# Monitoring the Gene Pool of Sea-Buckthorn Cultivars (*Hippophae Rhamnoides* L.) for Breeding in the Conditions of the Nonchernozem Zone of Russia

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**Abstract.** The research materials of *Hippophaerhamnoides* L. cultivars in the Nonchernozem zone of Russia are presented in this paper. The issues of phenology, productivity and resistance to ecological factors of the environment are considered. It was found that the phenophases of the beginning of vegetation, ripening of berries, leaf fall, duration of fruiting and vegetation have a slight variation, i.e., the cultivars slightly differ in the calendar phenophase onset dates. At the beginning of the growing season, this phenophase can be divided into 3 groups: early (18-22 days – Botanicheskaya Aromatnaya, Botanicheskaya and Perchik), medium (23-26 Moskovskaya Ananasnaya, Botanicheskaya Lyubitelskaya, Gibrid Perchika and Lomonosov) and later (27-30 – Podarok Sadu and Vorobyovskaya) bud breaks. There are 3 groups of cultivars according to the duration of vegetation: short (171-174 days – Podarok Sadu, Moskovskaya Ananasnaya and Botanicheskaya), medium (175-178 – Botanicheskaya Lyubitelskaya, Gibrid Perchika, Vorobyevskaya, Otradnaya and Lomonosovskaya) and long (179-182 – Botanicheskaya Aromatnaya). The analysis of the sea-buckthorn cultivars yield showed that, on the average, it amounted to 85±21 c/ha with the variation of 88% over the years. The cultivars with the highest yield in c/ha units were identified as Botanicheskaya (109.48±30.06), Moskovskaya Ananasnaya (121.24±28.46) and Botanicheskaya Aromatnaya (151.74±34.58); the lowest in yield cultivars were Otradnaya (32.98±6.24), Podarok Sadu (52.48±14.72) and Gibrid Perchika (64.24±17.50). It was revealed that the cultivars berry mass in different years has a weak (0-17%) and average (22-27%) variation. Cultivars Lomonosovskaya (0.51±0.0 g) and Vorobyevskaya (0.58±0.1 g) had small fruits. The most winter-hardy cultivars were identified as Moskovskaya Ananasnaya, Botanicheskaya Aromatnaya, Botanicheskaya Perchik, Botanicheskaya Lyubitelskaya and Lomonosovskaya.

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## 1 Introduction

Sea-buckthorn *Hippophaerhamnoides* L. belongs to the family of Elaeagnaceae. It is a large shrub or a small tree up to 9 m tall with a top-level root system and a strongly branched trunk and branches. Its shoots are initially silvery, then rusty-brown, ending in thorns. The leaves are alternate, short-stemmed, linear or linear-lanceolate, up to 8 cm long and 0.8 cm wide. The flowers are unisexual, and the plant is dioecious. Male flowers are collected in short spikes up to 8 mm long, female ones - in the axils of twigs on pedicels up to 0.5 mm long with a tubular brown perianth covered with rare white scales on the outside. The fruits are juicy, shiny drupes, red or yellow in colour, up to 1 cm long and up to 0.8 cm wide. The seeds are dark brown, shiny, ovate-oblong with a longitudinal groove. Sea buck-thorn blooms in April-May; fruits ripen in July-August, sometimes at the end of June, remaining until the spring of the following year. The flowering duration is only 10-12 days [1, 2].

It is widely distributed in the temperate zone of Europe and Asia, although it has an intermittent range. Its main arrays are concentrated in the Caucasus, Central Asia, Western and Eastern Siberia, including Dauria. Especially large thickets of it were found in Altai. It is cultivated in many CIS countries [3-6]. Fruits, containing a large amount of biologically active substances, including fatty oil (in the pulp – up to 9%, in seeds – up to 12%), representing a mixture of glycerides: oleic, linoleic, palmatin and stearic acid, a mixture of carotene and carotenoids (up to 180 mg%), are used as food, and its fruits contain tocopherol (up to 110 mg%). In addition, the fruits contain phospholipids (up to 1%), steorins (up to 2%), vitamin C (up to 900 mg%), carotene (up to 60 mg%), vitamin B (up to 0.035 mg%), B2 (up to 0.056 mg%); B6, E (up to 145 mg%), F, P, folic acid (up to 0.79 mg%), sugars (up to 3.6%), inositol; flavonoids (isoramnetin, narcissin, rutin, etc.); organic acids – malic, tartaric, nicotinic and tannins. Of all fruit plants, sea-buckthorn fruits contain tocopherols most of all – from 4 to 18 mg%. In fruit pulp oil, there are up to 160 mg% of vitamin E. In addition, valuable sea-buckthorn oil contains: B-carotene, vitamins K, B, B2, B6; sterols, stigmasterin, β-sitosterol; fatty organic acids, sugars and glycerides of oleic, linoleic, palmatic and stearic acids. Fruits accumulate a large amount of macro- and microelements: potassium, calcium, magnesium, iron, manganese, copper and zinc. Chromium, aluminum, selenium, nickel, iodine and boron were also found in them [7-19].

