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Research on the Introduction of Seabuckthorn Varieties in North Russia

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ABSTRACT

This paper first deals with the results of seabuckthorn (*Hippophae rhamnoides* L.) introduction in the European North of Russia, then the research results of the development of seabuckthorn varieties. A conclusion was drawn about its sufficient adaptation in the North and its regular fruiting. At the same time, it was found out that seabuckthorn cultivars, developed in other regions of the country, are not adapted under the Arkhangelsk conditions. Successive seabuckthorn introduction to the North is impossible without selective improvement, directed to the development of forms with high winter hardiness in the new region of introduction.

Key words: Seabuckthorn (*Hippophae rhamnoides* L.), introduction, selection, winter hardiness, frost resistance, breeding, cultivars, fruits, hybrid and fruits quality.

INTRODUCTION

Seabuckthorn (*Hippophae rhamnoides* L.) is a highly valuable berry shrub, fruits of which contain the complex of different vitamins and other biologically active substances. Collective horticulture began to develop intensively in the North. For the development of northern collective horticulture, a great need was felt to widen the variety of available fruit/berry cultivars, suitable for growing in the region. Seabuckthorn introduction in the middle zone of the European part of the country is successful, but it was found out, that after few years, seabuckthorn plants in new growing regions were subjected to high mortality. The main reason of seabuckthorn mortality in introduction is damping-out the root systems in soft winters with heavy snow (Jelisejev, 1976). Therefore, successful introduction of seabuckthorn is not possible without breeding improvement directed to the development of forms with high winter resistance, especially resistant against root system damping-out (Jelisejev, 1980).

Seabuckthorn introduction in the north Russia started in 1969 in the Dendrological Garden of Northern Research Institute of Forestry. The results of the initial introduction test allowed to rely on success of seabuckthorn introduction to the European North (Nilov, 1986), It fruited regularly and abundantly under the conditions of Arkhangelsk and led to development of forms with fruits of normal size and quality. Plants of existing varieties, developed in the climatic conditions of other areas of the country, suffer in the north from being frosted over that reduced the yield considerably. Because of the unfavorable combination of natural conditions (wet autumn, high snow cover and winter thaws) mortality due to root system damping-out is high. Successive seabuckthorn introduction to the north is possible only under its selective improvement. The aim of these investigations was to reveal the adaptation possibility of seabuckthorn to the northern conditions and conduct selection of most worthwhile plants with the help of improvement methods and selecting of forms with high berry quality.

RESULTS AND DISCUSSION

Results of seabuckthorn introduction in Arkhangelsk

Arkhangelsk region is located in the north Russia. The Garden is situated in the northern taiga zone, near Arkhangelsk (64° 33' north, 39° 40' east). The climate is maritime, subarctic and average annual temperature of the air is +0.8°C. The average temperature of January is 12.5°C and of July is 15.6° N. An absolute annual minimum temperature of the air is 49°. The average quantity of precipitation on a long-term data is 675 mm in a year, including 203 mm of summer months. The average duration of the vegetation period is about 136 days. Effective temperature (positive difference between the mean temperature of the growing season and 5°C multiply on the length of the growing season) is 920°C. Stable snow cover is formed in November and reaches the maximum value in March. The climate is characterized by frequent changes in the air. The arctic cold air invades every summer months and brings frosts during the vegetation period. There is no summer month when such frosts don’t occur. In winter, frequent thaws are observed. Soils in the garden are podzolized loam and sand loam, a shallow depth weakly water-permeable. Soils are characterized by acidic reaction, low content of nitrogen, mobile phosphorus and potassium contents and base-deficient.

