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Qualitative indicators of redcurrant varieties (*Ribes rubrum* L.) selected by the Professor V.L. Symyrenko Department of Horticulture of NULES of Ukraine

Abstract. This study presents the findings on the qualitative indicators of seven varieties of redcurrant (*Ribes rubrum* L.), five of which are selected by the Professor V.L. Symyrenko Department of Horticulture of NULES of Ukraine. The largest average weight of berries had the varieties “Buzhanska” (0.58 g) and “Polyana Hosiivska” (0.59 g). These varieties also stand out among others in terms of maximum berry weight. In certain years of research, the fruits of “Buzhanska” weighed 1.05 g. The “Lebidka” variety had the largest cluster weight (6.98 g) due to the large number of berries in it (17 pcs.). The uniformity of berries in the cluster of the studied varieties is average (from 63 to 73% depending on the variety). The highest yields per bush were achieved by “Buzhanska” (4.20 kg/bush), “Kyianochka” (4.42 kg/bush) and “Polyana Hosiivska” (4.0 kg/bush). The varieties “Jonkheer van Tets” (c.), “Polyana Hosiivska”, “Buzhanska” and “Snizhanka” are rich in vitamin C. The highest dry soluble solids content was found in the “Lebidka” variety (12.94%). The most sugars in the fruit were accumulated by the varieties “Snizhanka” (5.40%), “Buzhanska” (5.23%) and “Malva” (5.13%). The white-fruited varieties “Snizhanka” and “Lebidka” are particularly notable for their dessert flavour, as they have the best sugar to total acidity ratio (TAR) among the varieties studied – 4 and 3, respectively, and the highest flavour score (9 points)

Keywords: berry weight, cluster, bush, biochemical composition, taste assessment, berry quality, taste

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RELEVANCE

To provide the population with nutritious food and vitamins, it is necessary to develop and improve the present selection of berry crops, including redcurrants (*Ribes rubrum L.*). The fruits of redcurrants have great taste and consumer qualities, as well as a rich chemical composition, so the prospects for their cultivation are quite high (Cristina *et al.*, 2013). This berry crop is characterised by high yields, winter hardiness, resistance to terry and bud mites, and is relatively uncomplicated to maintain (Makarkina, 2013). Therefore, with the correct selection of varieties to suit the conditions of cultivation, it is possible to obtain environmentally friendly, high-quality products (Karhu *et al.*, 2020).

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Purslane (red and white) is a common crop in Ukraine and the rest of the world, with the largest scale of production in the United States (Heijerman & Gessel, 2020). It is also common in Europe: The Netherlands, the United Kingdom, the Czech Republic, France, Germany, Belgium, and Russia (Zdunic *et al.*, 2016). In Ukraine, redcurrants are not as popular as currants, but they are in demand among gardeners because of their drought and winter hardiness, resistance to pests and diseases, high yield and durability of branches and bushes (Kopan', 2005; Tarapata, 2005). Because of all its properties, this crop is becoming more and more common in industrial plantations, as demand for red berry products is growing (Salina *et al.*, 2020). The fruits are used for consuming fresh, making juices, wine, jelly, marmalade, and jam. Unlike black currants, redcurrants have no essential oils, but the berries accumulate a large amount of coumarin (up to 4.4 mg/100 g of berry weight), which is used in the perfumery, soap, and confectionery industries as an aromatic substance. A derivative

of coumarin, decoumarin, is used in medicine to treat patients with increased blood clotting (Gündeşli *et al.*, 2019). Due to the high content of organic acids, its juice quenches thirst, eliminates nausea, improves appetite and is a good tonic for recuperating from serious illnesses. Due to the content of salicylic acid, consumer of berries helps to reduce the body temperature of patients and thin the blood, which is important for people with high blood pressure. The juice accelerates the release and removal of harmful salts from the human body (Sherenhovyi, 2011).

Since the 1980s, more than 20 varieties of redcurrants have been developed in Ukraine (Yareshchenko *et al.*, 2012). The main centres of black currant and redcurrant selection in Ukraine are the Institute of Horticulture of the National Academy of Agrarian Sciences and its regional structural units, and the Professor V.L. Symyrenko Department of Horticulture of the National University of Life and Environmental Sciences (NULES) of Ukraine. During this period, a number of competitive redcurrant varieties were developed at the university under the guidance of PhD in Biology P.Z. Sherengovyi (Mezhenskyj *et al.*, 2020). As of February 5, 2021, 12 varieties of redcurrant were included in the State Register of Plant Varieties Suitable for Distribution in Ukraine for 2021: "Rovada" – Dutch selection; "Vatra", "Svyatomykhailivska", "Troitska", "Darnytsia", "Samburska" and "Lasunia" – IH NAAS selection; and five varieties of NULES of Ukraine selection – "Lebidka", "Buzhanska", "Pol-yana Holosiivska", "Kyianochka" and "Olha" (Derzhavnyi reiestr, 2021).

