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RESEARCH ARTICLE

The new earliest cultivar of cornelian cherry (*Cornus mas* L.)

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Abstract

The fruits of cornelian cherry (*Cornus mas* L.) have long been eaten and used for medicinal purposes. During the long history of their use, many cultivars have been created with a wide range of shapes, sizes, colors, biochemical composition, and fruit ripening dates, allowing the planting of the cornelian cherry in different geographical locations and a wide range of environmental conditions. The M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (Kyiv, Ukraine) has an extensive collection of *C. mas* cultivars, which differ in many respects, including the time of fruit ripening. Recently a new cultivar, 'Vytivka Svitlany', marked by a very early ripening time, has been bred. The fruits of cultivar 'Vytivka Svitlany' are red or dark red, oval and more or less elongated, cut off at the top and slightly concave, shiny, juicy, sweet-sour, and slightly tart, with a delicate aroma. After full ripening, the fruits crumble quickly. They are deliciously fresh and suitable for processing in the food industry. In the present paper, the morphological features and biometric characteristics of the fruits of the new cultivar in comparison with other early-ripening cultivars (red-fruited 'Olena' and yellow-fruited 'Alyosha'), as well as the principal biochemical composition of the fruits and its phenological phases for the seasonal development in 2021 according to BBCH scale are represented.

Keywords: *Cornus mas*, cultivars, biometrics, biochemistry, phenology, Ukraine

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Introduction

Many plants serve as a valuable source of high-quality fruits, demonstrating productivity and resistance to adverse environmental conditions (Mal, 2007; Baldi et al., 2022). The world is aware of the need to cultivate such plants for healthy nutrition as an alternative source of minerals, vitamins, antioxidants, essential oils, and other valuable substances (Rop et al., 2010; Baldi et al., 2022). In the last few decades, cornelian cherry, guelder rose, elderberry, hawthorn, cherry, rosehip, blackberry, and many other species have been introduced into Ukraine (Klymenko, 2019). Among them, the cornelian cherry (*Cornus mas* L., Cornaceae), which fruits are famous for their high nutritional and healing properties, is attracting extensive attention (Kazimierski et al., 2019; Güzel, 2021).

The natural range of *C. mas* includes the Pontic and Mediterranean regions of the world and extends from Europe (South and Central) to the Caucasus and Asia Minor (Turkey, Syria, and Lebanon). This species is introduced and naturalized as an ornamental plant in many US states, as an ornamental and medical plant in China, as well it is actively cultivated in the countries of Northern Europe – Denmark, Great Britain, Sweden, and Norway (Da Ronch et al., 2016).

It is suggested that the first cultivars of cornelian cherry appeared in ancient Greece and Rome (Weaver, 1976; Da Ronch et al., 2016). Currently, numerous local cultivars are bred or introduced in Europe (Drkenda et al., 2014; Cetkovská et al., 2015; Brindza et al., 2007, 2009; Mratinić et al., 2015; Cornescu & Cosmulescu, 2019; Szot et al., 2019; Jaćimović et al., 2020; Jurečková et al. 2021) and Asia (Güleryüz et al., 1998; Maghradze et al., 2006; Hassanpour et al., 2012; Moradi et al., 2019).

Ukraine has the largest assortment of *C. mas* cultivars hosted at the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (NBG). This collection was initiated in 1960 (Klimenko, 1990, 2004, 2007; Klymenko et al., 2017). Since that, experiments on the breeding of new cornelian cherry cultivars were carried out using analytical (spontaneous hybridization and selection) and synthetic (creation of genotypes with specific characteristics and properties) selection methods and involved cultivars of different origins. The principal selection criteria of the new cultivars were primarily associated with the fruit properties (shape, size, color, size of the endocarp, biochemical composition, etc.). Such important indicators as yield, fruit ripening period, plant growth vigor, and winter and drought resistance were also taken into account. As a result, many cultivars of *C. mas* were bred at the NBG, 14 of which were included in the "Register of Plant Cultivars of Ukraine" for the first time in the history of Ukrainian horticulture.