We have got a big collection of this species with great diversity of ecological, qualitative and quantitative properties, during 30-years of seabuckthorn introduction period in the European north of Russia. Resulting from the introduction of 54 seabuckthorn samples from different parts of its natural distribution, almost 50 thousands plants were involved for the trials. It included plants from Altai, Fenno-Scandinavia, Tuva, Buriatija, Pamir-Tien Shan, Caucasian, Kaliningrad, West-European parts of the natural areas, as well as the cultural samples from different introduction centers. The initial introduction of seabuckthorn test in the Arkhangelsk conditions was the first stage of selection work for creating northern cultivars. Thus, the main criterion of the perspective plants selection was high winter hardiness. Later, we used fruits quality as the second selection criterion.

In Table 1, the mortality dynamics in samples of different origin is presented. Basically, the plants mortality occurs in the first 2 years of their growth. Then, intensive selection of the most resistant plants was conducted, and weak plants, damaged by frost and dumped out plants were rejected as defective. There in after, the plant's quantity in samples depends on the winter conditions, when mortality of introduced plants occurs annually. Altai seabuckthorn was one of the most numerous in the introduction test. Its initial quantity made up almost 35,000 seedlings. From Biisk sample, we have selected a number of the perspective forms. We have received the progeny of 1 and 2 generations from them, both from free pollination and directed crossings. Tuva seabuckthorn seedlings (as more warm loving) have shown, that all of them are subject to high mortality due to the frosts. The similar results were received in the seabuckthorn test from mountain regions of Tajikistan and Caucuses. Mortality after first wintering was 100%. The majority of 465 Pamir-Tien Shan seedlings were dead from root systems damping-out in the first years.

Table 1. Mortality dynamics in seabuckthorn samples of different origin (number of alive plants)

Year	***Khakassia***	***Karaganda***	***Przhevalsk***	***Khorog***	***Tuva***
1979			21		
1980	700	67	6	73	600
1981	471	42	4	36	252
1982	320	31	3	10	118
1983	65	22	3	2	32
1984	59	21	2	2	25
1985	43	16	2	2	23
1986	41	13	2	1	19
1987	37	12	2	1	15
1989	30	12	2	1	8
1990	3	-	2	-	-
1991	3	-	2	-	-
1992	2	-	2	-	-
1993	1	-	-	-	-
1994	1	-	-	-	-
1995	1	-	-	-	-
1996	1	-	-	-	-
1997	-	-	-	-	-

Baltic (Kaliningrad) seabuckthorn gene bank, which was formed in marine climate conditions, was involved in the test on account of its high resistance to root systems damping-out. This assumption has appeared quit justified, since no plant died because of damping-out. However, being more cold sensitive in comparison with Altai seabuckthorn, Kaliningrad seabuckthorn more often suffered from winter frosts, and in some plants 100% freezing of plants was noted already in the first wintering. Nevertheless, individual plants have reached the age of their generative maturity and were used in the hybridization. The large number of seedlings from west central European part of its natural range, has appeared in the collection in the last years. Seedlings from France, Switzerland, Poland, Czech Republic, Ukraine died after the first wintering. Chinese seabuckthorn appeared in the collection in 1994. Its seeds differ by low germination ability. It was only 10%, therefore it was submitted in small quantity of seedlings. As a result of the first winter there was complete seedlings mortality.

Fenno-Scandinavian seabuckthorn appeared to be fully resistant under Arkhangelsk conditions. Norwegian and Finnish seedlings, in young age, already are characterized by the earliest growth termination, which is not peculiar for the seedlings of other populations. They differ by high winter hardiness and frost tolerance. In long-term test (since 1982), strong freezing and root systems damping-out are not marked. Though, we didn't select any perspective forms in Fenno- Scandinavian group, because of its high thorniness and small berry size, yet it was widely used for breeding with selected plants from other populations.

Among cultural samples, received from other introduction centers, special qualities have not been marked. We have tested 8 Altai cultivars, 5 cultivars and forms from Nijhni Novgorod, later cultivars from Moscow University and new Barnaul cultivars. The introduction test of well known Altai cultivars, conducted in Garden's conditions has shown, that all of them to some extent suffered from damping-out the root systems and frost and as a result, were subjected to high mortality (Table 2). Basically, plants' mortality occurs in the first years of their life and after the first mass fruitage. We have made the conclusion about the impossibility of successive seabuckthorn introduction to the north, without its breeding improvement, directed to the development of local cultivars with high winter hardiness and frost resistance.