The purpose of the study is to investigate the quality indicators of fruits of redcurrant varieties selected by NULES of Ukraine (characteristics of berries, clusters, yield, the content of basic organic substances in fruits and tasting evaluation of berries), to identify the best varieties according to these characteristics.

MATERIALS AND METHODS

The study was conducted in the plantations of redcurrants of the educational laboratory (EL) “Fruit and Vegetable Garden” of the Professor V.L. Symyrenko Department of Horticulture of NULES of Ukraine, which is located in the right-bank zone of the Western Forest-Steppe of Ukraine. The climate is temperate continental with warm, moderately humid summers, the warmest month is July with an average monthly temperature of +19.3°C. The winters are cloudy, with frequent thaws and only in some years with severe frosts; the coldest month is January with an average monthly temperature of 5.9°C.

The soil of the experimental plot is soddy-medium podzolic coarse-dusty light loam. It is characterised by a humus content of 1.48% in the topsoil.

Overall, the soil and climatic conditions of the research area are suitable for growing berry crops, in particular redcurrants.

The experiment was established in 2008 in accordance with the Methodology for State Testing of Varieties of Fruit and Berry Crops. The subject of the study is seven varieties of redcurrants, including five selected by NULES of Ukraine. The well-known variety of the Dutch selection “Jonkheer van Tets” was used as a control. The plants were planted according to a 3 × 0.75 m pattern, 5 plants each in three replications. The variants were arranged randomly.

The tests and observations were carried out according to the above-mentioned methodology and the “Programme and methodology of the varietal study of fruit, berry and nut crops” (Sedov & Ogoltsova, 1999). The content of basic organic substances in redcurrant fruits was determined by the following methods: dry matter content in fruits – DSTU EN 12143:2003 Fruit and vegetable juices. Determination of soluble solids content. Refractometric method; sugar content – in accordance with DSTU 4954:2008 Fruit

and vegetable processing products. Methods for determining sugars; vitamin C content – in accordance with GOST 24556-89 Fruit and vegetable processing products; acidity determination – in accordance with DSTU 4957:2008 Fruit and vegetable processing products. Methods for determining titrated acidity. Statistical processing of the data was carried out using Microsoft Excel® computer programmes.

RESULTS AND DISCUSSION

The fruits of redcurrants have great taste and consumer properties, so the prospects for their cultivation are quite high. Today, the market is filled with a diverse range of varieties, but an important sign of their competitiveness is the marketability and taste qualities of berries (Metodyka, 2012).

Temperature and precipitation during the period of berry growth and ripening are the factors that affect the weight of berries, the accumulation of dry soluble substances and sugars, and therefore the taste and nutritional value of berries (Sherenhovyi, 2011).

The varieties “Buzhanska” and “Polyana Holosiivska” have the highest average berry weight among the studied varieties, which is 6 and 7% more than the control, respectively. The average weight of Lebidka berries is the same as that of the control variety, while Malva, Kyianochka and Snizhanka are 2-7% less than the control.

The weight of the berry depends to some extent on soil and air moisture, and the age of the bush; on older branches, the weight of the berry decreases. When describing a variety, attention is paid to determining the maximum mass of berries, which is an important indicator, but not a determining one (Sedov & Ogoltsova, 1999).

The varieties “Buzhanska” and “Polyana Holosiivska” have a higher maximum berry weight than the control. According to the methodology, berries over 0.85 g are considered very large.

It is important to note that during the research, individual Buzhanska berries reached a weight of 1.05 g. On average, the maximum weight of berries varies from 0.70 g in “Snizhanka” to 0.92 g in “Buzhanska”, which is 11% more than the control.

The average and maximum berry weight of the cultivar, as well as the number of berries per cluster, affect the cluster weight (Mikulic-Petkovsek *et al.*, 2016). In 2015, the “Lebidka” variety had an average of 17 berries per cluster, while the control had 13. In some years of research, the number of “Lebidka” berries reached 22 pieces per cluster. It is worth noting that an important marketable feature of the variety is the uniformity of the berries. According to the methodology, the uniformity of berries in the bunches of the studied varieties is average, ranging from 63 to 73%. The “Lebidka” variety has the largest weight of clusters, which is 2.54 g more than in the control. In 2015, the average weight of the cluster of

the studied varieties was in “Buzhanska” (9.19 g) and “Lebidka” (9.16 g).

