Currant breeding in Western Siberia

Breeding of black currant from the beginning of the decade 1930s of 20th century to the present is shown. Eighteen cultivars have been developed since 1990. A scheme to reduce the length of breeding process, system of estimate, use and improvement of primary currant stocks has been developed. The necessity to involve genetically heterogeneous stocks in the breeding process has been determined. The sources and donors of productivity components combining disease and pest resistance, high self-fertility and earliness were identified during the research. Highly disease resistant and productive cultivars 'Zonalnaya', 'Aleandr', 'Berdchanka', 'Ranniaya Potapenko', 'Karachinskaya', 'Obskaya Chernaya', 'Berdskaya Chernaya', 'Rakhil', 'Mariushka' and 'Glarioza' are recommended for agricultural industry in Siberia. Cultivars with the large berries are recommended for agricultural industry and amateur gardeners: 'Pamiati Potapenko', 'Shadrikha', 'Kalinovka', 'Degtiarevskaya' and 'Podarok Kuminovu'.

Introduction. Black currant has the leading position in the bulk production as the basic berry crop of Russia. It occupies an area of 44 860 ha in the industrial and amateur gardens of Russia. The area occupied by black currant was 11 600 ha (Kuminov, 1983) in Siberia. At present, there are 1 170 ha in the Novosibirsk region planted with this crop.

The preference for black currant growing can be explained with not a complicated technology of the crop, its high winter hardiness, frost resistance and berry-forming potential being up to 5 t/ha (Volodina, Naumova 1980), easy vegetative reproduction, transportability, large amount of active biological agents and minerals in berries, useful for human health. Black currants are rich in organic acids, sugars, tanning agents and vitamins C, P, B, B1, B2, B9, PP. Only the berries of actinidia and dog-rose hips (Samorodova-Bianki, 1969) accede them in the content of ascorbic acid. The positive qualities of black currant mentioned above are the reasons why currant breeding was initiated in Siberia.

Currant breeding was started by N. I. Davidovich and agrotechnician A. I. Skakova in 1935. The first experimental currants were planted and 8 overseas varieties and those

of Michurin's breeding. Two clones were selected in wild berry study in 1936 and 9 ore varieties were included into the second trial. The beginning of regular work at currant breeding is connected with D. A. Andreichenko. It was mostly analytical work involving European cultivar 'Goliath'. The scientific-research institute (Michurinsk) conducted detailed investigations of the Siberian and Far Eastern berry areas in the 1930 s. The expedition headed by D. A. Andreichenko (1952) was one of the most memorable.

T h e a i m of the work is to present the results of currant breeding in Siberia at the Novosibirsk Michurin Zonal Fruit-berry Experimental Station from the beginning of 1930s of 20th century to the present.

Results. The basic outcome of black currant breeding for 60 years is presented in Table 1.

Table 1. Achievements of currant breeding
1 lentelė. Serbentų selekcijos rezultatai

Years Metai	Cross-combination number Kryžminimo kombinacijų skaičius	Seed number Sėklų skaičius	Seedling number Sėjinukų skaičius	Studied in the garden Tirta sode	Selected Atrinkta			Regionalized cultivars number Rajonuotų veislių skaičius
					prospective perspektyvių	elite elitinių	cultivars veislių	
				Black currant Juodieji serbentai				
1935–1955				1 323	56	23	6	6
1963–1969	57	74 276	22 287	18 107	119	10	4	2
1970–1979	114	245 496	33 513	188	82	6	1	1
1980–1989	139	267 980	43 067	12 033	63	14	12	1
1990–1994	274	132 625	18 162	11 301	103			
Total Iš viso (1935–1994)	594	720 377	109 029	59 312	367	30	23	10
Ribelaria Agrastiniai serbentai				1 350	13			

The breeding data are fragmental (till 1963) and were almost not mentioned in the reports. Other documents have not been preserved. 13231 seedlings had been studied for 20 years, 56 were chosen for the prospect, 26 as elite and further 6 cultivars were developed according the report of 1995. Those were 'Berdskaya', 'Rus', 'Danko', 'Kolkhoznitsa', 'Zarnitsa' and 'Obskaya'. Origin of these cultivars is shown in Table 2.