The main reason of seabuckthorn's lack of adaptation is that the European North is located within the limits of two climatic zones, sub-arctic and moderate in the Atlantic-European climatic area. It experience, especially during winter time, strong influence of the Atlantic Ocean. Thaws are a consequence of this influence, which occur each winter almost in all territories of the region. Such winter thaws, as well as high snow cover are the reasons for strong seabuckthorn damping-off, especially for plants, introduced from continental Siberian part of its range. Thaws reduce frost tolerance of all tissues, result in reduction in buds frost resistance, especially in the male plants. During winter dormancy, from January to March, critical temperature for male plants is -30 to -35°C, and for female about -45°. Tissues and buds, which have lost some resistance, can be damaged and have mortality after thaws, even if strong frosts don't occur.

Table 2. Results of seabuckthorn cultivar test

Cultivar	***Planted in 1979***	***Inventory of 1992***		***Mortality (%)***	***Year of mortality***
		Quantity	***Height (cm)***		
Vitaminnaja	29	1	120	96.6	1993
Dar Katuni	24	3	200	87.5	1993
Zolotoi pochatok	25	3	180	88.0	1993
Maslichnaja	28	3	250	89.3	1994
Novost Altaja	19	3	165	84.2	1993
Obilnaja	17	1	140	94.1	1986
Oranzhevaja	11	-	-	100	1985
Chuiskaja	13	-	-	100	1985
Katunskaja-24	10	2	180	80.0	1990
Sajanskaja	9	5	180	44.4	1990
Shcherbinka 1	15	2	225	60.0	1990
Shcherbinka 2	18	1	190	88.9	1990
Shcherbinka 6	18	1	180	88.9	1990

Observations have shown that the most winter hardiness resistant plants are those, which grow in more severe climatic conditions of their the natural habitat. The early phenological stages, approach of Finnish seabuckthorn in the Arkhangelsk conditions, can be explained by similarity of ecological and climatic conditions of the regions of its natural growing and introduction. Finnish seabuckthorn has appeared to be the most flexible in its introduction to other geographical regions, as its adaptation processes are faster, for example, like Altai seabuckthorn.

Polyploidy and chemical mutagenesis for seabuckthorn introduction

It is evident from the literature, that the opportunities for getting the positive results in the introduction work can be considerably increased by the application of methods of genetics with the purpose of changing their hereditary properties, for increasing their resistance in new conditions of introduction. Polyploidy is one of the methods of plant adaptation to the conditions of new ecological niches. Darmer found out seabuckthorn polyploids in 1947. In his work, he pointed out that diploid form (2n = 12) prefers best places for growing, whereas diplokaryotic form (2n = 24) grows on flat opened places with less fertile soil and is subjected to resist the effect of salt marine splashes.

Availability of diplokaryotic form in natural populations makes seabuckthorn a very interesting object for opportunities to study the polyploidy usage in the introduction, both from the theoretical and practical point of views. Seabuckthorn is the example of such case, when the introduction work goes simultaneously with breeding work, directed on creation of local resistant cultivars.

Chemical mutagenesis is widely used in fruits, berry and decorative plants selection. It gives much wider opportunities for successful plant introduction. The adaptation of introduced plants to new climatic condition is related with the accumulation of hundreds of mutations. This process is intensified by chemical mutagenesis effect. Since 1980, a number of cholchiploids have been induced from cholchicin treated seeds and added to our collection. Cholchiploides of the 1st generation were characterized by delayed growth of shoots length and insufficient winter hardiness.

In the cholchiploides of the second generation, macromutations with following expressed phenotypic effect were screened out; plantlets with three epigeal cotyledons, seedlings with reduced "needle-like" leaf, seedlings with chlorophyll mutation. The majority of mutants were characterized by low growth and they died in the very first year of their life. Among hybrid progenies of local perfect forms and cholchiploidies of the 1st generation, some resistant seedlings were selected. They are interesting for selection for different times of fruits ripening.