Due to the enormous value of sea-buckthorn cultivars, they are studied everywhere, and the phenomenon of the most adaptive ones to local conditions, which was the subject of our research, is revealed.

## 2 Materials and Methods

Ten sea-buckthorn cultivars of the breeding by the Botanical Garden of the Lomonosov Moscow State University were studied. The studies were carried out at the collection sites of planting in 2009. The plots were laid with seedlings of the same age, in the amount of 30 registered plants of each sample in 3 repeats. The layout scheme is 3x1 m. The research was carried out at the Leninsky State Cultivar Studies site in the Moscow region in 2014-2018 in accordance with the generally accepted methodology “Program and methodology of studying fruit, berry and nut crop cutivars” [20].

## 3 Results and Discussion

Analysing the average dates of the phenophase onset, it was noted that the be-ginning of bud break occurs on the 24th (± 2 days) day from the average date of the air temperature transition through 0 ° C (April 1), the beginning of berry ripening – on the 124th (± 4) day, the end of berry ripening - on the 146th (± 1) day and leaf-fall on the 200th (± 2) day. Thus,

the berries ripening duration, on the average, is 22 (± 1) days, and the vegetation lasts 176 (± 2) days on the average (Fig. 1).

The obtained variation coefficients show that the phenophases of berry-ripening, leaf fall, duration of fruiting and vegetation have a weak variation, i.e., the cultivars differ slightly according to the calendar phenophase onset dates. On the contrary, the beginning of bud break is marked by a large variation. Thus, the cultivars, according to the calendar time of this phenophase onset, can be divided into 3 groups: early (18-22 days), medium (23-26) and late (27-30) bud breaks.

The earliest bud break (18-22 days) distinguished cvs Botanicheskaya Aromatnaya, Botanicheskaya and Perchik. The late bud break (27-30 days) was noticed in cvs Podarok Sadu and Vorobyovskaya. In the cultivars Moskovskaya Ananasnaya, Botanicheskaya Lyubitelskaya, Gibrid Perchika and Lomonosovskaya, an average flower blooming was observed. Due to the fact that the beginning of vegetation varies and its end is stable, 3 groups of cultivars can be distinguished according to the duration of vegetation: short (171-174 days), medium (175-178) and long (179-182). Cultivars Podarok Sadu, Moskovskaya Ananasnaya and Botanicheskaya have a short growing season. The average growing season is characteristic for cvs Botanicheskaya Lyubitelskaya, Gibrid Perchika, Vorobyovskaya, Otradnaya and Lomonosovskaya. The cultivar Botanicheskaya Aromatnaya has a long growing season.

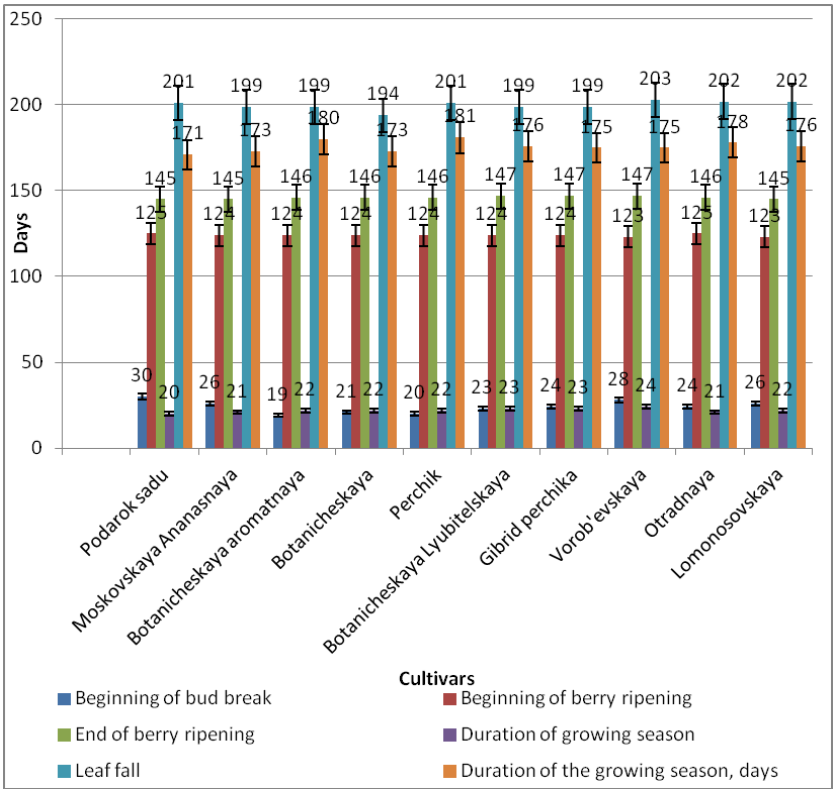


**Fig. 1.** The phenophase onset of sea-buckthorn cvs depending on the date of air temperature transition through 00C.

The analysis of the yield of Hippophaerhamnoides L. cultivars for 2014-2018 showed that the average yield of the species on the total of the studied cvs was 85 ± 21 c/ha. The cultivars variation is also high and it amounted to 88% (Table 1, Fig. 1). The average yield