It is impossible to draw conclusions about the potential yield of a variety based only on the weight of the berry and the cluster, it is also necessary to determine the number of clusters per plant. Each variety has its own fruiting characteristics. In particular, the “Kyianochka” variety has an average berry weight and cluster weight, but due to the bouquet branches having a large number of multi-cluster nodes, the yield per branch, and thus per bush, is the highest. The varieties “Buzhanska” and “Polyana Holosiivska” also have a large number of multi-clustered nodes, with bouquet branches occupying 2/3 of the branch and located on the upper part of the bush. The varieties “Kyianochka”, “Buzhanska” and “Polyana Holosiivska” have the highest yield per bush, 23, 17 and 11% more than the control, respectively.

Table 1. Characteristics of yield components of redcurrant varieties (average for 2013-2015)

Cultivar name	Berry weight, g		Cluster weight, g	Yield per 1 bush, kg
	average	the highest		
“Jonkheer van Tets” (k.)	0.55	0.83	4.44	3.60
“Buzhanska”	0.58	0.92	5.60	4.20
“Kyianochka”	0.51	0.78	5.08	4.42
“Lebidka”	0.55	0.81	6.98	3.84
“Malva”	0.54	0.75	4.78	2.86
“Polyana Holosiivska”	0.59	0.85	5.17	4.00
“Snizhanka”	0.51	0.70	4.68	3.39
LSD ₀₅	0.064	0.093	0.708	0.387

One of the main indicators of consumer quality of fresh fruits is vitamin C. Redcurrant fruits are significantly (3-5 times or more) inferior to currants in terms of ascorbic acid content (Djordjević *et al.*, 2014). The berries of the control variety are rich in vitamin C (43.00 mg/100 g of fresh weight), as well as “Polyana Holosiivska”, “Snizhanka” and “Buzhanska” (42.24...42.93 mg/100 g of fresh weight).

The content of dry soluble substances varies from year to year, due to weather conditions, specifically the amount of rainfall and soil moisture at harvest time (Djordjević *et al.*, 2020). The largest amount of dry soluble substances (12.00-12.94%) is accumulated by berries of the varieties “Polyana Holosiivska”, “Snizhanka” and “Lebidka”. The flavour of red berries is more influenced by the acid content than by sugars. However, the

sugar content also matters. The varieties “Buzhanska”, “Malva” and “Snizhanka” accumulated the highest amount of sugars among the studied varieties, which was 9%, 7% and 13% more than in the berries of the control variety, respectively. “Polyana Holosiivska” has the lowest sugar content (19% less than the control), while “Lebidka” and “Kyianochka” are almost at the control level.

The fewer acids berries accumulate, the tastier they are. Redcurrant fruits are typically characterised by an acid content of 1.2-3.9% (Golayeva, 2010). White-fruited varieties “Snizhanka” and “Lebidka” had the lowest values of total acids (1.26 and 1.27%, respectively), and “Buzhan-

ska” had the highest. All berries of the studied varieties were characterised by low total acidity.

The sugar-to-acid ratio (SAR) determines the flavour of red berries. A high index is typical for berries of dessert flavour, which have an excellent tasting score. They are intended primarily for fresh consumption, and the lowest score is assigned to varieties with average flavour qualities (Berk, *et al.*, 2020). The varieties “Snizhanka”, “Polyana Holosiivska”, “Malva” and “Lebidka” stand out positively by this indicator. The varieties Buzhanska and Kyianochka have the lowest sugar-acid index, although they have a high sugar content in berries.

Table 2. Content of basic organic substances in fruits of redcurrant varieties (average for 2013-2015)

Cultivar name	Vitamin C, mg %	Dry soluble substances, %	Total sugar, %	Total acidity, %	SAI
“Jonkheer van Tets” (k.)	43.00	11.60	4.80	1.47	3
“Buzhanska”	42.24	10.85	5.23	2.38	2
“Kyianochka”	31.58	11.10	4.93	2.10	2
“Lebidka”	20.40	12.94	4.22	1.27	3
“Malva”	36.50	11.27	5.13	1.69	3
“Polyana Holosiivska”	42.93	12.00	3.90	1.50	3
“Snizhanka”	42.34	12.27	5.40	1.26	4

Redcurrant clusters can be stored in the refrigerator for a long period of time without losing their appearance and shape. The content of organic matter is also preserved after defrosting, which makes it popular in cooking, for making desserts, marmalades, and jellies (Paprstein *et al.*, 2016). The berries of redcurrants exhibit different berry colours; they can be red, dark red, white, yellow, or flesh-coloured (Milošević, 2018).

Among the varieties studied, five have red berries, and two: “Snizhanka” and “Lebidka” have white berries. The berries of all the varieties studied have a certain shade, for example, the fruits of “Malva” are dark red, while those of “Kyianochka” are light red. The fruits of “Snizhanka” are white, transparent; “Lebidka” are white with stripes, and transparent when ripe.