Among the plants within the experiment with chemical mutagenesis, several resistant forms with the good fruits quality were selected. These plants, as well as cholchiploids, are being used in further breeding work.

Winter hardiness as the main criterion for selection in the north

As it was pointed out earlier, that production of the seabuckthorn cultivars with high ecological stability depends on the problem of development of correlation between growth and plants resistance. In the selection process, a combination of high resistance to reasonably high productivity is a very tough challenge. The valuation of stability (frost tolerance, resistance to the root systems damping off) and selection of best-tested varieties, and plants, through this parameter, raised from the seeds, have been carried out from the beginning of seabuckthorn introduction work for the European North of Russia. Thus, in the first season after winter, the selection of the best plants was conducted on the basis of direct sowings. This method of selection is still used and gives good results in years with extreme weather conditions.

Period of shoot's growth is one of the major factors affecting vegetation. It determines plant's winter success, as shoot growth termination at appropriate time, determine the degree of preparation for a winter. An annual shoot growth in length can be reasonably and effectively used for the forecast of plants frost tolerance. The growth termination is one of the necessary conditions for development of plants for frost tolerance. It was established, that with annual shoots length growth dynamics, due to termination of their intensive growth, there is an inverse correlation between shoot growth and degree of their freezing during winter. Observations have shown that in Arkhangelsk, seabuckthorn shoots of young plants are in a condition of active growth before autumn start getting colds and, as a rule, do not form terminal buds. Annual shoots usually grow up to a moment of return transition of the daily mean temperature of air, through + 5°C. Thus, seabuckthorn shoots growth is stipulated, basically by the thermal factor and does not reflect individual plant's features. However, as it was found out that together with shoots growth termination, the speed of their growth in length differs during season. The most distinctions are evident at time of active growth of the main part of annual shoots' length. It has been found that plants with slow growth, as a rule, differ in low winter hardiness. It shows itself not only in strong winter shoots freezing, but also in great mortality of such plants, because of root system damping-off. Therefore, the comparative analysis of times of annual shoots' length growth of different plants permits to forecast their resistance in winter. It could be applied for the perspective seabuckthorn selection. Results of linear shoots' growth study on model plants, through measuring the increase in linear shoot growth on every 7th day, and subsequent calculation of average times of a certain length achievement are used for this purpose. The comparison of these dates shows distinctions in shoots length growth dynamics and permits to arrive at conclusions about their winter hardiness.

Winter hardiness in plants differs by intensive and short period of growth that testifies sufficient preparation for them to wintering. Wintering of the plants influence the phenological periods. Tissues and buds freezing results in irregularity of their flushing and shoots growth, which in turn influences the flowering abundance and seabuckthorn harvest. As it was told, seabuckthorn differs by short winter dormancy. In early spring, buds start to grow under heat influence. In Arkhangelsk conditions, buds flushing of all plants from different natural populations are observed in the second half of May. Shoot's growth usually begins at the end of May-beginning of June, during these days seabuckthorn is in the flowering.

The study of annual shoots' length growth dynamics on seabuckthorn plants, with various frost resistance, was conducted on plants of Finnish, Altai, Kaliningrad and Przhevalsk origins. The distinctions, between plants of different populations in times of vegetation beginnings and rates of development in a spring period are 3-7 days. Finnish seabuckthorn differs by early bud flushing. Duration of shoot growth, investigated in different seabuckthorn populations is different. Plants of Fenno-Scandinavian population finish their linear shoots growth in the beginning of August, Altai, in the first 10 days of September. Plants of Kaliningrad and Przhevalsk populations grow for a long time, they fall significantly behind Finnish seabuckthorn in the rate of the annual shoot length growth. Obviously, it is the main reason of their strong winter freezing (Table 3). Thus, Fenno-Scandinavian seabuckthorn in Arkhangelsk conditions has very intensive, but not extended period of growth and has time to prepare for winter.