varies greatly over the years. The lowest yield (19±4 c/ha) was recorded in 2014, the highest – in 2015 (154±35) and 2018 (154±54). The yield variation of all cultivars over the years is average and high. The average variation was noticed in 2014 and amounted to 33%. In 2015, the variation also turned out to be average (36%). This indicates that, in these years the difference in yield, due to the belonging of a cultivar, is average. In 2016-2018, the variation was strong (2016 – 69%, 2017 – 49%, 2018 – 57%), and this indicates a significant difference in the yield of cultivars in the years under consideration.

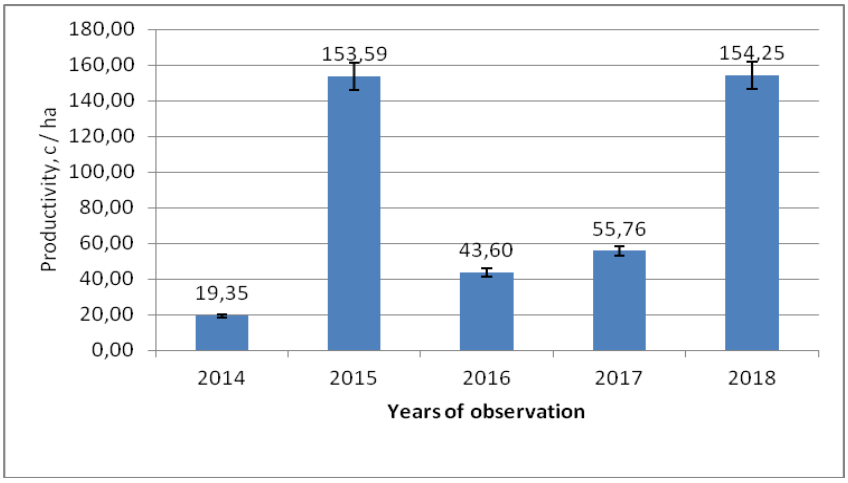


**Fig. 2.** Yield of *Hippophaerhamnoides* L. cvs over years.

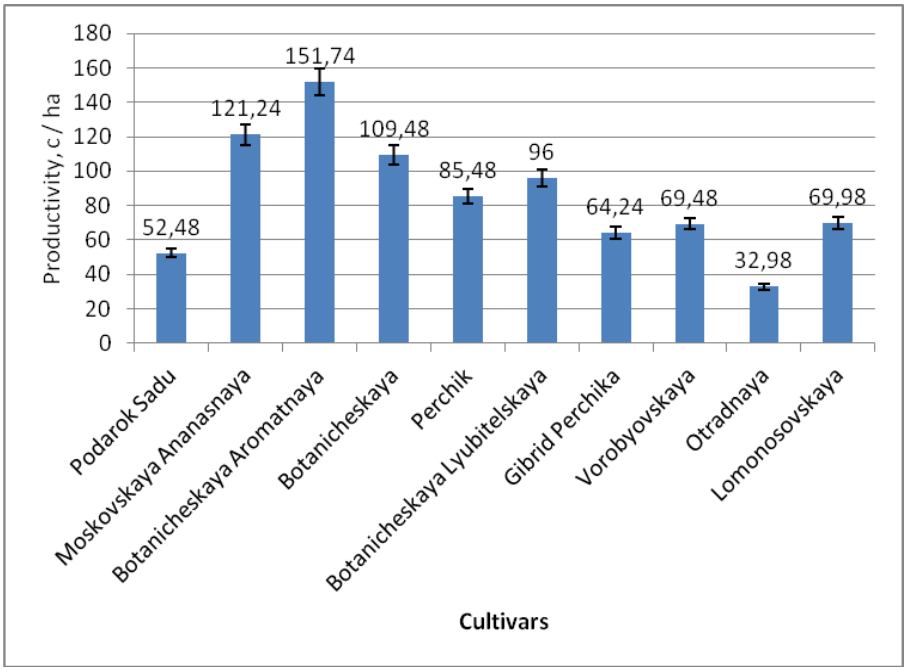


**Fig. 3.** Average yield of *Hippophaerhamnoides* L. cvs.

The average yield of cultivars varies greatly, and it indicates different weather conditions in the years under consideration. Cultivars Podarok Sadu (91%), Moskovskaya Ananasnaya (76%), Botanicheskaya Aromatnaya (74%), Botanicheskaya (89%), Perchik