The gene pool of the collection of cornelian cherry cultivars at the NBG includes over a hundred wild and cultivated genotypes from Ukraine, Bulgaria, Slovakia, Great Britain, Austria, Georgia, and other countries (Klimenko, 2004; Klymenko, 2012). Cornelian cherry cultivars of the NBG selection differ significantly from each other both in terms of phenotypic characteristics and genotype, which allows the selection of the prospective forms for horticulture and initial genotypes for further breeding work (Klimenko, 2007; Klymenko, 2012; Klymenko et al., 2019). In particular, the NBG collection includes such early-ripening (with fruit ripening in the third decade of July – the second decade of August) cultivars of *C. mas* as 'Alyosha', 'Nikolka', 'Elegantnyi', and 'Olena'. There are also mid-early-ripening (with fruit ripening in the second decade of August – the second decade of September) cultivars 'Radist', 'Bukovynskiy', 'Vyshgorodskiy', 'Nizhnyi', 'Galytskyi', 'Grenader', 'Koralovyi', 'Slastyona', 'Ugolyok', and 'Yantarnyi'. The mid-late-ripening (with fruit ripening in the third decade of August – the third decade of September) cultivars are represented by 'Vavilovets', 'Volodymyrskiy', 'Yevgeniya', 'Koralovyi Marka', 'Lukiyanivskiy', 'Mriya Shaidarovoyi', 'Nespodivanyi', 'Oryginalnyi', 'Pervenets', 'Priorskiy', 'Samofertylnyi', 'Svitlyachok', 'Starokyivskiy', and 'Ekzotychnyi'. The late-ripening cultivars hosted at the NBG are 'Kozerog', 'Kostya', 'Semen', 'Sokolyne', and 'Suliya' (Klymenko, 2000; Klimenko, 2004, 2007, 2013).

In this article, we described and analyzed the morphological features and biometric indicators of the fruits of the new cultivar 'Vytivka Svitlany' bred based on the cultivars 'Armen-1' and 'Armen-2' and compare its properties with other similar cultivars – early red-fruited 'Olena' and yellow-fruited 'Alyosha'. In particular, the biochemical composition, the passage of the phases during the seasonal development in 2021, and a brief pomological description of the new cultivar are provided in this article.

Material and methods

Research objects

The following cultivars of *C. mas* were studied: 'Vytivka Svitlany', 'Olena', and 'Alyosha'. The new cultivar 'Vytivka Svitlany' was bred using the analytical selection method involving the mass sowing of seeds and random selection of promising seedlings. The cultivar 'Olena' was bred among seedlings of free pollination in 1975 (Klimenko, 2013). The genotype 'Alyosha' was found in the village Murovani Kurylyvtsi in

Table 1. Average monthly precipitations and temperatures in Kyiv in 2021.

Months	Precipitations, mm		t, °C	
	norm	2021	norm	2021
January	42	61	−3.8	−2.6
February	40	62	−3.0	−5.2
March	45	18	1.9	2.7
April	50	46	9.6	8
May	65	77	15.8	14.3
June	75	24	19.6	21.3
July	91	63	21.5	24.6
August	57	66	20.6	21.1
September	63	23	15.1	13.5
October	48	1.6	8.7	8.4
November	49	31	3.2	4.8
December	51	67	−1.3	−1.5

the Vinnytsia region in 1996 and vegetatively propagated at the NBG (Klimenko, 2013).

Study conditions

The research was conducted in 2019–2021 at the NBG (southeastern part of Kyiv, low Pechersk slopes of Kyiv Upland, urochysche Zvirynets). The actual values of average monthly temperatures and precipitation for January–December 2021 following Raspisaniye Pogody (2021) and Climate Data (2021) are provided in Table 1. In 2021, Kyiv had one of the twenty warmest (since 1889) and driest years. The coldest day was January 20, with a temperature of −20.0 °C; the hottest day was June 24, with the temperature in the shade reaching +35.5 °C. The spring with sharp temperature drops and very dry autumn were especially notable in 2021. For example, on April 8, the minimum daily temperature was +0.4 °C, while the end of April was characterized by high temperatures reaching +21.0 °C. In September 2021, precipitations counted at 36.5% of the norm. In October 2021, the rainfalls were almost absent; in November 2021, only 63.3% of the precipitations' norm fell.

Fruit biometrics

The study involved 50 fruits of each cultivar. Biometric measurements included the length, diameter, and weight of the entire fruit and its endocarp. The shape index was defined as the ratio of the average length of the fruit to its average diameter. The level of variability of metric features was determined following Mamaev (1975).

Biochemical analysis

The biochemical study was conducted in the laboratory of the Department of Cultural Flora of the NBG. The total sugar content was determined by the Bertrand method (Krishchenko, 1983). The content of ascorbic acid was determined by Tillman's titration method (Krishchenko, 1983). The content of tannins was determined by the titrimetric method in the presence of indigo carmine and with titrated acidity (Krishchenko, 1983). The content of carotenoids was determined using Unico UV 2800 spectrophotometer at a wavelength of 440 nm (Musienko et al., 2001).