Table 3. Degree of shoots freezing depending on features of their growth

Sample	*Origin*	*Shoots length (%)*	*Degree of freezing (%)*
137-82	Finland	96.5	0.0
115-81	Norway	98.9	0.0
250	Altai	83.8	32-100
3-83	Kaliningrad	84.5	18-62
217-78	Przhevalsk	83.2	74-100

Seabuckthorn seedlings' resistance to the root system damping off

Large part of the breeding seabuckthorn material in the garden, at present, consists of seedlings of Arkhangelsk, reproduced from open pollination and hybridization. Seedlings from open pollination of Finnish seabuckthorn, differ in its high winter hardiness, and are resistant to root systems damping-off. It is found out that the hybrids with Kaliningrad seabuckthorn are also resistant to root systems damping-off.

The plants quantity with root system damping-out in that groups was 0-12.5%. The plants quality with greater quantity of damaged plants from damping-off is found out in Karaganda progenies of free pollinated seedlings (63.7%), as compared to hybrids (22.2-67%). Taking into account above-mentioned observations, it is clear, that hybrids of Finnish seabuckthorn and selected plants have selection value with big berries. As it was pointed out, Finnish seabuckthorn is the most winter hardy under Arkhangelsk conditions. But, because of high thorniness and small berry size, perspective forms in this group were not selected, but it was widely used for the hybridization. First of all, Finnish seabuckthorn was used as the donor of high winter hardiness.

Extreme wintering of 1992-93 has completely confirmed the conclusion, drawn earlier about high winter hardiness of Finnish seabuckthorn in Arkhangelsk conditions. Moreover, it was found that hybrid progeny, received after hybridization, where one of the parents was planted from this population, to some degree inherited property of high winter hardiness. Therefore, if hybrids of 1989 sowing were, as a whole, characterized after wintering 1992-93 with survival rate of 56 %, than hybrids with Finnish seabuckthorn as female, this parameter was 92.5%. It testifies that hybrid progeny inherited the high winter hardiness in the first generation. Survival rate of 3- years old hybrids from crossing of selected plants from Khakassia (by their berry quality) with Finnish seabuckthorn after wintering of 1992-93 varied from 33 up to 100% and as a whole it was 92%. The absolute resistance was shown by seedlings from pollinator No. 137-82-4. This plant could be used for further breeding, as pollinator inherited high winter hardiness to hybrids. This was confirmed by the further investigations during last years. Thus, the long-term test of Fenno-Scandinavian seabuckthorn, and in the last years, its hybrids has shown, that plants from this population and its progeny in Arkhangelsk conditions are of great viability and considerably suppresses Siberian seabuckthorn.

In view of this, we have determined some correctors in further work on updating our selection of seabuckthorn germplasm, using selections of Fenno-Scandinavian origin. Among seedlings, growing in our garden since 1993, the material from Fennoscandia was represented by 97%. The weather conditions of autumn 1990 and winter 1991 (snowfall on soft ground, numerous winter thaws) have appeared extremely unfavorable for seabuckthorn wintering and have caused significant root systems damage to not only seedlings, but also adults plants (Table 4). At the same time, not only Fenno-Scandinavian, but also Kaliningrad seabuckthorn in this wintering did not suffer from roots system damping-off. There were several extreme winters during the 1991-99 and not a single plant of Fenno-Scandinavian origin died. As a result of selection work of 1985-90, 29 perspective forms were selected. They are characterized by high fruit quality. In winter of 1992-93, we lost 6 selected forms, and other 5 forms could not recover from damages received in that winter, after wintering of 1993-94, they too died. As a result of research carried out during 1991-95, we have selected only 7 plants as the most winter hardy plants, 4 seedlings from open pollination of Altai cultivars and three hybrids of Kaliningrad seabuckthorn. As a result of further research during 1996-99, we have selected 3 forms with high winter hardiness and good berry quality, which could be projected, as our new candidates for northern seabuckthorn varieties.