Table 2. Origin of black currant cultivars
2 lentelė. Sukurtų juodųjų serbentų veislių kilmė

Cultivar Veislė	Origin of cultivar Veislės kilmė	
	Genotype* Genotipas	Parents Tėvai
'Berdskaya'	ES	'Chernaya local' × 'Goliath'
'Zarnitsa'	ES	'Chernaya local' × 'Goliath'
'Rus'	ES	'Chernaya local' × 'Goliath'
'Kolkhoznaya'	ES	'Chernaya local' № 18 × 'Goliath'
'Danko'	ES	'Chernaya local' × 'Goliath'
'Obskaya'	S	'Chernaya local № 1'
'Agrolesovskaya'	ESD	'Druzhnaya' × 'Altaiskaya Dessertnaya'
'Iskitimskaya'	ESD	'Druzhnaya' × 'Altaiskaya Dessertnaya'
'Berdchanka'	ESD	'Druzhnaya' × 'Altaiskaya Dessertnaya'
'Ranniaya Potapenko'	HESD	'Kanadskaya' № 5 × 21-1-65 ('Nadezhda' × 'Primorskij Champion' 1 + 'Zoya' + 'Golubka' + 'Druzhnaya')
'Zapozdalaya'	ESD	'Druzhnaya' × 'Altaiskaya Dessertnaya'
'Kalinovka'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Shadrikha'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Aleandrp'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Zonalnaya'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Pamiati Potapenko'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Karachinskaya'	ScESD	23-29-66 ('Druzhnaya' × 'Altaiskaya Dessertnaya') × 'Brödtorp'
'Obskaya Chernaya'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Berdskaya Chernaya'	ScESD	'Agrolesovskaya' × 'Brödtorp'
'Degtiarevskaya'	ESD	'Seyanets Golubki' × 'Berdchanka'
'Podarok Kuminovu'	ESD	'Berdchanka' × 'Seyanets Golubki'
'Rakhil'	HScESD	125-1-75 ('Agrolesovskaya' × 'Kanadskaya 2') × 'Ojebin'
'Glarioza'	ScESD	'Iskitimskaya' × 'Ojebin'
'Mariushka'	HScESD	125-1-75 ('Agrolesovskaya' × 'Kanadskaya 2') × 'Ojebin'

*D – *Ribes dikuscha*; E – *Ribes nigrum* ssp. *Europeum*; S – *Ribes nigrum* ssp. *Sibiricum* Sc – *Ribes nigrum* ssp. *Scandinavicum*'; H – *Ribes hudsonianum* ssp. *Canadense*

Locally selected currant forms and European 'Goliath' were used in creation of new cultivars. The first varieties were quite winter-hardy with high yield performance. Potapenko established that industrial monovarietal plantations had either weak berry-forming capabilities or no harvest at all. Therefore, they were not spread in plant industry (Potapenko, 1969).

From the beginning of the 1950s till early 1960s breeding of currant weakened. Research was basically focused on the studies of wild selected plant forms and those

developed in breeding. Breeding of currants intensified when Potapenko began working at the experimental station in 1962. Three hundred ten cross-combinations were made by him during 1963–1987: 30 elite forms were studied, out of which 17 were sent to State cultivar testing (SCT). It equaled to 0.002 % of the seed number obtained with crosses and 0.02 % out of seedlings studied in the breeding garden.

As a result, cultivars 'Agrolesovskaya', 'Iskitimskaya', 'Berdchanka', 'Zapozdalaya' were created in a family 'Druzhnaya' × 'Altaiskaya Dessertnaya' and 'Ranniaya Potapenko' was selected in a family 'Canadian' No 5 × elite seedling 21-1-65. Cultivar 'Ranniaya Potapenko' was the first cultivar developed in Russia using Canadian currant. The cultivars mentioned above have a number of economic traits and high yield potential (Table 3). Cultivar 'Berdchanka' demonstrated resistance to gall mite and American powdery mildew during observations, just as 'Ranniaya Potapenko' and 'Zapozdalaya'. Cultivars 'Agrolesovskaya' and 'Iskitimskaya' can be affected by powdery mildew and gall mite, but are still highly tolerant and have high yield performance (Potapenko, 1985).