Seasonal rhythm of development

Phenological observations for the cultivar 'Vytivka Svitlany' were performed twice–thrice weekly. Phases of seasonal development were classified using the extended BBCH (Biologische Bundesanstalt, Bundessortenamt und CHemische Industrie) scale (Hack

et al., 1992; Meier et al., 1994; Klymenko & Ilyinska, 2021).

Results and discussion

The origin of the cultivar 'Vytivka Svitlany'

The new cultivar 'Vytivka Svitlany' was selected from seedlings of cultivars 'Armen-1' and 'Armen-2', seeds of which were obtained in 2001 from A.M. Ambartsumyan from the A.L. Takhtajan Institute of Botany of the National Academy of Sciences of the Republic of Armenia. Both initial cultivars (Armen-1' and 'Armen-2') have small fruits of early ripening (late July – early August) with an average weight of 3.5–4.5 g and an intense red-black color during full ripening. They were sown in the fall of 2009 and sprouted in the spring of 2011. Several seedlings in the nursery gave fruit in the fifth year, in 2016. One of them was selected due to early fruit ripening and high productivity compared to other cultivars of the NBG gene pool. It was named 'Vytivka Svitlany'.

In the NBG gene pool, there are other cultivars with early fruit ripening (starting from August 1–5), in particular, 'Alyosha', 'Elegantnyi', 'Nikolka', and 'Olena'. The newly bred cultivar 'Vytivka Svitlany' starts ripening seven to ten days earlier than mentioned above cultivars. Full fruit ripeness in 'Vytivka Svitlany' has been already noted in August 20–25, while most cultivars showed only the beginning of ripening at that time.

Biometric analysis of fruits

Biometric analysis of fruits is the first stage of selection and reproduction of the best genotypes for breeding (Bijelić et al., 2011b, 2012; Cornescu & Cosmulescu, 2017, 2019; Güzel, 2021; Salkić et al., 2021; Jurečková et al., 2021). Biometric descriptors are an integral part of the pomological characteristics of each plant cultivar (Moradi et al., 2019). They are important for monitoring the acclimatization process of newly introduced plants. In particular, biometric descriptors are successfully applied in the breeding work on *Asimina triloba* (L.) Dunal (Brindza et al., 2019), *Ziziphus jujuba* Mill. (Ivanišová et al., 2017), *Castanea sativa* Mill. (Grygorieva et al., 2017a; Horčinová Sedláčková et al., 2020), *Diospyros virginiana* L. (Grygorieva et al., 2017b), *Elaeagnus multiflora* Thunb. (Grygorieva et al., 2018a), *Mespilus germanica* L. (Grygorieva et al., 2018b), *Lycium* spp. (Zhurba et al., 2021) and many other plant species. Biometric data also make it possible to monitor the response of genotypes, including fruit size and weight, to weather and climate changes in the study region (Geng et al., 2014, 2020; Cosmulescu & Stefanescu, 2018; Escuredo et al., 2018, 2020).

The cultivar 'Vytivka Svitlany' is not marked by large fruits (Fig. 1). Among the cultivars of NBG selection, similar or slightly larger fruits have other early or middle-early cultivars like 'Olena', 'Elegantnyi', 'Alyosha', 'Yantarnyi', and 'Coralovyi' (Klimenko, 1990, 2007; Klymenko, 2000). The fruits of the new cultivar fall off quickly after ripening, like in other yellow-fruited cultivars. In 2021, the length of the fruits in the cultivar 'Vytivka Svitlany' was 20.6–24.0 mm, and the diameter was 14.4–17.3 mm. Similar characteristics were in the cultivars 'Olena' (fruit length – 20.9–29.9 mm, diameter – 13.5–20.9 mm) and 'Alyosha' (fruit length – 20.8–30.0 mm, diameter – 15.0–19.5 mm). The fruits of the cultivar 'Vytivka Svitlany' are slightly smaller on average than those in the cultivars 'Olena' and 'Alyosha' (Fig. 1). The index of the form was 1.43 : 1.50 : 1.39 in the cultivars 'Vytivka Svitlany', 'Olena', and 'Alyosha', respectively.