Table 4. Damping off and freezing of seabuckthorn of different geographical origins

Sample	*Origin*	*Number of plants*	*Degree (%)*		*Mortality (%)*
			Damping out	*Freezing*	
250	Altai	14	75.0	45.4	-
217-78	Przhevalsk	14	85.7	95.2	21.1
113-80	Khorog	14			
2-83	Kaliningrad	12	0.0	30.7	-

115-81	Norway	44	0.0	0.0	-
136-82	Finland	13	0.0	0.0	-
137-82	Finland	29	0.0	0.0	-

Seabuckthorn fruitage and fruit quality in Arkhangelsk conditions

Results of long-term study of fruitage features and fruits' qualities in the Dendrological Garden present certain interest for seabuckthorn valuation as horticultural plant for the European Russian North. On the basis of long-term (1974-1999) seabuckthorn phonological observations, average times of main phases of seasonal development, phenological periods duration and their provision for warm weather were determined. It has been considered that for the beginning of seabuckthorn flowering, a sum of daily average temperatures above 5°C, about 23.5°C is needed. According to our data, a sum of accumulated positive temperatures for the beginning of seabuckthorn flowering makes up 250 ± 14.8°C, a sum of daily average temperatures above + 5°C - 206 ± 14.4°C, i.e. a little lesser than in more southern regions of the country. The tendency of reduction of provision of warm weather for other woody plants was marked in the north too.

Seabuckthorn fruit yield first of all depends on the winter hardiness of its female plants. The partial or complete loss of flowering buds as a result of damage by frost, leads to the reduction of fruit yield and even to their complete absence. However, the dependence of a seabuckthorn crop on male plants' damage, in wintering should also be taken into account. Furthermore, dispersion analysis of the results of frost damage plants from different geographical origins and sex has shown, essentially of plants sex influence at 99% level on their winter hardiness. The plants' sex influence on winter hardiness amounts to 17.7%, which reflects even higher influence of the factor of plants geographical origins. Doubtless, strong damage of male plants in wintering can considerably lower seabuckthorn fruitage abundance in subsequent vegetation period. The crop reduction in 1985, 1987 and 1991 was stipulated basically by frost damage in previous winters.

As it was already marked, phonological periods in different years are not equally supplied with warmth, therefore the fruits ripening period lasts from 25 up to 40 days. Finnish seabuckthorn differs for early fruits ripening from Kaliningrad seabuckthorn in the Arkhangelsk conditions, characterized by long ripening period. And in separate years (1990, 1992, 1993, 1994), its fruits did not ripen before steady autumn colds. Seabuckthorn fruits of Arkhangelsk reproduced both from free pollination and hybridization, ripen basically at time close to Altai seabuckthorn. The hybrids with Finnish seabuckthorn have the same times of fruits ripening as that of Finnish population. However, content of biologically active substances in seabuckthorn fruits of Barnaul cultivars, growing in the Arkhangelsk conditions, considerably varies. It is worth mentioning, that, compared to cultivars characteristics, fruits differ by the increased content of vitamin C and higher acidity, but less content of carotene and oil.

It was found, that seabuckthorn fruits in Arkhangelsk are characterized by^the increased content of vitamin C and higher acidity, but less contents of carotene and oil. Since plants in the North do not receive sufficient warmth during generative phases of seasonal development. In this connection, it is offered to lower the requirements of carotene and oil contents in fruits for new seabuckthorn cultivars for the North. Dynamics study of biologically active substances accumulation in seabuckthorn fruits has shown, that during ripening gradual accumulation of carotene, sugar and oil occurs, thus, the content of vitamin C is reduced. The least carotene quantity accumulates in Baltic seabuckthorn (2.03 mg%) and a highest content in Finnish seabuckthorn (8.82 mg%) (Table 5).