Table 3. Taste assessment of redcurrant berries (average for 2013-2015)

Cultivar name	Colour	Appearance	Flavour	Overall score
"Jonkheer van Tets" (k.)	red	5.0	7.0	7.0
"Buzhanska"	red	9.0	7.5	8.1
"Kyianochka"	light red	9.0	8.5	7.8
"Lebidka"	white	9.0	9.0	8.5
"Malva"	dark red	6.5	7.0	5.9
"Polyana Holesiivska"	red	6.5	7.0	7.4
"Snizhanka"	white	8.5	9.0	7.7

"Buzhanska", "Kyianochka", and "Lebidka" varieties were rated the highest for their attractive appearance. The clusters of these varieties are dense, full, uniform, the berries have a rich colour, the skin of the fruit is translucent; the separation of the berries from the stem is dry. The powdery mildew damage negatively affected the assessment of the appearance of clusters of "Jonkheer van Tets" (k.), "Malva" and "Polyana Holesiivska". The white-fruited varieties "Lebidka" and "Snizhanka" have the best (dessert) taste. They have a sweet and sour taste, delicate due to the optimal ratio of sugars and total acids. Other varieties had a sweet and sour taste, which negatively affected the score. The aroma of redcurrant berries is barely noticeable. The best overall score, considering all organoleptic characteristics, was given to the varieties "Lebidka" and "Buzhanska".

CONCLUSIONS

The varieties "Buzhanska" and "Polyana Holesiivska" can be singled out as large-fruited varieties, as they had the highest average and maximum berry weights. In particular, in some years

of research, the weight of the fruit of the variety "Buzhanska" reached 1.05 g. The best indicators in terms of cluster weight (6.98 g) and number of berries per cluster (17) are those of the "Lebidka" variety.

The uniformity of berries of all varieties is average. The most productive varieties under study are "Buzhanska", "Kyianochka" and "Polyana Holesiivska", with an average yield of 4.00-4.42 kg per bush.

"Jonkheer van Tets" (c.), "Polyana Holesiivska", "Buzhanska" and "Snizhanka" accumulated the highest amount of ascorbic acid. The highest dry soluble solids content was found in the fruits of "Lebidka" (12.94%). Berries of "Snizhanka" (5.40%), "Buzhanska" (5.23%) and "Malva" (5.13%) are rich in sugar. The white-fruited varieties "Snizhanka" and "Lebidka" have a distinctive dessert flavour due to their low organic acid content. They have a sugar-to-total acidity ratio of 4 and 3 points, respectively, and they also received the highest (9 points) flavour score. The red-fruited varieties "Buzhanska" and "Kyianochka" and the white-fruited variety "Lebidka" were rated the highest in terms of appearance.

The clusters of these varieties are dense, full, of the fruit is translucent; the separation of the uniform, the berries have a rich colour, the skin berries from the stem is dry.

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**Якісні показники сортів порічок (*Ribes rubrum* L.)
селекції кафедри садівництва
імені професора В.Л. Симиренка НУБІП України**

Анотація. У роботі наведено результати вивчення якісних показників семи сортів порічок (*Ribes rubrum* L.), п'ять з яких селекції кафедри садівництва ім. професора В.Л. Симиренка НУБІП України. Найбільшу середню масу ягід мали сорти “Бужанська” (0,58 г) та “Поляна Голосіївська” (0,59 г). Ці сорти також виділяються серед інших за максимальною масою ягоди. В окремі роки досліджень плоди сорту “Бужанська” мали масу 1,05 г. Сорт “Лебідка” мав найбільшу масу гроно (6,98 г) за рахунок великої кількості ягід у ньому (17 шт.). Вирівняність ягід у гронах досліджуваних сортів середня (від 63 до 73% залежно від сорту). Найвищої врожайності з куща досягли сорти “Бужанська” (4,20 кг/кущ), “Кияночка” (4,42 кг/кущ) та “Поляна Голосіївська” (4,0 кг/кущ). Сорти “Jonkheer van Tets” (с.), “Поляна Голосіївська”, “Бужанська” та “Сніжанка” багаті на вітамін С. Найвищий вміст сухих розчинних речовин виявлено у сорту “Лебідка” (12,94%). Найбільше цукрів у плодах накопичили сорти “Сніжанка” (5,40%), “Бужанська” (5,23%) та “Мальва” (5,13%). Білоплідні сорти “Сніжанка” та “Лебідка” особливо вирізняються десертним смаком, оскільки мають найкраще серед досліджуваних сортів співвідношення цукру до загальної кислотності (ЗК) – 4 та 3 відповідно, а також найвищу оцінку смаку (9 балів)

Ключові слова: маса ягід, гроно, кущ, біохімічний склад, дегустаційна оцінка, якість ягід, смак