Fruit weight in the cultivar 'Vytivka Svitlany' ranged from 3.0 to 4.6 g, and endocarp weight – from 0.2 to 0.4 g. Although the fruits of the new cultivar are slightly smaller than in the cultivars 'Olena' and 'Alyosha' (Fig. 2), they are less variable in their biometric parameters. Variation in weight of the fruit and endocarp of the studied cultivars was as follows: 'Vytivka Svitlany' – fruit 3.0–4.6 mg and endocarp – 0.2–0.4 mg; 'Olena' – fruit 3.5–6.6 mg and endocarp 0.2–0.5 mg; 'Alyosha' – fruit 3.0–5.6 mg and endocarp 0.4–0.6 mg. According to Mamaev (1975) classification, fruits of the cultivar 'Vytivka Svitlany' are characterized by very low level of variability in size, while fruits of the cultivars 'Alyosha' and 'Olena' are characterized by low variability in size. In all three studied cultivars, the fruit and endocarp weights varied more than their sizes.

The share of endocarp mass in fruit weight is an important parameter for assessing the quality of cornelian cherry fruit, especially

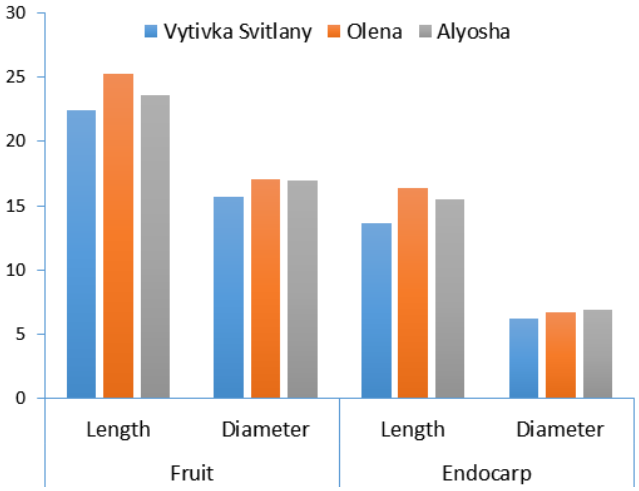

Figure 1. Average morphometric indicators (mm) of fruits in the studied cultivars of *Cornus mas* in 2021.

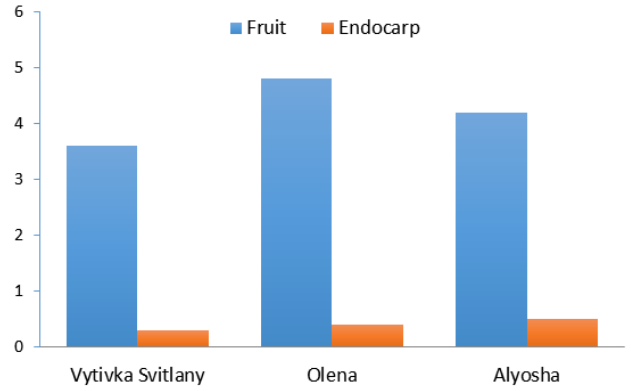

Figure 2. Average weight (mg) of fruits and endocarps of cultivars *Cornus mas* in 2021.

for the processing industry (Grygorieva et al., 2018a; Moradi et al., 2019; Martinović & Cavoski, 2020). Fruits with developed endocarp can serve as a raw material for producing oils rich in unsaturated fatty acids (Bijelić et al., 2008; Kucharska et al., 2009; Spychaj et al., 2021). Cultivars of Ukrainian selection have the smallest share of endocarp in their fruits, reaching from 7.5 to 11.0% (Klimenko, 2004). In Polish cultivars, the percentage of endocarp ranges from 10.13 to 15.32% per fruit (Szot et al., 2019). In the cultivar 'Vytivka Svitlany', the endocarp comprises nearly 12.0% of the fruit weight.

Usually small fruits are represented in the cultivars and genotypes of local selection, especially in Turkey, Iran, Georgia, and some European countries (Ercisli, 2004; Prokaj et al., 2009; Ercisli et al., 2011; Bijelić et al., 2011b, 2012; Cornescu & Cosmulescu, 2017; Kalalagh et al., 2016; Moradi et al., 2019; Hassanpour et al., 2012). For example, in Iranian cultivars of *C. mas*, the length of the fruit ranges from 14.84 to 22.57 mm and the diameter from 10.26 to 16.71 mm (Hassanpour et al., 2012; Moradi et al., 2019), in Turkish – from 15.75 to 29.82 mm and from 11.81 to 20.63 mm, respectively (Bayoğlu, 2021). The fruit weight in Georgian cultivars ranges from 2.8 to 4.9 g. In particular, in the red-fruited cultivar 'Shavi Sagviani' and yellow-fruited cultivar 'Okroshinda' it is 2.8 and 3.0 g, respectively (Maghradze et al., 2006). Thus, the size and weight of the fruits of the cultivar 'Vytivka Svitlany' lay within the range of variability of the Caucasian–Western Asia cultivars and genotypes of cornelian cherry.