(113%), Botanicheskaya Lyubitelskaya (79%) and Gibrid Perchika (88%) have very high variability values. High variation was noted in cvs Vorobyovskaya (68%), Otradnaya (61%) and Lomonosovskaya (56%). The lowest average yield was observed in cvs Otradnaya (32.98±6.24 c/ha), Podarok Sadu (52.48±14.72) and Gibrid Perchika (64.24±17.50). The highest average yield (Table 1, Fig. 3) was distinguished by cvs Botanicheskaya (109.48±30.06 c/ha), Moskovskaya Ananasnaya (121.24±28.46) and Botanicheskaya Aromatnaya (151.74±34.58).

**Table 1**. Qualitative characteristics of *Hippophaerhamnoides* L. cvs (2014-2018).

| Name of cv | Productivity (kg/tree) | Average yield (c/ha) | Average berry mass (g) | Tasting evaluation, points |
|---|---|---|---|---|
| Podarok Sadu | 4,2±0,8 | 52,48±14,72 | 0,60±0,1 | 4,8 |
| Moskovskaya Ananasnaya | 17,2±2,1 | 121,24±28,46 | 0,60±0,0 | 4,5 |
| Botanicheskaya Aromatnaya | 25,2±2,8 | 151,74±34,58 | 0,69±0,1 | 4,5 |
| Botanicheskaya | 18,8±1,9 | 109,48±30,06 | 0,78±0,1 | 4,8 |
| Perchik | 10±1,3 | 85,48±30,04 | 0,64±0,1 | 4,3 |
| Botanicheskaya Lyubitelskaya | 17,3±2,2 | 96±23,47 | 0,68±0,0 | 4,4 |
| Gibrid Perchika | 10,1±1,4 | 64,24±17,50 | 0,81±0,2 | 4,8 |
| Vorobyevskaya | 8,3±1,1 | 69,48±14,59 | 0,58±0,1 | 4,2 |
| Otradnaya | 5,9±0,9 | 32,98±6,24 | 0,76±0,2 | 4,7 |
| Lomonosovskaya | 8,8±1,2 | 69,98±12,11 | 0,51±0,0 | 4,4 |
| Average value | 12,58±4 | 85,31±21 | 0,67±0,04 | 4,5±0,8 |
| Cv,% | 53 | 87,94 | 16,1 | 3,2 |

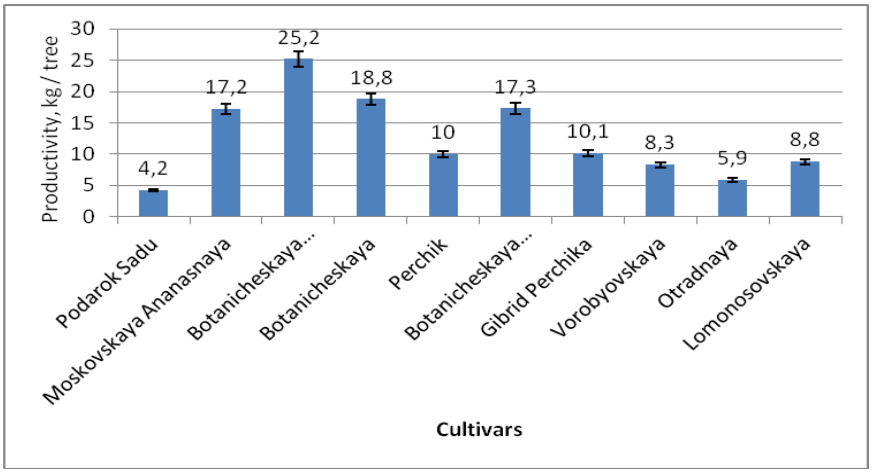


**Fig. 4.** Productivity of *Hippophaerhamnoides* L. cvs.

The productivity varies greatly among the cultivars (Table 1, Fig. 4). The variation coefficient was 53%, which indicates significant differences in the cultivars productivity. The average cultivars productivity was 13±4 kg/tree. The lowest productivity was noticed in cvs Podarok Sadu (4.2±0.4 kg/tree and Otradnaya (5.9±0.5). The most productive cultivars were Botanicheskaya Aromatnaya (25.2±0.8 kg/tree), Botanicheskaya (18.8±0.7) and Botanicheskaya Lyubitelskaya (17.3±0.7). The berry mass analysis of Hippophaerhamnoides L. cultivars for 2014-2018 showed that the average fruit weight of the species on the total of the studied cultivars was 0.67 ± 0.04 g (Table 1, Fig. 5). The cultivars variation was not high (21%).