Cultivars 'Berdchanka' (1987), 'Ranniaya Potapenko' (1991), 'Agrolesovskaya' (1995), 'Shadrikha' (1997), 'Pamiati Potapenko' (2000) and 'Glarioza' (2001) were included into the regionalized set of cultivars. Many efforts were put in interspecific hybridization of currant and gooseberry during the 1940s–1950s. Thirteen forms were selected for the prospect (Table 1) out of 1 350 plants in the experimental garden. Breeding *Ribelaria* stopped after the retirement of Andreichenko. At present, many breeders think that a resistant cultivar can be only parasite resistant under unfavourable environments. New fungus races often develop and follow each other under intensive agricultural production; a resistant cultivar can soon become sensitive (Torlina, 1978; 1981). In this connection, a search for resistance sources on the genetic background is necessary among currant species and cultivars. Thus, cultivars with balanced disease resistance over various geographical regions of the country are of primary importance both in production and as donors. Hybridization was initiated in 1990 involving the donors of powdery mildew resistance carrying *M1*, *M*, *M2*, *Ms*, *Sph2* and *R* genes.

Earlier investigations on American powdery mildew resistance by Potapenko (1981; 1987) and us (Sorokopudov, 1991) showed that the chosen way of developing cultivars resistant to the pathogen is reasonable.

A collection of currant species from South-Eastern Asia and the European part of Russia has been established in recent years and is being studied. Some seedlings were selected from free pollinated seeds of cultivars 'Ben Alder' and 'Stor Class', received from V. Traikovsky (Sweden). Two hundred seventy-four cross-combinations have been made since 1990; 132 655 seeds have been obtained and 18 162 seedlings have been grown in the experimental field; 11 301 seedlings have been studied in the breeding field. One hundred three seedlings have been focused on for the prospect including those from the hybrid stock of Potapenko (Table 1).

A search for the ways to shorten the breeding process has been made on black currant. Earlier the term of developing a new cultivar was 14–24 years. The novelties introduced by means of rapid reproduction, selection on pathogen resistance and cultivar tests allow creating new cultivar in 10–12 years.

Eighteen black currant cultivars have been sent to SCT since 1991. They have

high yield performance, winter hardiness, pest and disease resistance and a high tasting score (Table 3). Cultivars 'Glarioza' and 'Pamiati Potapenko' have become prospective according to the results of SCT in the Novosibirsk region. Cultivars 'Shadrikha' and 'Kalinovka' have been regionalized in the Novosibirsk region and cultivar 'Agrolesovskaya' in the Irkutsk region.

Alongside with high yield performance, easy transportability, resistance to extreme environments, new cultivars have complex disease and pest resistance and it is very important for dietetic production (Sorokopudov, 1993, Sorokopudov at al., 1994, Sorokopudov, 2007).

Table 3. Length of breeding process of black currant at the Novosibirsk Michurin Zonal Fruit-berry Experimental Station

3 lentelė. Juodųjų serbentų veislių sukūrimo trukmė Novosibirsko Mičiurino vardo zoninėje uoginių augalų eksperimentinio tyrimo stotyje

Cultivar Veislė	Years Metai			Length of breeding process (year) Selekcijos proceso trukmė, metai
	obtaining seeds sėklų gavimas	selection atrinkimas	sending to SCT perdavimo valstybiniams veislių tyrimams	
'Agrolesovskaya'	1966	1979	1982	16
'Iskitimskaya'	1966	1979	1982	16
'Berdchanka'	1966	1979	1982	16
'Zapozdalaya'	1966	1973	1990	24
'Ranniaya Potapenko'	1974	1981	1988	14
'Kalinovka'*	1980	1987	1991	11
'Shadrikha'*	1980	1987	1992	12
'Aleander'*	1980	1987	1992	12
'Zonalnaya'*	1980	1987	1993	13
'Pamiati Potapenko'*	1980	1987	1993	13
'Karachinskaya'*	1981	1988	1994	13
'Obskaya Chernaya'*	1980	1987	1994	14
'Berdskaya Chernaya'*	1980	1987	1994	14
'Degtiarevskaya'*	1985	1990	1994	9
'Podarok Kuminovu'*	1985	1990	1994	9
'Rakhil'*	1986	1990	1994	8
'Glarioza'*	1985	1990	1994	9
'Mariushka'*	1986	1990	1999	13
'Augusta'*	1979	1990	2001	22
'Chernysh'*	1979	1990	2001	22
'Solomon'*	1979	1990	2001	22
'Irmen'*	1979	1991	2001	21
'Perepel'*	1981	1991	2001	20