Biochemical analysis of fruits

The chemical properties of fruits determine the consumer, medicinal, and processing suitability of cornelian cherry cultivars. Cornelian cherry fruits are rich in sugars, ascorbic acid, tannins, phenols, flavonoids, and anthocyanins (Güleryüz et al., 1998; Demir & Kalyonku, 2003; Bijelić et al., 2011a; Rop et al., 2010; Ercisli et al., 2011; Hassanpour et al., 2011; Szot et al., 2019; Cosmulescu et al., 2019; Bayram & Ozturkcan, 2020; Klymenko et al., 2021). They generally have a pleasant sweet-sour, slightly tart taste, and delicate aroma. However, fruits of different cultivars may taste somewhat differently due to a certain combination of sugars, ascorbic acid, tannins, and carotenes (Klimenko, 1990, 2007; Klymenko, 2000).

The content of dry matter in the fruits of the cultivar 'Vytivka Svitlany' is relatively low – 16.08% (Table 2). In other Ukrainian cultivars, it ranges from 16.7 to 26.7% (Klymenko, 2017). In the fruits of Turkish cultivars, it ranges from 16 to 28% (Tural & Koca, 2008), and in Polish genotypes – from 19.02 to 24.07% (Szot et al., 2019).

The total sugar content in the fruits of the cultivar 'Vytivka Svitlany' is within the range of variation of this indicator in Turkish cultivars (7.7–15.4% – Turnal & Koca, 2008; Güzel, 2021), but was lower than in local Serbian (13.49–25.23% – Bijelić, 2011a), Ukrainian (9.14–16.41% – Klymenko, 2017), and Polish (10.1–16.4% – Kucharska et al., 2011) cultivars.

Ascorbic acid is widely known as a powerful antioxidant (Kostecka et al., 2017; Smirnoff, 2018). Cornelian cherry fruits are a rich source

Table 2. The content of phytochemicals in the fruits studied cultivars of *Cornus mas* in 2021.

Dry matter, %	Total sugar *, %	Ascorbic acid *, mg/%	Titrated acidity *, %	Tannins *, %	Carotenes, mg/%
'Vytivka Svitlany'					
16.08	8.97	62.8	2.92	0.53	0.39
'Olena' (Klimenko, 2007, 2013; Klymenko, 2000)					
22.3	7.7	137.4	1.7	0.49	0.38
'Alyosha' (Klimenko, 2007, 2013; Klymenko, 2000)					
19.8	12	145	1.63	0.61	0.57

Note. Converted to the raw substance.

of ascorbic acid, the content of which varies widely due to a complex of factors, including cultivar, climate, and local weather conditions, including temperature and precipitation (Demir & Kalyoncu, 2003; Kostecka et al., 2017). The content of ascorbic acid in the fruits of the cultivar 'Vytivka Svitlany' was higher than in wild Serbian genotypes (14.96–39.22 mg/%), was in the range of variability of this indicator in Polish cultivars (54.9–82.5 mg/%) and wild genotypes of Turkey (16.0–88.0 mg/% and 29.0–103.3 mg/%), as well as cultivars of different origins and local genotypes of Montenegro (48.0–108.0 mg/%). In the fruits of Ukrainian cultivars, the content of ascorbic acid varies from 86.6 mg/% in the cultivar 'Coralovyi' to 193.0 mg/% in the cultivar 'Semen' (Klymenko, 2000; Klimenko, 2007). In combination with sugars, titrated acidity, and tannins create harmony and completeness of taste without causing a feeling of tartness. The content of tannins in the fruits of the cultivar 'Vytivka Svitlany' is relatively high (Table 2).

In most NBG cultivars of *C. mas*, the content of tannins in the fruit is slightly lower and ranges from 0.2 to 0.4%. Only in the early cultivar 'Nikolka' the fruits included 0.86% of tannins, and in the yellow-fruited 'Yantarnyi' – 0.15% of tannins (Klimenko, 2013).

Cornelian cherry fruits are not high in carotenes. In the new cultivar, the content of carotenes was 0.39 mg/%, which is almost twice less than in the dried fruits of wild *C. mas* from Romania (0.77 mg/%).