The berry mass analysis of Hippophaerhamnoides L. cultivars for 2014-2018 showed

that the average fruit weight of the species, on the total of the studied cultivars, was 0.67±0.04 g (Table 1, Fig.5). The cultivars variation was not high (21%).

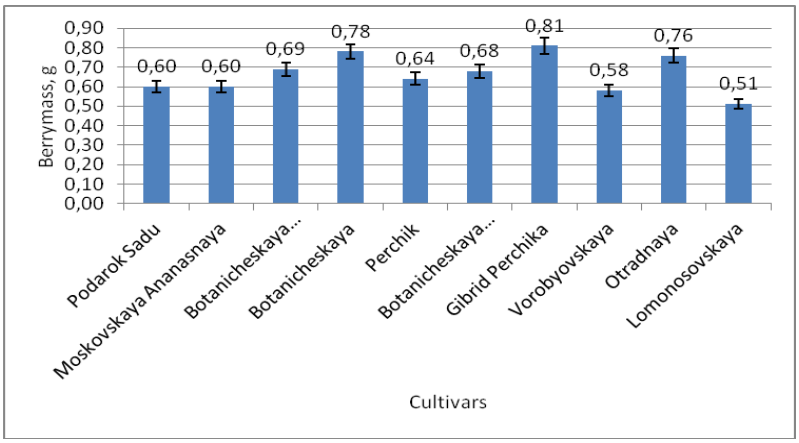


**Fig. 5.** Berry mass of *Hippophaerhamnoides* L. cvs.

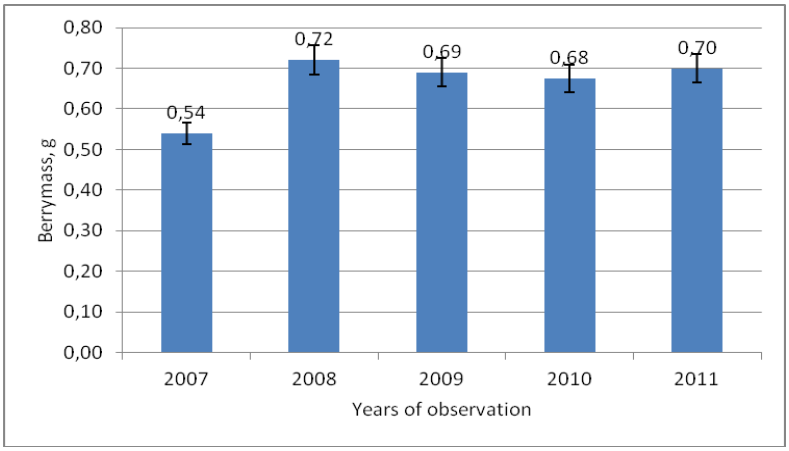


**Fig. 6.** Distribution of berry mass in *Hippophaerhamnoides* L. cvs over years.

The average weight of fruits slightly varies over the years. The lowest fruit weight (0.54±0.04 g) was noticed in 2014, and the highest (0.72±0.06) – in 2015 (Table 1, Fig.5). The fruit weight variation of all cultivars over years is weak and average. Weak variations were noticed in 2014 (13%) and 2015 (14%). In 2016 (22%), 2017 (22%) and in 2018 (19%), the variation turned out to be average. The data obtained indicate the berry mass stability in different years.

The cultivars berry weight varies slightly and on the average in different years. The smallest variation was shown by cvs Moskovskaya Ananasnaya (0%) and Botanicheskaya Lyubitelskaya (7%). Weak variations were shown by cvs Podarok Sadu (12%), Botanicheskaya Aromatnaya (17%), Botanicheskaya (14%), Perchik (14%), Vorobyovskaya (14%) and Lomonosovskaya (11%). The average variation was shown by cvs Gibrid Perchika (22%) and Otradnaya (27%).

The lowest average fruit weight was observed in cvs Lomonosovskaya (0.51± 0.0g) and Vorobyovskaya (0.58±0.1 g). Cultivars Gibrid Perchika (0.81±0.2g), Botanicheskaya (0.78±0.1 g) and Otradnaya (0.76±0.2 g) had the highest fruit weight.

