

# Some results of breeding in the genus *Ribes* L. in the Asian part of Russia

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**Abstract.** Black currant is the main berry crop due to the rich biochemical composition of the fruit, winter hardiness, early fruitfulness, high yield, unpretentiousness in reproduction and cultivation. The purpose of the work was to summarize the results of the work on black currant breeding in the breeding centers of the Urals and Siberia. The article reflects the historical development of black currant breeding in Asian Russia. Academician M.A. Lisavenko developed a strategy for creating varieties of three types by origin, combining valuable economic and biological traits in hybrids. Varieties of the first type are obtained from crosses of Western European varieties created on the basis of *Ribes nigrum* var. *europaeum* Jancz., with the variety 'Primorsky Champion' (*R. dikuscha* Fisch. ex Turcz.). The second type of varieties is obtained from crossing selected forms of *R. nigrum* var. *sibiricum* W. Wolf with the variety 'Primorsky Champion' (*R. dikuscha*). The third type of varieties is derived from the crossing of forms and varieties of two varieties of *R. nigrum* – *R. nigrum* var. *europaeum* and *R. nigrum* var. *sibiricum* W. Wolf. The main assortment of black currant in the Asian part of Russia was created by scientists at the Novosibirsk Zonal Horticulture Station, at the Research Institute of Horticulture of Siberia n.a. M.A. Lisavenko and Bashkir Research Institute of Agriculture. Systematic improvement of the assortment is the main way to increase the intensity of gardening and increase the production of berries. The contribution of breeders to the creation of adapted varieties is shown.

## 1 Introduction

In the genus *Ribes* L. the *Grossulariaceae* DC. family about 150 species have been identified, which are distributed in the zone of the circumboreal climate of Asia, Europe, North Africa, South and North America. In the Urals and Siberia, black currants – species of section *Botrycarpum*, subgenus *Ribes* (*R. nigrum* L., etc.) - are of great food importance [1-6]. The high value of black currant is characterized by a rich biochemical composition of

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berries, sufficiently high winter hardiness, yield, early fruitfulness, unpretentiousness in reproduction and cultivation [7-9].

Black currant fruits contain biologically active substances (BAS), sugars, including pectins and phenolic compounds, which play a major role in improving human health, especially in regions with a significantly unfavorable environmental situation. The fruits are suitable for winemaking, freezing, fresh consumption, production of multivitamin foods (marmalade, compote, juice, jam) and soft drinks [10-13]. In folk medicine of the Russian Federation, the fruits and leaves of black currant are widely used.

Continuous improvement of black currant assortment is the main way to increase the intensity of gardening and the steady growth of fruit and berry production. Currently, the main direction in berries production is the cultivation of productive varieties of the type. High-intensity orchards require plastic, fast-growing, high-yielding, adapted varieties with high production and consumer qualities, giving high profits – these are the modern requirements of the market to produce berry products [14-17].

The main assortment of black currant in the Asian part of Russia was created by scientists at the Novosibirsk Zonal Fruit and Berry Experimental Station of Horticulture n.a. I.V. Michurin, in the Research Institute of Horticulture of Siberia n.a. M.A. Lisavenko (a division of the Federal Altai Scientific Center of Agro-Bio Technologies) and Bashkir NIISH (a division of the Ufa Federal Research Center of the Russian Academy of Sciences). In the last two institutions, active selection work on currant is still underway [18-19]. The purpose of the work was to summarize the results of work in the field of black currant breeding in these breeding centers.

