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Garden Strawberry Varieties of the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery

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Abstract

The genetic potential of the strawberry selections/cultivars grown in the Russian Federation in enormous. The State Register of Breeding Achievements lists 106 varieties of garden strawberry approved for use, only 17 of them are patented. Eighty-eight of the listed varieties are of Russian origin and only 18 – foreign-bred. About 26 % (23 varieties out of 88) have been bred in the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery. The varieties have different berry ripening times that allow increasing their fresh produce consumption period. The Al'fa, Slavutich, Vityaz', Lyubava and Bereginya selections are very perspective not only in terms of their commensal growing but also in terms of their further selection. To study the berries' biochemical composition and successfully conduct the breeding process using the pollen-free of harmful viruses, a network of field repositories has to be set up in the Russian Federation.

Key words: garden strawberry, breeding achievement, assortment, field repository

Introduction

The garden strawberry (*Fragaria ananassa*) is one of the most wide-spread berries grown all over the world. The latest research data attest that regular consumption of the berries positively affects human blood plasma composition and increases erythrocyte resistivity to oxidation. The phenolic compounds and flavonoids in the berries have a powerful antioxidant effect on the whole human body. They contain sugars (mostly fructose and glucose), organic acids (mostly malic ones), vitamin C and its vitamin B_9 content is higher than in any other fruit and berries. When it comes to vitamin E, the garden strawberry is way ahead of the orange, tangerine, banana, red currant, cherry, and others. Apart from the substances listed above, the garden strawberry is a source of other vitamins such as A, B_1, B_2, PP, K (Hannum, 2004). However, all this goodness is only available when the berry becomes eating -ripe.

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Since the berries are, in fact, a carpophore, they often become unfit for long-lasting transportation due to the tissue softening and sugar and aroma accumulation typical for certain pomological varieties. For that reason, the exported strawberry is commonly yielded before its ripe to be colored and aromatized to make them attractive for the buyer. Also, berries are often fumigated with diphenyl that, on one hand, protects them from fungal and bacterial infections but, on the other hand, is cancerogenic.

Russia is currently exporting fresh strawberries from such countries as Turkey, Egypt, and Mexico, whose climate favors bumper yields and whose workforce is cheap. However, due to Russia's more northern geographical location, its fields produce strawberries of higher quality that have richer antioxidants content. Due to the close relationship between nutrition and human health, consumers increasingly use food products that correspond to their preferences, such as taste, nutritional and biological value, etc (Rassolov et al., 2019). Nanotechnology is an extremely vital space of research in trendy science and technology (Dubey and Singh, 2019). In the course of a long evolution, all living organisms on the Earth have fully adapted to their natural conditions and a natural dependence on freshwater (Suvorov et al., 2018).

Despite the enormous genetic potential of the strawberry selections/cultivars grown in the Russian Federation, the country is being a large importer of not only low-quality berries but also of seedlings, which the country may very well grow itself in necessary quantities. This sad state of affairs, in many ways, has become possible due to the omnifarious production of plant material and insufficient knowledge of the pomological qualities of multiple Russian and foreign-bred strawberry selections.

Results

The State Register of Breeding Achievements of the Russian Federation lists 106 varieties of garden strawberry approved for use, only 17 of them are patented. Eighty-eight of the listed varieties are of Russian origin and only 18 – foreign-bred. The countrywide distribution of the selections can be seen in Fig. 1 (State Register, 2020).

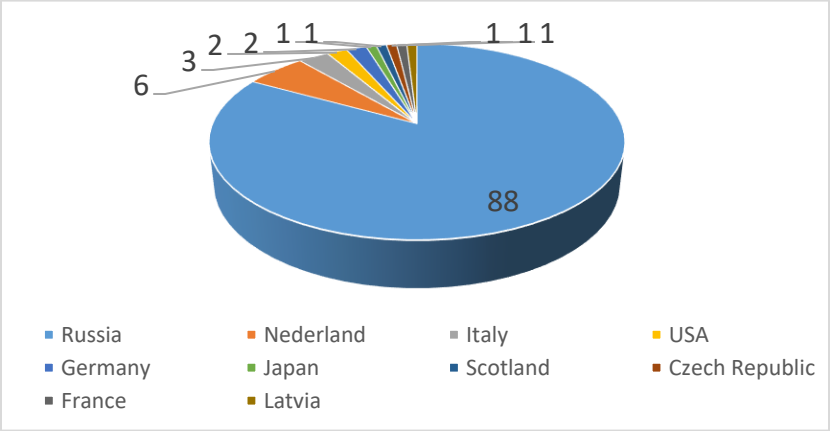

Figure 1. Countrywise distribution of the strawberry selections in the State Register of Breeding Achievements that are approved for use in the Russian Federation (2020).