The cultivars tasting evaluation (Table 1) showed their high taste qualities. The highest

score was given to cvs Podarok Sadu (4.8 points), Botanicheskaya (4.8 points) and Gibrid Perchika (4.8 points). Due to the high acid content, the lowest score was given to the Vorobyovskaya cultivar (4.2 points). The winter hardiness of sea-buckthorn cultivars was determined (Table 5). In 2014, all cultivars were absolutely winter-hardy. In 2015, cvs Botanicheskaya, Perchik and Lomonosovskaya were absolutely winter-hardy (0). Minor damages were found in cvs Botanicheskaya Aromatnaya (1 point), Moskovskaya Ananasnaya (0.5 points) and Botanicheskaya Lyubitelskaya (0.5 points). The average winter hardiness was noticed in cvs Podarok Sadu (2.5 points), Gibrid Perchika (2.5 points), Vorobyovskaya (2.5 points) and Otradnaya (2.5 points). In 2016, cvs Botanicheskaya Lyubitelskaya (0), Vorobyovskaya (0) and Lomonosovskaya (0) turned out to be absolutely resistant to winter conditions. Minor damages were noticed in the cvs Moskovskaya Ananasnaya (0.5 points), Botanicheskaya Aromatnaya (0.5 points), Botanicheskaya (1 point) and Perchik (0.5 points). Moderate damages were found in cvs Podarok Sadu (2.5 points), Gibrid Perchika (2.5 points) and Otradnaya (2.5 points). The winter hardiness in 2017 was different for the cultivars. The following absolutely stable cultivars were identified: Botanicheskaya Aromatnaya (0) and Lomonosovskaya (0). Weak damages were noticed in cvs Moskovskaya Ananasnaya (1 point), Botanicheskaya (1 point), Perchik (1.5 points), Botanicheskaya Lyubitelskaya (1.5 points), Gibrid Perchika (1.5 points), Vorobyovskaya (0.5 points) and Otradnaya (1.5 points). Moderate damages were found in the cultivar Podarok Sadu (2.5 points). In 2018, cvs Botanicheskaya Aromatnaya, Botanicheskaya and Lomonosovskaya distinguished themselves by their absolute winter hardiness (0). Cultivars Podarok Sadu (1.5 points), Moskovskaya Ananasnaya (1 point), Perchik (0.5 points), Botanicheskaya Lyubitelskaya (0.5 points), Vorobyovskaya (0.5 points) and Otradnaya (1 point) had minor damages.

According to the results of five-year observations, cvs Moskovskaya Ananasnaya (0.5 points), Botanicheskaya Aromatnaya (0), Botanicheskaya (0), Perchik (0.5 points), Botanicheskaya Lyubitelskaya (0.5 points) and Lomonosovskaya (0) can be considered winter-hardy. The medium-hardy cultivars were Podarok Sadu (2.5 points), Gibrid Perchika (1.5 points) and Otradnaya (1.5 points). When assessing drought tolerance, it was found that the cultivar Podarok Sadu (3.5 points) had an average drought tolerance. Cultivars Moskovskaya Ananasnaya (4.5 points), Botanicheskaya Aromatnaya (5 points), Botanicheskaya (5 points), Perchik (4.5 points), Botanicheskaya Lyubitelskaya (4.5 points), Gibrid Perchika (4.5 points), Vorobyovskaya (4.5 points), Otradnaya (4 points) and Lomonosovskaya (5 points) had a high drought tolerance (Table 5). In 2016, cvs Botanicheskaya Lyubitelskaya (0), Vorobyovskaya (0) and Lomonosovskaya (0) were absolutely resistant to winter conditions. Minor damages were noticed in cvs Moskovskaya Ananasnaya (0.5 points), Botanicheskaya Aromatnaya (0.5 points), Botanicheskaya (1 point) and Perchik (0.5 points). Moderate damages were found in cvs Podarok Sadu (2.5 points), Gibrid Perchika (2.5 points) and Otradnaya (2.5 points). The winter hardiness in 2017 was different for the cultivars. The following absolutely stable cultivars were identified: Botanicheskaya Aromatnaya (0) and Lomonosovskaya (0). Weak damages was noticed in cvs Moskovskaya Ananasnaya (1 point), Botanicheskaya (1 point), Perchik (1.5 points), Botanicheskaya Lyubitelskaya (1.5 points), Gibrid Perchika (1.5 points), Vorobyovskaya (0.5 points) and Otradnaya (1.5 points). A moderate damage was found in the cultivar Podarok Sadu (2.5 points). In 2018, cvs Botanicheskaya Aromatnaya, Botanicheskaya and Lomonosovskaya distinguished themselves by their absolute winter hardiness (0). Cultivars Podarok Sadu (1.5 points), Moskovskaya Ananasnaya (1 point), Perchik (0.5 points), Botanicheskaya Lyubitelskaya (0.5 points), Vorobyovskaya (0.5 points) and Otradnaya (1 point) had minor damages. When assessing drought tolerance, it was found that cultivar Podarok Sadu (3.5 points) had an average drought tolerance. Cultivars Moskovskaya Ananasnaya (4.5 points), Botanicheskaya Aromatnaya (5 points),

Botanicheskaya (5 points), Perchik (4.5 points), Botanicheskaya Lyubitelskaya (4.5 points), Gibrid Perchika (4.5 points), Vorobyovskaya (4.5 points), Otradnaya (4 points) and Lomonosovskaya (5 points) had high drought tolerance values (Table 2).