Thus, compared to other tested cultivars, the new earliest cultivar 'Vytivka Svitlana' has the lowest content of dry matter and ascorbic acid and the average content of sugars and tannins. The content of carotenes in the cultivar 'Vytivka Svitlana' is almost the same as in the cultivar 'Olena' and significantly lower compared to the cultivar 'Alyosha'.

Seasonal rhythm of development of the cultivar 'Vytivka Svitlany'

The activity of plants is constantly under the influence of the environment, adapting to which they change the timing of the growing season, organic and forced rest, and the rhythm of growth and development. The course of seasonal plant development is due to the combined action of many factors, including a species or cultivar's important inherited genetic basis, sensitivity to the photoperiod, temperature, humidity, and others. The influence of weather conditions on different stages of seasonal plant development has been widely studied (Parmesan, 2006; Wilczek et al., 2010; Zettlemoyer & Peterson, 2021). The role of flowering phenophase as a key biological indicator of climate change has been proven (Rafferty & Nabity, 2017; Chmura et al., 2019; Rafferty et al., 2020). Therefore, in the selection of cornelian cherry, like in many other fruit plants, special attention is paid to the fruit ripening time. Leaf unfolding, shoot formation and growth, and fruit development are less studied than terms and duration of flowering and fruit ripening.

In the climatic conditions of NBG, the cultivar 'Vytivka Svitlany', like other cultivars and species of the subgenus *Cornus* (i.e., *Cornus* s. str.), undergoes a complete cycle of seasonal development, beginning with swelling, cracking and opening of inflorescence buds and flowering due to certain sum of effective temperatures (Klimenko, 1990; Klymenko & Ilyinska, 2021). Visually noticeable development of vegetative

buds is observed a few weeks later, compared with generative. According to the BBCH scale, the new cultivar clearly distinguishes eight of the ten main stages of seasonal development (Table 3; Fig. 3), in particular: development of buds, leaves, shoots, inflorescences, flowering, fruit development, fruit ripening, aging, and dormancy.

Principal growth stage 5: *inflorescence emergence.* In 2021, swelling and cracking of buds in a new cultivar 'Vytivka Svitlany' was visually observed in early April at very low effective temperatures, which was apparently abnormally warm in the last decade of February, when the minimum temperature exceeded 0 °C and the maximum temperature in some days reached +11 °C.

Principal growth stage 6: *flowering.* For the new cultivar, like for other cultivars of cornelian cherry, the flowering phase is critical due to possible spring frosts, which can lead to the freezing of the flowers. In the Kyiv region, according to long-term observations, cornelian cherry begins to bloom at the sum of effective temperatures of 28.4–58.0 °C (Klimenko, 1990). In 2021, the effective temperature at the beginning of flowering of the cultivar 'Vytivka Svitlany' was close to its lowest yearly limit (Table 3), which once again emphasizes the relationship between the beginning of flowering and the value of effective temperature. Flowering lasted almost a month, which correlates with a fairly low temperature in the first decade of April when the average daily temperature for three days was below the biological minimum of +5 °C and the monthly average was lower by +1.6 °C compared to the norm (Table 1).

Principal growth stage 0: *bud development.* Vegetative buds began to crack and develop two weeks after generative buds and, as during the development of the latter, at very low effective temperatures (Table 3).

Principal growth stage 1: *leaf development.* In the new cultivar, as in other cultivars of *C. mas*, the phenophase 10 (green tips of leaves about 10 mm long) coincides with the phenophase 69 (end of flowering). The first pair of leaves was wholly developed in the first decade of June. In total, 3–5 pairs of leaves were formed on annual shoots. The last two pairs remained underdeveloped (smaller), which may have been due to weather conditions, especially the autumn drought.

Principal growth stage 3: *shoot development.* The primary growth of shoots ended in the second half of August. The first three internodes with the best-developed leaves were the longest. At the beginning of autumn, the growth of shoots slowed down, and the length of the last two internodes was smaller than the first, which is also due to the dry autumn of 2021.

Principal growth stage 7: *fruit development.* The duration of the phase of fruit formation was almost two months. They acquired their characteristic size in the first decade of July (Table 3). Visually, it was noticeable that first their length increased, and later – the diameter, which is typical of other cultivars of *C. mas* (Klimenko, 1990).