About 26 % (23 varieties) of the Russian varieties have been selected in the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery (Aytzhanova et al., 2007, Andronov et al., 1997). One of these breeds is Krasavitsa Zagor'ya that has been in the State Register since 1959, is distinguished for its high yield (more than 130 dt/ha for northern territories), and can be grown almost everywhere in Russia (see Table 1).

Table 1. Strawberry breeds selected in the All-Russian Horticultural Institute for Breeding, Agrotechnology that has been included in the State Register of Breeding Achievements, and admitted for growing in Russia (2020).

Variety, ®	Included since / Regions of admission	Authors	Origin
Al'fa	2006/ 3	S. D. Ajtzhanova, V. I. Andronov	Syurpriz Olimpiade × Festival'naya Romashka
®Bereginya	2012/ 3	S. D. Ajtzhanova, N. V. Andronova	Solovushka×Induka
®Borovitskaya	2003/ 4, 12	I.V. Popova, A.U. Zalakashvili	Nadezhda × Red Gauntlet
Vityaz'	1999/ 2, 3, 4, 7	S. D. Ajtzhanova	Syurpriz Olimpiade × Festival'naya Romashka
Desnyanka Kokinskaya	1985/4, 10	A.A. Vysockij	Sparkl × Zenga Zengana
Zolushka	1989/2, 3, 4, 5, 6, 10	I.V. Popova	Festival'naya × Zenga Zengana
Kalinka	2009/ 2, 4	I.V. Popova, S. M. Reznik	Purpurovaya × Marieva Maherauha
®Corrado	2003/ 3, 12	I.V. Popova, A.U. Zalakashvili	# 188-16-25 × Red Gontlet
Kokinskaya Rannyaya	1985/ 2, 3	A.A. Vysockij	Catskill × Rannyaya Maherauha
Krasavitsa Zagor'ya	1959/ 2, 3, 6, 7, 8, 9, 10	M. N. Simonova	Komsomolka (open pollination)
®Kubata	2013/ 3	I.V. Popova	Kubenskaya × Holidey
®Lyubava	2014/ *	S. D. Ajtzhanova, N. V. Andronova	Solovushka × Zheneva
Nadezhda	1989/ 1, 2, 3, 7, 10, 11	I.V. Popova	Festival'naya × Purpurovaya
Naydena Dobraya	2001/ 4	I.V. Popova	Festival'naya × Purpurovaya
Rosinka	2009/ 3	S. D. Ajtzhanova, N. V. Andronova	(Kokinskaya Rannyaya × Syurpriz Olimpiade) × Vityaz'
Rusich	2002/ 3, 7	S. D. Ajtzhanova, N. V. Andronova	Festival'naya Romashka × Syurpriz Olimpiade
®Ruslan	2009/ 2, 3, 4, 10	I.V. Popova	Festival'naya × Purpurovaya
Slavutich	2006/ 3, 7	S. D. Ajtzhanova, N. V. Andronova	Festival'naya Romashka × Syurpriz Olimpiade
Sudarushka	2000/ 2, 3, 4, 7	G. D. Alexandrova	Festival'naya × Roksana

®Toros	2008/ 12	I.V. Popova	Red Gontlet × (Purpurovaya × Marieva Maherauha)
®Troickaya	2006/ 2, 3	I.V. Popova	Makovka × Samaryanka
Tsaritsa	2009/ 3	S. D. Ajtzhanova, N. V. Andronova	Venta × Red Gontlet
®Estafeta	2004/3,4	I.V. Popova, S. M. Reznik	Nadezhda × Red Gontlet

The breeds have different ripening times that allows increasing their fresh produce consumption period (see Table 2)

Table 2. Ripening times of the garden strawberry breeds selected in the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery.