* cultivars developed with our assistance / veislės, išvestos su mūsų pagalba

Earlier the breeding process of black currant lasted for 14–24 years. We suggest the following scheme of shortening the breeding process based on the carried out experimental work:

- 1st year – developing seeds;
- 2nd year – growing seedlings, selection at early stages of growth and development on resistance to powdery mildew and septoriosis under on the provocative background, establishing a breeding plot;
- 3rd–5th year – studying of seedlings in the experimental plot on the expression degree of economic traits (disease and pest resistance, winter hardiness, yield performance), detecting prospective seedlings;
- 5th–6th year – establishing a plot of primary cultivar studies;
- 6th–10th year – estimation of the selected seedlings on a complex of economic traits and detection of the elite with their parallel reproduction.

Ten–twelve years are considered a real term to develop a new black currant cultivar under Siberian environment based on the gained experience and the scheme suggested. Eight–nine years could be considered a real term to study breeding stocks for the possible shortest time.

It is necessary to select prospective seedlings with the least number of stomata on leaf surface and the closest location of the longest internode on a shoot to the ground for a quicker estimate of breeding stock at early ontogenetic stages, as age powdery mildew resistance is typical to black currant cultivars. Higher ascending of internode curve length on shoots show early aging and bigger resistance to powdery mildew – the fungus evolutionarily adapted to young plant tissues. Dividing the primary shrub into 15–20 parts was used for a quicker set up of the primary cultivar studies plot; propagation by cutting was carried out simultaneously to set up initial plots. Besides, some shoots of interest were being studied in the breeding garden for 2, but not 3 years. All these undertakings considerably affected the reduction of breeding terms. Moreover, we used the techniques recommended by Potapenko (1970, 1974).

The stocks dealt with also influence the acceleration of the breeding process. Naturally, it proceeds quicker when using donors and sources of economic traits. Based on the research performed, we believe that it is quite real to produce a new black currant cultivar in Siberia in 10–12 years or even more quickly.

According to bi-factor dispersion analysis, all new currant cultivars considerably accede control cultivar in yield performance (Table 4). Many of cultivars stand out in the degree of certain trait expression. Black currant cultivars 'Podarok Kuminovu', 'Pamiati Potapenko', 'Degtiarevskaya' are twice more productive than those of control 'Avgusta', 'Irmen', 'Mariushka' and 'Solomon' are distinct in their high content of vitamin C. Complex pest and disease resistance is typical for cultivars 'Berdskaya', 'Chernaya', 'Karachinskaya', 'Irmen', 'Degtiarevskaya', 'Glarioza', 'Zonalnaya', 'Perepel', 'Shadrikha', 'Rakhil', 'Podarok Kuminovu'. Such cultivars as 'Degtiarevskaya', 'Podarok Kuminovu' and 'Pamiati Potapenko' have maximal berry weight, which exceeds 5 g.

Table 4. Description of new currant cultivars under dry-farming land of the breeding at the Novosibirsk Zonal Experimental Station (1990–2001)
4 lentelė. Naujų veislių, sukurtų Novosibirsko zoninėje eksperimentinėje stotyje (1990–2001 m.) ir augintų sausame dirvožemyje, charakteristika, 1990–2001 m.