Principal growth stage 8: *maturity of the fruit.* In 2021, the duration of phenophase 8 in the cultivar 'Vytivka Svitlany' was about a month. The first red fruits were observed seven to ten days earlier than the early cultivars in mid-July, and their technical maturity in the first decade of August. The somewhat stretched process of fruit ripening was probably due to the longer phase of flowering in 2021, which was a reaction to the low temperature in early April.

Principal growth stage 9: *senescence, beginning of dormancy.* Phenological stage 9 in the cultivar 'Vytivka Svitlany', as in other cultivars of cornelian cherry, is stretched in time and begins at the end of the period of mass ripening. First, the oldest leaves of the first and second metamers change color and fall off (phenophases 92 and 93), later other leaves also die. In 2021, all the leaves (phenophase 97) fell by the end of October. Usually, on the tops of shoots of many cultivars of cornelian cherry, one or two pairs of leaves remain very long, sometimes until spring, but in 2021 dry autumn and relatively low minimum temperature in the last decade of October caused complete leaf fall.

So, in 2021 the vegetation period (from the beginning of bud cracking to the end of leaf fall) of the new earliest cultivar 'Vytivka Svitlany' lasted 202 days.

A brief pomological description of the cultivar 'Vytivka Svitlany'

The cultivar was selected due to very early fruit ripening and high productivity

Table 3. Seasonal development of the cultivar 'Vytivka Svitlany' in 2021 according to the BBCH scale.

Stage	Characteristics	Date	t_{eff} °C
Principal growth stage 5: inflorescence emergence			
51	The buds began to crack: the outer bracts are slightly separated, the axis of the inflorescence is slightly elongated	4.03	3.3
53	The bracts are separated, the tops of several flower buds are visible	16.03	3.3
55	All light brown-green bracts are separated; flower buds are clearly visible, pressed against each other; pedicels short	29.03	17.1
59	The bracts are rejected almost at an angle of 45 °; a significant part of the flower buds raised above the bracts and form umbellate inflorescence	31.03	25.3
Principal growth stage 6: flowering			
60	The first flower revealed	1.04	29.2
61	Beginning of flowering: opened about 10 % of flowers	7.04	35.4
65	Full flowering: at least 50% of the flowers are open, and the petals of the first flowers fell off	15.04	65
67	The withering of most flowers: fertilization occurs; petals and stamens fall off	22.04	89.3
69	End of flowering: petals and stamens of all flowers fell off	30.04	114.1
Principal growth stage 0: bud development			
1	The beginning of swelling of the buds: buds (vegetative) noticeably enlarged, elongated scales and have a light border	16.03	3.3
3	The end of swelling of the buds: the scales are separated, light green areas of the leaves are visible	29.03	17.1
7	The beginning of buds burst: the tips of the first green leaves are visible	1.04	29.2
9	The green tips of the leaves are about 5 mm long	22.04	89.3
Principal growth stage 1: leaf development			
10	Green tips of leaves about 10 mm long; the first leaves begin to develop	30.04	114.1
11	The first leaves unfolded; others are still being deployed	6.05	161.6
15	More leaves unfolded, and the first pair of leaves reached about half (ca. 7 cm) in size	11.05	197.3
19	The first leaves are fully developed: they have reached the typical size for the cultivar size (ca. 15 cm)	7.06	486.5
Principal growth stage 3: shoot development			
31	The beginning of the growth of shoots: the axes of the developing shoots are visible; about 10 % of the expected length	22.04	89.3
32	Shoots (annuals) have reached about 20% of the expected length	6.05	161.6
35	Shoots (annuals) have reached about 50% of the expected length	19.05	277.2
39	Shoots (annuals) have reached about 90% of the expected length	17.08	1822.6
Principal growth stage 7: fruit development			
71	Fruit set: ovaries increase in size; the beginning of fall of the ovaries	22.04	89.3
72	The ovaries are green, surrounded by a dying crown of the calyx	6.05	161.6
73	The second fall of the ovaries	19.05	277.2
75	The fruits have reached about half of the final size	7.06	486.5
77	The fruits are about 70 % of the final size	22.06	738.6
79	The fruits have reached the final size, green	8.07	1060.2
Stage	Characteristics	Date	t_{eff} °C

Table 3. Continued.