Variety	June			July			Destination
	I	II	III	I	II	III	
Lyubava	.	.	.	.	.	.	Day-neutral universal breed
Rosinka	.	.	.				Early-ripening universal breed
Kokinskaya Rannyaya	.	.	.				Early-ripening universal breed
Ruslan	.	.	.				Early-ripening universal breed
Toros		.	.	.			Early-ripening universal breed
Corrado		.	.	.			Middle/early - ripening universal breed
Desnyanka Kokinskaya		.	.	.			Middle-ripening universal breed
Kalinka		.	.	.			Middle-ripening universal breed
Krasavitsa Zagor'ya	.	.	.				Middle/early - ripening table breed
Borovitskaya		.	.	.			Middle/late-ripening universal breed
Vityaz'		.	.	.			Middle-ripening universal breed
Nadezhda		.	.	.			Middle-ripening universal breed
Naydena Dobraya	.	.	.				Middle-ripening universal breed
Slavutich		.	.	.			Middle/early - ripening table breed
Sudarushka		.	.	.			Middle-ripening universal breed
Tsaritsa		.	.	.	.		Middle-ripening universal breed
Estafeta		.	.	.			Middle-ripening universal breed
Zolushka		.	.	.	.		Middle-ripening universal breed
Rusich		.	.	.	.		Middle/late-ripening universal breed
Al'fa							Middle/late-ripening universal breed
Bereginya		.	.	.	.		Late-ripening technical breed
Kubata			.	.	.		Late-ripening universal breed
Troickaya			.	.	.		Late-ripening universal breed

Long-term studies (Aytzhanova et al., 2008, 2017) have enabled us to select the most promising varieties of the garden strawberry for both industrial growing (Aytzhanova et al., 2018) and further selection (Aytzhanova et al., 2012, Andronova et al., 2007).

Lyubava. This day-neutral early-ripening universal breed has a middle-size well-leafed brunchy shrub that produces a moderate number of the runners of anthocyan color. The leaves of middle size are green, weekly rugate, dense, slightly ribbed, shining, glabrous, and bent-in. The leaf dents are straight and wide. The moderately pubescent leaf stalk is mid-size. The scale leaf is red, narrow, and long. The white flowers are mid-size, androgynous, and untwisted. The mid-size flower stalks are densely pubescent and are at the same level as the leaves. The inflorescence is compact and multiflorous. The necked berries are diamond-shaped, red and shining; their weight varying from 5 to 20 g. A berry contains 6.2 % of sugar, 0.9 % of acid, and 85 mg% of vitamin C. The berries are sweet and sour and exude aroma, their tissue is red, dense and juicy. The variety's average yield capacity may reach 206 dt/ha. The degustation evaluation of fresh berries is 4.5 points. The breed has middle winter hardiness and is heat-tolerant. It is also resistant to fungal leaf diseases and strawberry blossom blight.

Figure 2. The Lyubava strawberries.

Slavutich. This middle-ripening universal breed has a middle-size non-remontant semi spreading leafy shrub that produces a moderate number of the runners of pink-green color. The leaves of middle size are green, weekly rugate, slightly ribbed, low-arched, glabrous, dim, wide. The leaf's margin is crenate and its mid lobe - oval. The scale leaf is pink-green, wide, and mid-size. The white flowers are mid-size, androgynous, and untwisted. The mid-size flower stalks are low- pubescent and are at the same level as the leaves. The inflorescence is mid-size, compact, and moderately flowered. The fruit stalks are long and moderately thick. The neckless berries are cone-shaped, red and shining; their average weight is up to 18.9 g. A berry contains 7.1 % of sugar, 0.8 % of acid, and 63.4 mg% of vitamin C; its tissue is red, dense and juicy. The breed's average yield capacity is 116.1 dt/ha.

Figure 3. The Slavutich strawberries.

Vityaz. This middle-ripening universal breed has a middle-size semi spreading flat and rounded shrub of moderate density and height. The leaf is green, weekly arched, and blistered and has a blunt base. The number of runners is moderate. The flower stalks are at the same level as the leaves. The flower is mid-size, its inner flower cup is bigger than the outer one. The berry is wider than longer, its shape is round and weakly conic. Its seedless part is narrow and universally colored in red. The seeds are on the same level as the berry's external membrane. The tissue is orange-red and slightly heterogeneous. A berry contains 9 % of sugar, 1.2 % of acid, and 60 mg% of vitamin C. The breed's fructification type is non-remontant, its average yield capacity varying from 150 to180 dt/ha. The cultivar has high winter hardiness and is high - resistant to powdery mildew, strawberry mite, and verticillium wilt. Its resistance to other strawberry diseases is above average.