## 2 Materials and methods

The black currant varieties created in Siberia and the Urals were obtained by intraspecific and remote hybridization methods. M.A. Lisavenko, the founder of the Institute of Horticulture of Siberia, which currently has his name (a division of the Federal Altai Scientific Center of Agro-Bio Technologies), initially defined a strategy for creating varieties of three types by origin, combining valuable economic and biological traits in hybrids. Varieties of the first type are obtained from crosses of Western European varieties created on the basis of *R. nigrum* var. *europaeum* Jancz., with the variety 'Primorsky Champion' (*R. dikuscha* Fisch. ex Turcz.). The second type of varieties is obtained from crossing selected forms of *R. nigrum* var. *sibiricum* W. Wolf with the variety 'Primorsky Champion' (*R. dikuscha*). The third type of varieties is derived from the crossing of forms and varieties of two varieties of *R. nigrum* – *R. nigrum* var. *europaeum* and *R. nigrum* var. *sibiricum* W. Wolf [13-14, 18]. During the period from 1966 to 2017, the breeder L.N. Zabelina in the city of Gorno-Altaiisk carried out hybridization in the amount of 215.1 thousand flowers. Depending on the weather conditions and objective reasons, from 1.0 to 12.0 thousand flowers were pollinated per year. In the last 10 years, the volume of hybridization has decreased and amounts to an average of 2 thousand flowers per year. In total, 620 combinations of crosses were carried out, 192.4 thousand hybridogenic seeds were isolated. 35.5 thousand seedlings were planted in the breeding garden and worked out, 290 of them were allocated to the elite [19].

During the years of work from 1978 to 2020 breeder N.I. Nazaryuk in the city of Barnaul carried out 1165 combinations of crosses on varieties of various ecological, geographical, and genetic origin, 135.9 thousand flowers were pollinated. In the last 10 years, the volume of hybridization is on average 2.0 thousand pollinated flowers per year. 1522.6 thousand seeds were collected, including 81.8 thousand seeds from free pollination. Only 233.4 thousand seedlings were grown. As a result of the analysis for resistance to powdery mildew, 110.3 thousand healthy (not affected by powdery mildew) and slightly

affected seedlings were selected for the breeding garden, which is 47.2%; 123.1 thousand pieces or 52.8% were rejected. As a result of the breeding work, a hybrid fund was created in the amount of 43.8 thousand seedlings. Among the fruit-bearing hybrid fund, 16 elite forms, 8 donors and sources of resistance to gall mites, gall aphids and powdery mildew were selected.

In the conditions of the city of Novosibirsk since 1990, more than 20 thousand hybrids, 250 varieties of black currant have been studied. The hybrid fund was obtained on the basis of *R. nigrum* var. *europaeum* and *R. nigrum* var. *sibiricum*, *R. dikuscha*, *R. americanum* Mill., *R. hudsonianum* Richardson and *R. pauciflorum* Turcz. ex Pojark.. A total of 22,678 hybrid seedlings were studied. 156 cultivars were used as the female parent, and 178 cultivars were used as the male parent.

The selection of hybrid seedlings was carried out according to such basic characteristics as resistance to early spring frosts, large-fruit, dessert taste of fruits, high productivity, suitability for mechanical harvesting of fruits (high skin density, easy fruit separation), resistance to the main diseases and pests of black currant common in the Asian part of the Russian Federation [5,13,17-21].

### 3 Results and discussion

Siberia is one of the centers of certain currant types origin. The identification of large-fruited, high-yielding selections of *R. nigrum* var. *sibiricum* with fruits of dessert taste was the basis for the use of this large-fruited variety in black currant breeding.

Varieties of the first type from the hybridization of European varieties created based on *R. nigrum* var. *europaeum* Jancz., with the variety 'Primorsky Champion' (*R. dikuscha* Fisch. ex Turcz.) - Chernaya Lisavenko, Golubka, Stakhanovka Altaya - are self-fertile, potentially productive and quite high-winter-hardy. They have long been in the zoned assortment in Russia and in the eight union republics, and in some regions of Russia they are still in the zoned assortment.

Varieties of the second type from hybridization of promising forms of *R. nigrum* var. *sibiricum* W. Wolf with the cultivar 'Primorsky Champion', derived from *R. dikuscha* - Altysky Champion, Zoya, Chernaya Grozd - were characterized by rapid fertility, large-fruited, self-infertility, but had the disadvantage of being damaged by a gall mite. These cultivars played an active role in the breeding for large-fruited and rapid-fruited. Modern varieties derived from them have inherited these characteristics.

Varieties of the third type from hybridization of two varieties of *R. nigrum* - *R. nigrum* var. *europaeum* and *R. nigrum* var. *sibiricum* - Altayskaya Desertnaya, Karakol, Katun, Biya - have high frost resistance of vegetative and generative organs of wintering buds. Varieties of this type inherited low self-fertility. The productivity of these varieties correlates with fairly favorable weather conditions during the flowering period, this phenomenon is very rare in Siberia. Cultivars of this group, such as Karakol, were used as donors of high frost resistance of vegetative and generative buds. Currently breeders issued the entire galaxy of the latest varieties In the NIISS n.a. M.A. Lisavenko (Table 1). The cultivars created in this institution have a high winter hardiness, having endured the critical winter of 2000-2001 with a temperature of -46.0 °C, are drought-resistant, heat-resistant, have high self-fertility and early maturity. The varieties have a universal purpose, they enter fruiting in the second year after planting, so they are recommended for cultivation in private gardens and as an industrial crop.