**Table 2**. Resistance to abiotic factors of *Hippophaerhamnoides* L. cvs for 2014-2018.

| Name of cv | Winter hardiness, points | | Drought tolerance, points | |
|---|---|---|---|---|
| | Average | Characteristic | Average | Characteristic |
| Podarok Sadu | 2,5 | medium-hardy | 3,5 | medium-tolerant |
| Moskovskaya Ananasnaya | 0,5 | hardy | 4,5 | tolerant |
| Botanicheskaya Aromatnaya | 0 | hardy | 5 | tolerant |
| Botanicheskaya | 0 | hardy | 5 | tolerant |
| Perchik | 0,5 | hardy | 4,5 | tolerant |
| Botanicheskaya Lyubitelskaya | 0,5 | hardy | 4,5 | tolerant |
| Gibrid Perchika | 1,5 | medium-hardy | 4,5 | tolerant |
| Vorobyovskaya | 0,5 | medium-hardy | 4,5 | tolerant |
| Otradnaya | 1,5 | medium-hardy | 4 | tolerant |
| Lomonosovskaya | 0 | hardy | 5 | tolerant |

When assessing drought tolerance, it was found that the cultivar Podarok Sadu (3.5 points) had an average drought tolerance. Cultivars Moskovskaya Ananasnaya (4.5 points), Botanicheskaya Aromatnaya (5 points), Botanicheskaya (5 points), Perchik (4.5 points), Botanicheskaya Lyubitelskaya (4.5 points), Gibrid Perchika (4.5 points), Voro-byoskaya (4.5 points), Otradnaya (4 points) and Lomonosovskaya (5 points) had high drought tolerance values (Table 5). In 2016, cvs Botanicheskaya Lyubitelskaya (0), Vorobyovskaya (0) and Lomonosovskaya (0) were absolutely resistant to winter conditions. Minor damages were noticed in cvs Moskovskaya Ananasnaya (0.5 points), Botanicheskaya Aromatnaya (0.5 points), Botanicheskaya (1 point) and Perchik (0.5 points). Moderate damages were found in cvs Podarok Sadu (2.5 points), Gibrid Perchika (2.5 points) and Otradnaya (2.5 points). The winter hardiness in 2017 was different for the cultivars.

The following absolutely stable cultivars were identified: Botanicheskaya Aromatnaya (0) and Lomonosovskaya (0). Weak deviations were noticed in cvs Moskovskaya Ananasnaya (1 point), Botanicheskaya (1 point), Perchik (1.5 points), Botanicheskaya Lyubitelskaya (1.5 points), Gibrid Perchika (1.5 points), Vorobyovskaya (0.5 points) and Otradnaya (1.5 points). Moderate damages were found in the Podarok Sadu cultivar (2.5 points). In 2018, cvs Botanicheskaya Aromatnaya, Botanicheskaya and Lomonosovskaya distinguished themselves by their absolute winter hardiness (0). Cultivars Podarok Sadu (1.5 points), Moskovskaya Ananasnaya (1 point), Perchik (0.5 points), Botanicheskaya Lyubitelskaya (0.5 points), Vorobyevskaya (0.5 points) and Otradnaya (1 point) had minor damages. When assessing drought resistance, it was found that the cultivar Podarok Sadu (3.5 points) had an average drought tolerance. Cultivars Moskovskaya Ananasnaya (4.5 points), Botanicheskaya Aromatnaya (5 points), Botanicheskaya (5 points), Perchik (4.5 points), Botanicheskaya Lyubitelskaya (4.5 points), Gibrid Perchika (4.5 points), Vorobyovskaya (4.5 points), Otradnaya (4 points) and Lomonosovskaya (5 points) had high drought tolerance values (Table 2).

Due to its rich biochemical composition of fruits, high productivity, early ripening, winter hardiness, and ecological plasticity, sea-buckthorn is one of the leading industrial crops at present, especially in the gardens of Siberia. Sea-buckthorn fruits are widely used in food and pharmacological industries, cosmetology, forestry, and land reclamation. The main reason that hinders the broader introduction of this crop into industrial horticulture is the use of cvs with low ecological plasticity, particularly those affected by diseases, in particular, by mycotic drying out, which leads to a significant thinning of sea-buckthorn