Figure 4. The Vityaz strawberries.

Tsaritsa. This middle-ripening universal breed has a middle-size semi spreading and mildly - a foliated shrub that produces a moderate number of mildly thick densely -pubescent runners of dull-red color. The leaf is large, green, smooth, slightly ribbed, bent-in, glabrous, dim, with blunt dents. The mid lobe is sharply obovate. The moderately pubescent leaf stalk is of mid-size, the trichomes are standing. The flowers are big, untwined, and white. The flower stalks are below the leaves. The inflorescence is mid-size, compact, and has a few flowers. The berry's average weight is 12 g, they are neckless, dark-red, and shining. The tissue is red, dense, sweet-sour, and exudes aroma. A berry contains 11.1 % of dry matter, 9.0 % of sugar, 0.9 % of acid, and 76.0 mg% of vitamin C. The cultivar's degustation estimation is 4.8 points. The yield capacity varies from 98.9 to 130 dt/ha. Its resistance to pests and diseases is comparable to that of the standard cultivars. The breed has high drought hardiness and heat tolerance. Its winter hardiness is moderate, so in absence of snow at -15 °C, the reproductive buds can be damaged if the frost reaches 1.5 points.

Figure 5. The Tsaritsa strawberries.

Al'fa. This late-ripening technical breed has a middle-size well-leafed, non-remontant, semi spreading shrub that produces a moderate number of the thick runners of pink-green color. The mid-size leaves are green, weekly rugate, slightly ribbed, arched, glabrous, and dim. The leaf's margin is crenate and its mid lobe –

circular. The leaf stalk is wide and short. The white flowers are mid-size, androgynous, and untwisted. The flower stalks are below the leaves. The inflorescence is compact and mildly fluorous. The neckless berries are of regular shapes, of mild glossiness. They are sweet and sour, the dense tissue exudes aroma. A berry contains 5.9 % of sugar, 1.0 % of acid, and 75 mg of vitamin C. The degustation evaluation of fresh berries is 4.5 points. The variety's average yield capacity may reach 150 dt/ha.

Figure 6. The Al'fa strawberries.

Bereginya. This late-ripening non-remontant universal breed has a middle-size densely - foliated semi spreading shrub that produces a big number of the mid-size runners of dull-red color. The mid-size leaves are bright - green, mildly rugate, slightly ribbed, arched, pubescent, and shining. The leaf dents are blunt and wide with obovate mid lobe. The leaf stalk is mid-size, longer than the side ones, the trichomes are standing. The scale leaves are green wide and long. The white flowers are mid-size, androgynous, and untwisted. Then flower stalks are mid-size, densely pubescent, and at the same level as the leaves. The inflorescence is compact and multiflorous. The fruit stalk is mid-size. The neckless berries resemble a blunt cone and are red and shining; their weight varying from 14.1 to 26.6 g. A berry contains 5.7 % of sugar, 0.8 % of acid and 79 mg% of vitamin C. The berries are sweet and sour and exude aroma, their tissue is red, dense and juicy. The degustation evaluation of fresh berries is 4.5 points. The breed has good winter and high drought and heat hardiness. Its resistance to strawberry diseases and pests exceeds that of the standard varieties. The cultivar's average yield capacity may reach 250 dt/ha.

Figure 7. The Bereginya strawberries.

In the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery, the parent plants of the abovementioned cultivars have been obtained for further reproduction that does not hazard the plants' genetic stability, so they can be used to start a field repository where the cultivars will be assessed not only in terms of their yield capacity but also in terms of their vendibility, resistance to biotic and abiotic stressors and biochemical content of antioxidants and other nutrients that strengthen the human immune system.

Conclusion

1. Twenty-three varieties (26 %) of the national assortment from the State Register of Breeding Achievements approved for use in the Russian Federation are varieties bred in the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery.
2. The varieties bred in the All-Russian Horticultural Institute for Breeding, Agrotechnology, and Nursery can ensure an uninterrupted and long-term supply of fresh products to the market.
3. As a result of long-term research, the most perspective varieties of strawberries (Tsaritsa, Al'fa, Slavutich, Vityaz', Lyubava, Bereginya) have been selected to be included a field repository, where comprehensive research will be conducted to study the biochemical composition of berries, the adaptability of varieties, as well as the breeding using hybridization pollen free from harmful viral diseases.

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