**Table 1.** Chemical characteristics of black currant cultivars of the breeding of NIISS n.a. M.A. Lisavenko (2000-2020)

Variety, maturation period	Biologically active substances					Productivity, kg/bush/berry weight, g
	DSS, %	Pectins, %	Ascorbic acid, mg/100 g	Sugars, %	Acids, %	
Kanahama, medium	11.6– 15.2	1.1–2.5	53.5–104.7	4.4–12.4	1.9–2.8	2.0-3.5 / 1.8–3.5
Baritone, early	10.8– 16.5	1.0–3.4	58.5–137.1	7.7–9.8	2.4–4.2	3.0-4.0 / 2.3–4.2
Isolda, early	13.6– 15.0	1.7–3.2	70.0–144.0	9.8–11.8	1.8–2.4	4.8-5.3 / 1.4–2.8
Yubileynaya Lisavenko, medium	10.4– 13.5	1.5–2.6	74.1–210.0	7.9–9.2	1.7–2.8	4.7-5.3 / 1.6-2.7
Pamyati Kukharskogo, medium	10.6– 15.2	1.0–2.2	88.7–143.0	6.2–10.7	2.6–3.1	2.7-4.1 / 1.6–2.5

Note: DSS – dry soluble substances.

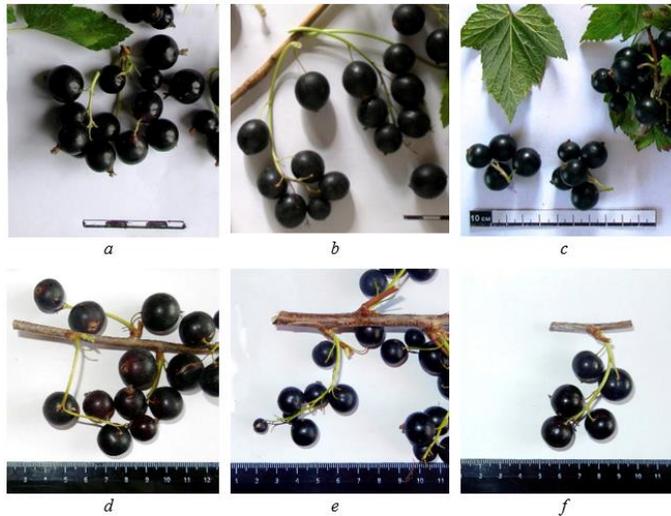
A great contribution to the creation of the gene pool at the Novosibirsk Zonal Horticulture Station was made by the breeder A.A. Potapenko, on the basis of which since 1990 V.N. Sorokopudov has created a galaxy of varieties adapted for Siberia. Varieties of the Novosibirsk breeding are distinguished by a harmonious, rich taste of fruits (the presence of aroma) and their denser consistency (Table. 2), in most cases - and improved biochemical composition (with an increased content of pectin and P-active substances). All varieties in any year have a dry separation of fruits.