plantations and a decrease in yield. It is necessary to breed varieties well-adapted to local climatic conditions, resistant to abiotic and biotic environmental factors, with high yields, well marketable and consumer qualities of fruits. Our yield analysis showed that the yield of sea-buckthorn cultivars in the Moscow region, on the average, over five years was 85±21 c/ha with a year-to-year variation of 88%. Cultivars Botanicheskaya (109.48±30.06), Moskovskaya Ananasnaya (121.24±28.46) and Botanicheskaya Aromatnaya (151.74±34.58) were identified with the highest yield in c/ha.; The smallest yield had cultivars Otradnaya (32.98±6.24 c / ha), Podarok Sadu (52.48±14.72 c/ha) and Gibrid Perchika (64.24±17.50 c/ha). The cvs with the largest berries have the highest yield. It was revealed that the mass of sea-buckthorn cvs in different years has a weak (0-17%) and medium (22-27%) variation. Small fruits were typical of the Lomonosovskaya (0.51±0.0 g) and Vorobyovskaya (0.58±0.1 g) cvs. The largest ones are the fruits of cvs Gibrid Perchika (0.81±0.2 g), Botanicheskaya (0.78±0.1 g), and Otradnaya (0.76±0.2 g). In the plasticity of cvs, winter hardiness, which the yield depends on, is of special importance. The most winter-hardy cvs were Moskovskaya Ananasnaya, Botanicheskaya Aromatnaya, Botanicheskaya, Perchik, Botanicheskaya Lyubitelskaya and Lomonosovskaya. Abiotic environmental factors are of no small importance, and even more so when, in recent years, cases of dry summer seasons have become more frequent, which affects a set of factors, including productivity. According to the drought tolerance, it was found that the Podarok Sadu cv. had an average drought tolerance. Cultivars Moscovskaya Ananasnaya, Botanicheskaya Aromatnaya, Botanicheskaya, Perchik, «Botanicheskaya Lyubitelskaya, Gibrid Perchika, Vorobyovskaya, Otradnaya and Lomonosovskaya had high drought resistance (4.5-5 points). In this regard, the introduction of new promising varieties into the sea- buckthorn assortment, most adapted to changing environmental conditions and resistant to biotic environmental factors, is an urgent problem in current conditions. The variety study of sea-buckthorn should be based on a comprehensive economic and biological assessment to identify adaptive to biotic and abiotic factors and high-yielding sea-buckthorn cvs in current conditions for industrial cultivation.

## 4 Conclusion

According to the phenophases of berry ripening, leaf fall, duration of fruiting and vegetation, the cultivars have a slight variation in their calendar phenophase onset dates. The cultivars, according to their calendar phenophase onset time of the beginning of bud break, are divided into 3 groups: early (18-22 days – Botanicheskaya Aromatnaya, Botanicheskaya and Perchik, medium (23-26 – Lyubitelskaya, Gibrid Perchika and Lomonosov) and late (27-30 – Podarok Sadu and Vorobyovskaya). Three groups of cultivars were identified by their vegetation duration: short (171-174 days – Podarok Sadu, Moskovskaya Ananasnaya and Botanicheskaya), medium (175-178 – Botanicheskaya Lyubitelskaya, Gibrid Perchika, Vorobyovskaya, Otradnaya and Lomonosovskaya) and long (179-182 – Botanicheskaya Aromatnaya).

The sea-buckthorn cultivars yield analysis showed that the average yield was 85±21 c/ha with the variation of 88% over the years. The cultivars with the highest yield in c/ha were identified as Botanicheskaya (109.48±30.06), Moskovskaya Ananasnaya (121.24±28.46) and Botanicheskaya Aromatnaya (151.74±34.58). The lowest yield was noticed in cvs Otradnaya (32.98±6.24 c/ha), Podarok Sadu (52.48±14.72) and Gibrid Perchika (64.24±17.50).

It was found that the cultivars berry mass in different years has a weak (0-17%) and average (22-27%) variation. Cultivars Lomonosovskaya (0.51±0.0 g) and Vorobyovskaya (0.58±0.1 g) had small fruits. With the largest fruits, cultivars Gibrid Perchika (0.81±0.2 g), Botanicheskaya (0.78±0.1 g) and Otradnaya (0.76±0.2 g) were pointed out.

The following winter-hardy cultivars were identified: Moskovskaya Ananasnaya, Botanicheskaya Aromatnaya, Botanicheskaya, Perchik, Botanicheskaya Lyubitelskaya and Lomonosov (0.5 points) were identified; medium-hardy cultivars Podarok Sadu (2.5 points), Gibrid Perchika (1.5) and Otradnaya (1.5) were also identified.

In terms of drought tolerance, it was found that the cultivar Podarok Sadu (3.5 points) had an average drought tolerance value. Cultivars Moskovskaya Ananasnaya, Botanicheskaya Aromatnaya, Botanicheskaya, Perchik, Botanicheskaya Lyubitelskaya, Gibrid Perchika, Vorobyevskaya, Otradnaya and Lomonosovskaya had high drought tolerance values (4.5-5 points).

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