Cultivar Veislė	Yield (kg/shrub) Derlius iš kg/ krūmo		Berry weight Uogų masė (g)		Content of AA Askorbo rūgšties kiekis (mg/100 g)	Maximal affection (score) Maksimalus pažeidimo balas				
	average vidutiniškai	max. maksimalus	average vidutiniškai	max. maksimalus		septoriosis šviesmargė	wildfire virusinė šviesmargė	gall mite pumpurinė erkutė	powdery mildew miltligė	antracnosis degliai
'Berdchanka' (c)	1.5	1.7	1.1	1.6	132.1	2	4	0	0	0
'Avgusta'	1.9	2.2	1.6	3.0	174.2	1	1	1	0	0
'Aleandr'	1.9	3.48	1.6	2.3	143.5	2	1	1,5	0	0
'Berdskaya Chernaya'	2.2	2.4	1.1	1.6	132.4	1	1	0	0	0
'Glarioza'	2.7	3.1	1.7	2.7	98.1	1	1	0	0	0
'Degtiarevskaya'	3.3	3.7	2.2	5.0	100.5	1	1	0	0	0
'Zonalnaya'	2.2	2.6	1.3	1.7	170.8	2	1	0	0	0
'Irmen'	2.0	2.4	1.6	3.5	187.8	1	1	0	0	0
'Kalinovka'	2.3	2.9	1.5	1.9	132.8	2	1	1	0	0
'Karachinskaya'	2.3	2.7	1.2	1.7	150.7	1	1	0	0	0
'Mariushka'	2.2	2.4	1.6	3.2	184.4	1	1	0	0	0
'Obskaya Chernaya'	2.2	2.7	1.2	1.6	96.1	1	1	0	0	0
'Pamiati Potapenko'	2.8	4.1	1.85	6.0	141.9	2	1	1,1	0	0
'Perepel'	2.1	2.3	1.7	4.5	147.2	1	1	0	0	0
'Podarok Kuminovu'	3.2	3.6	2.3	5.0	95.8	1	1	0	0	0
'Rakhil'	2.9	3.3	1.4	2.2	60.4	1	1	0	0	0
'Solomon'	2.3	2.5	1.2	1.7	189.8	1	1	0	0	0
'Chernysh'	1.8	1.9	1.8	4.2	139.4	2	1	1	0	0
'Shadrikha'	2.1	2.8	1.6	4.3	133.2	2	1	0	0	0
LSD_{01} on cultivars / R_{01} veislės – 0.30 years / metai – 0.21										
Note / Pastaba: AA – ascorbic acid / askorbo rūgštis; (c) – control / kontrolė										

All the above-mentioned characteristics of black currants are interesting for breeding under Siberian conditions. New currant cultivars are economically efficient when cultivated under dry-farming land and are highly prospective compared to control.

Conclusions. 1. The regionalized assortment of black currant cultivars has been increased and improved in the Novosibirsk region as a result of 65-year research; 29 new cultivars have been developed. Eighteen cultivars having been developed since 1990 are distinct in their high productivity, berry-forming stability, large berries and tolerance to pests and diseases compared to earlier regionalized cultivars

'Primorsky Champion', 'Seyanets Golubki' and 'Berdchanka'.

2. The necessity to involve genetically heterogeneous stocks in the breeding process has been determined. The sources and donors of productivity components combining disease and pest resistance, high self-fertility and earliness were detected.

3. Highly disease resistant and productive cultivars 'Zonalnaya', 'Aleandr', 'Berdchanka', 'Ranniaya Potapenko', 'Karachinskaya', 'Obskaya Chernaya', 'Berdskaya Chernaya', 'Rakhil', 'Mariushka' and 'Glarioza' are recommended for agricultural industry in Siberia. Cultivars with large berries are recommended for agricultural industry and amateur gardeners: 'Pamiati Potapenko', 'Shadrikha', 'Kalinovka', 'Degtiarevskaya' and 'Podarok Kuminovu'.

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Straipsnyje apžvelgiami serbentų selekcijos Vakarų Sibire nuo XX a. ketvirtojo dešimtmečio iki šio meto rezultatai. Iki 1990 metų sukurta 18 veislių. Pateikta serbentų selekcijos schema, leidžianti sutrumpinti selekcijos procesą. Sukurtos veislės išsiskiria produktyvumu, atsparumu ligoms ir kenkėjams, aukštu savidulkos procentu ir ankstyva derėjimo pradžia.

Produktyvios ir atsparios ligoms veislės 'Zonalnaya', 'Aleandr', 'Berdchanka', 'Ranniaya Potapenko', 'Karachinskaya', 'Obskaya Chernaya', 'Berdskaya Chernaya', 'Rakhil', 'Mariushka' ir 'Glarioza' pasiūlytos versliniams serbentynams, o stambiauogės ir produktyvios veislės 'Pamiati Potapenko', 'Shadrikha', 'Kalinovka', 'Degtiarevskaya' ir 'Podarok Kuminovu' rekomenduotos ir versliniams serbentynams, ir mėgėjiškiems sodams.

Reikšminiai žodžiai: selekcija, serbentai, veislės.