**Table 2.** Evaluation of black currant varieties in the Novosibirsk region, 2006-2019

Variety	Maturation period	Productivity, kg/bush		Berry weight, g		Berry taste	
		average	max	average	max	character	score
Varieties of the breeding of the Novosibirsk ZPYaOS n.a. I.V. Michurin							
Avgusta	Mid-late	3.0	4.5	2.5	4.5	sweet and sour with aroma	4.5
Glariosa	Medium	4.0	6.0	2.0	4.0	sweet with aroma	4.9
Degtyarevskaya	Mid-early	2.8	4.0	2.8	5.2	sweet and sour with aroma	4.8
Irmen	Medium	4.0	6.5	2.0	4.3	sweet and sour with aroma	4.7
Kalinovka	Mid-early	3.5	5.5	2.5	3.6	sweet with aroma	4.9
Pamyati Potapenko	Medium	3.8	6.5	2.8	6.0	sweet and sour	4.4
Perepel	Mid-late	4.7	6.0	2.8	6.6	sweet and sour	4.7
Solomon	Mid-late	4.2	5.5	2.0	5.0	sweet with aroma	4.8
Chernysh	Mid-late	1.8	1.9	1.8	4.2	sweet and sour	4.5
Varieties of the Novosibirsk breeding, created on the basis of the varieties of the breeding of the NZPYaOS n.a. I.V. Michurin							
Vanyusha	Mid-early	4.0	7.0	1.8	3.8	sweet and sour with aroma	4.6
Darina	Very early	3.5	5.0	1.9	3.6	sweet with aroma	5.0
Nyanya	Mid-late	3.5	5.5	3.8	5.5	sweet and sour	4.5
Izolda	Mid-early	4.0	8.5	2.3	5.2	sweet and sour with aroma	4.7
Knyazhna	Medium	4.0	5.0	1.9	4.4	sweet with aroma	4.8
Kuzina	Medium	3.8	5.5	1.4	4.5	sweet and sour with aroma	4.7
Ryaska	Medium	2.1	2.8	1.3	2.5	sweet simple	4.9

Note: x - the average value, max - the maximum value.

In the conditions of the Bashkir Pre-Urals, a series of unique varieties included in the State Register of the Russian Federation has been created. Black currant breeding in the Bashkir Research Institute of Agriculture started by M.G. Abdeeva in the 70s, continued since 2010 by R.A. Nigmatzyanov. With his participation, a new generation of varieties with a complex of economically valuable traits were created: Karaidel, Chishma, Kushnarenkovskaya, Estafeta, Belskaya, Truzhenitsa, Iremel (Fig. 1).



**Fig. 1.** Fruiting of black currant varieties created on the basis of the gene pools of the Novosibirsk zonal gardening station (a – ‘Izolda’, b – ‘Nyanya’, c – ‘Darina’) and the Ufa Federal Research Center of the Russian Academy of Sciences (d – ‘Iremel’, e – ‘Bobrovaya’, f – ‘Belskaya’).

The new varieties have a high winter hardiness (they tolerate frosts of  $-40 \dots -42^{\circ}\text{C}$  without damage), a yield of 120-160 c/ha, an average berry weight of 1.2-1.5 g, field resistance to powdery mildew, and are weakly affected by anthracnose and gall mites (Table 3). Below is a brief description of the varieties.

**Table 3.** Evaluation of black currant varieties of the Bashkir selection, 2006-2019

Variety	Maturation period	Vitamin C content	Productivity, kg/bush		Berry weight, g		Berry taste	
			average	max	average	max	character	score
Varieties of the Bashkir NIISH breeding								
Estafeta	Medium	184.2	2.8	3.8	1.6	2.8	sweet and sour	4.8
Chishma	Mid-early	236.0	3.75	4.7	1.5	2.6	sweet and sour	4.7
Truzhenitsa	Mid-early	122.0	2.3	3.1	1.5	2.8	sweet and sour	4.8
Kushnarenkovskaya	Late	184.0	3.5	5.0	1.9	3.6	sweet	4.7
Karaidel	Late	192.0	4.4	4.7	1.4	3.5	sweet and sour	4.5
Iremel	Medium	201.3	3.6	4.0	2.0	3.2	sweet and sour	4.8
Valovaya	Medium	175.0	3.7	5.6	1.4	2.4	Sweet and sour	4.3
Bobrovaya	Medium	167.0	4.0	4.8	1.3	2.5	sweet and sour	4.3
Belskaya	Medium	181.2 mg/100 g	2.52	3.57	1.6	2.5	sweet	4.7

These varieties are cultivated in the conditions of the Bashkir Pre-Urals and show high adaptability in local conditions.

## 4 Conclusion

Many years of research have significantly improved the assortment of black currant in Asian Russia. The created varieties for Western, Eastern Siberia and the Urals exceed the standard assortment in terms of the complex of economic traits.

Breeding work carried out on black currant in Siberia for a long time on the basis of *R. nigrum* var. *europaeum* and *R. nigrum* var. *sibiricum*, *R. dikuscha*, has shown a high potential in creating adapted varieties.

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