Principal growth stage 8: maturity of the fruit			
81	The beginning of fruit ripening: change of color of fruits from light green to yellowish-pink	15.07	1208.9
85	Fruit color progresses; color intensity increases; the fruits become light red	28.07	1456.5
87	The fruits acquire a color characteristic of the cultivar; 80% of the fruits have reached technical ripeness	10.08	1693.3
89	Almost all fruits are ripe for consumption: they have a typical taste and hardness	17.08	1822.6
Principal growth stage 9: senescence, beginning of dormancy			
91	Shoot growth is complete; next year's buds are developed; the leaves are still entirely green	20.08	1865.6
92	The leaves begin to change color	9.09	2101.9
93	The beginning of leaf fall	8.10	2305.3
95	Half of the leaves are discolored or have fallen off	18.10	2336.5
97	All the leaves fell	29.10	2378.8
99	The beginning of winter dormancy	8.11	2406.8

from seedlings of 'Armen-1' and 'Armen-2' cultivars obtained in 2001 from the Republic of Armenia. The fruits of the cultivar 'Vytivka Svitlany' are red to dark red, oval and slightly elongated, truncated at the apex and slightly concave, shiny on top, juicy, sweet-sour, and a little tart, with a delicate aroma. Fruit length varies from 20.6 to 24.0 mm, diameter – from 14.4 to 17.3 mm; form index 1.43; endocarp length from 12.9 to 14.9 mm, diameter – from 5.6 to 6.9 mm. The weight of the fruit varies from 3.0 to 4.6 g, and the endocarp – from 0.2 to 0.4 g. The endocarp content is nearly 12.0 % of the weight of the fruit. Biochemical properties of the fruits of the cultivar 'Vytivka Svitlany' are next: sugars – 8.97 %, ascorbic acid – 62.82 mg / %, titratable acidity – 2.92 %, tannins – 0.53 %, carotenes – 0.39 mg / %.

Fruiting in the cultivar 'Vytivka Svitlany' is abundant due to the formation of a large number of generative shoots and many-fruited racemes. It is an early-ripening cultivar with ripening in mid-July – the second decade of August. The fruits crumble quickly after their full ripening. The fruits are deliciously fresh and serve as raw materials for processing in the food industry.

Conclusions

By the method of analytical selection, a new earliest cultivar of cornelian cherry (*C. mas*) was selected and named 'Vytivka Svitlany'. The morphological features and biometric parameters of the fruits of the new cultivar have been studied and compared with other early cultivars (yellow-fruited 'Alyosha' and red-fruited 'Olena'). It is determined that the size and weight of the fruits of 'Vytivka Svitlany' are similar to mentioned early cultivars, but are marked by even more early ripening.

The new cultivar has next main biochemical properties: sugars – 8.97%, ascorbic acid – 62.82 mg / %, titratable acidity – 2.92 %, tannins – 0.53 %, carotenes – 0.39 mg / %.

According to the BBCH classification, the new cultivar distinguishes eight of the ten main stages of seasonal development. The growing season in 2021 lasted 202 days; ripening began on July 15 and lasted until August 17. After a full ripening, the fruits of the cultivar 'Vytivka Svitlany' crumbled quickly. They are deliciously fresh and are suitable for processing in the food industry.

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Figure 3. Phenological stages of the cultivar 'Vytivka Svitlany' in 2021 according to the BBCH scale.

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Новий надранній сорт кизилу (*Cornus mas* L.)

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Кизил (*Cornus mas* L.) упродовж століть відомий як цінна плодова і лікарська рослина. За довгу історію його культивування виведено багато сортів з широким діапазоном форми, розміру, кольору, біохімічного складу та терміну дозрівання плодів, що дозволило вирощувати кизил у різних географічних зонах за дуже несхожих умов довкілля. У Національному ботанічному саду імені М.М. Гришка НАН України сформовано велику колекцію сортів кизилу, що різняться зокрема й за часом дозрівання плодів. Нещодавно створений новий сорт ‘Витівка Світлани’ відзначається

надраннім терміном дозрівання плодів. Плоди сорту ‘Витівка Світлани’ червоні або темно-червоні, овальні та більш-менш видовжені, зверху зрізані та злегка увігнуті, блискучі, соковиті, кисло-солодкі та трохи терпкі на смак з тонким ароматом. Вони смачні свіжі й придатні для переробки у харчовій промисловості. В цій статті наведено морфологічні особливості та біометричні характеристики плодів нового сорту у порівнянні з ранньостиглими сортами (червоноплодим ‘Олена’ та жовтоплодим ‘Альоша’), а також описано основний біохімічний склад плодів та фенологічні фази розвитку нового сорту у 2021 р. за кодифікацією ВВСН.

Ключові слова: *Cornus mas*, сорти, біометрія, біохімія, фенологія, Україна