
1	2	3	4	5	6	7	8	9	10	11
Introduced										
1	<i>Gerkules</i>	18.04	17.05	24.07	2.05	27.05	8.08	15.04	13.05	20.07
2	<i>Zabava</i>	19.04	13.05	25.07	2.05	22.05	2.08	12.04	10.05	18.07
3	<i>Zaglyaden'e</i>	18.04	17.05	29.07	2.05	24.05	10.08	17.04	12.05	23.07
4	<i>Kipiana</i>	17.04	16.05	28.07	4.05	24.05	10.08	16.04	13.05	25.07
5	<i>Chudnoe mgnovenie</i>	18.04	14.05	28.07	1.05	24.05	10.08	12.04	11.05	25.07
Breeding Sverdlovsk selection gardening station										
6	<i>Ataman</i>	18.04	13.05	27.07	2.05	24.05	8.08	14.04	11.05	18.07
7	<i>Vasilisa</i>	17.04	14.05	27.07	1.05	23.05	5.08	12.04	10.05	18.07
8	<i>Voevoda</i>	18.04	13.05	25.07	2.05	24.05	4.08	14.04	10.05	18.07
9	<i>Dobrokhhot</i>	17.04	12.05	26.07	2.05	24.05	8.08	13.04	11.05	20.07
10	<i>Kornet</i>	18.04	16.05	27.07	2.05	27.05	8.08	12.04	13.05	18.07
11	<i>Pilot</i>	20.04	15.05	27.07	3.05	25.05	8.08	15.04	11.05	20.07
12	<i>Slavyanka</i>	17.04	17.05	28.07	4.05	28.05	10.08	17.04	13.05	22.07
13	<i>Udalets</i>	17.04	15.05	27.07	2.05	25.05	3.08	12.04	12.05	18.07
14	<i>Fortuna</i>	17.04	12.05	27.07	3.05	23.05	8.08	15.04	10.05	20.07
15	<i>Shaman</i>	19.04	15.05	26.07	3.05	24.05	2.08	17.04	13.05	20.07
16	<i>1-1-010-13</i>	19.04	16.05	26.07	3.05	25.05	2.08	15.04	12.05	17.07
17	<i>1-2-010-13</i>	18.04	13.05	28.07	3.05	24.05	2.08	17.04	10.05	19.07
18	<i>1-3-010-13</i>	17.04	13.05	26.07	1.05	22.05	8.08	12.04	10.05	18.07
19	<i>1-4-010-13</i>	19.04	13.05	27.07	3.05	24.05	2.08	16.04	10.05	20.07
20	<i>2-1-010-13</i>	17.04	15.05	24.07	2.05	24.05	2.08	16.04	11.05	17.07
21	<i>2-2-010-13</i>	17.04	16.05	25.07	1.05	23.05	4.08	13.04	11.05	18.07
22	<i>2-3-010-13</i>	18.04	15.05	27.07	2.05	24.05	2.08	12.04	12.05	20.07
23	<i>2-4-010-13</i>	18.04	12.05	24.07	2.05	24.05	2.08	16.04	10.05	18.07
24	<i>2-5-010-13</i>	18.04	16.05	28.07	1.05	24.05	2.08	13.04	10.05	16.07
25	<i>3-1-010-13</i>	19.04	15.05	24.07	3.05	24.05	2.08	16.04	13.05	18.07
26	<i>3-2-010-13</i>	16.04	12.05	25.07	2.05	23.05	4.08	12.04	11.05	20.07
27	<i>3-3-010-13</i>	18.04	15.05	24.07	1.05	24.05	8.08	12.04	11.05	18.07
28	<i>3-4-010-13</i>	17.04	12.05	26.07	3.05	25.05	4.08	15.04	11.05	18.07
29	<i>4-1-010-13</i>	18.04	13.05	28.07	2.05	23.05	2.08	17.04	12.05	19.07
30	<i>5-1-010-13</i>	19.04	17.05	24.07	3.05	28.05	2.08	17.04	14.05	18.07
31	<i>5-2-010-13</i>	18.04	17.05	27.07	2.05	25.05	4.08	16.04	13.05	20.07
32	<i>6-37-00-03</i>	17.04	16.05	25.07	3.05	25.05	5.08	15.04	11.05	20.07
33	<i>6-44-00-03</i>	17.04	12.05	26.07	1.05	23.05	3.08	13.04	11.05	16.07
34	<i>7-52-00-03</i>	17.04	12.05	25.07	3.05	23.05	2.08	16.04	12.05	20.07
35	<i>7-63-00-03</i>	19.04	15.05	24.07	4.05	24.05	4.08	17.04	12.05	18.07
36	<i>8-1-010-13</i>	19.04	15.05	28.07	2.05	24.05	4.08	14.04	12.05	16.07
37	<i>8-2-010-13</i>	19.04	17.05	29.07	3.05	27.05	8.08	14.04	13.05	20.07

Some of the cultivars classified as medium, in some years showed themselves as early, some of the accessions – as late, depending on weather conditions. So, varieties Dobrokhot, Ataman, Voevoda, Vasilisa, 1-2-010-13, 1-4-010-13, 2-2-010-13, 2-4-010-13, 4-1-010-13, 7-52-00-03 during the years of research were twice marked as early flowering; cultivars Kipiana, Kornet, 5-2-010-13 – as late flowering. Variety samples Voivoda, Udalets, 1-1-010-13, 2-2-010-13, 2-5-010-13, 3-3-010-13, 6-44-00-03, 7-52-00-03, 7-63-00-03 over the years of the study were twice marked as early maturing. Samples 1-2-010-13, 2-5-010-13, 4-1-010-13, 8-1-010-13, 8-2-010-13 in 2017 were marked as late maturing.

Discussion and Conclusion

1. Black currant adapts well to the unstable weather conditions of recent years in the Middle Urals.

2. The shift in the dates of the onset of the main phases of the growing season can reach 14 days, nevertheless, all phases fit into the growing season due to a reduction or increase in the duration of one or another phase.

3. The introduced varieties pass through phenological phases at the same time as those bred in the Middle Urals.

4. As a result of the research carried out, five early flowering varieties were identified in the conditions of the Middle Urals: Zabava, Fortuna, 1-3-010-13, 3-2-010-13, 6-44-00-03; four late flowering: Hercules, Slavyanka, 5-1-010-13, 8-2-010-13; the remaining 28 cultivars have an average flowering period. Five varieties of early ripening were identified: Zabava, 2-1-010-13, 2-4-010-13, 3-1-010-13, 5-1-010-15; four late ripening periods: Zaglyadenie, Kipiana, Chudnoe mgnovienie, Slavyanka; the remaining 28 varieties have an average ripening period.

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