The high content of ascorbic acid is found in fruits of Baltic seabuckthorn (285 mg%) in the beginning of ripening period, by the middle of September, the content has decreased 4 times, Altai-3 times, and Finnish-2 times. The content of oil in fruits during ripening is slightly increased up to 2.1-2.3%.

Table 5. Dynamics of the carotene, vitamin C, sugar and oil content in seabuckthorn fruits

Sample	***Origin***	***Date***	***Content in fruits (on fresh weight basis)***			
			Carotene (mg%)	***Vitamin C (mg%)***	***Sugar (%)***	***Oil (%)***
5-83	**Baltic**	5.09	0.91	285	1.39	1.13
		10.09	1.28	174	1.41	1.48
		14.09	1.55	90	2.17	2.08
		20.09	2.03	70	2.94	2.09
		4.10	1.64	68	2.96	2.09

250-10	**Altai**	5.09	3.28	200	3.92	2.04
		10.09	4.23	194	4.05	2.25
		14.09	4.31	150	5.53	2.26
		20.09	4.94	76.5	6.17	2.29
137-82-13	**Finland**	5.09	4.51	173	4.49	1.57
		10.09	6.62	132	5.23	1.92
		14.09	8.82	115	5.28	2.07
		20.09	8.2	99	5.3	2.18
		4.10	6.07	92	6.34	2.18

Some morphological characteristics inheritance in seabuckthorn hybrid generation

The heredity laws in hybrid seabuckthorn progeny have not been investigated in detail. Usually, breeders establish those or other inherent characters and properties available in certain populations or separate seabuckthorn plants and consider these populations or plants as possible donors of these properties. However, it will be interesting enough to use hybridization for creation of new seabuckthorn cultivars and it will be possible only after accumulation of the necessary information about heredity laws in hybrid generation as useful, or harmful signs of parental forms.

The results of experimental researches on seabuckthorn crossings, conducted by us using geographically remote forms since 1984, allow us to make some conclusions for seabuckthorn use in further selection work. It was established, in particular, that the majority seedlings of hybrid progeny inherited habitat signs of female plants. Hybrids raised from combinations of crossings using plants of Finnish seabuckthorn, as one of parents, more or less rate inherited its high winter hardiness. However Finnish plants, besides high winter hardiness are characterized by high thorniness. It is very important to note that the quantity of high winter hardiness plants in hybrid progeny in all cases was more, than quantity of thorny seedlings. So, we had an opportunity to select thornless winter hardy seedlings. Among the male Finnish plants used for crossings, pollinator 137-82-16 was found useful. In all the families, progeny hybrids, having large berry size, were around 50-75%. The hybrids with largest size of berries with weight of 78 g/100 fruits were found in this experiment.

Therefore, it was found that pollinator is established in the seabuckthorn Finnish population, promoting transfer into hybrid female progeny with features of large berry size. It is difficult to underestimate the significance of this fact for further selection work. The high interest is presented by the 2nd generation hybrids from crossings with Finnish seabuckthorn. Part of hybrid families in this experiment, has not enough winter hardiness and that is possible due to recessive heredity in hybrids of the 2nd generations. Seedling mortality after the 1st wintering was 37%, and the shoots freezing degree of surviving plants varied from 5 to 89%. Nevertheless, in both variants of double cross, enough quantity of plants remained, that permits to hope for realization there after of hybrid valuations on berry size. This will fill up the selection fund through hybrids of Finnish seabuckthorn, including the 2nd generations, and will allow us to conduct further work for northern cultivars creation more effectively.

During 1993-99, a large group of seedlings sown in 1989-90, which started fruiting in the last years, was the main object of selection. This group at the beginning of research, consisted of 171 samples and was represented by 10,200 seedlings, among which hybrids (71%) and plants from free pollination dominated. Plants from different origins were about 8%. When these plants reached the age of generative maturity, we have selected 14 forms with large berries. The test of berries quality has shown that 7 hybrids were distinguished by high content of vitamin C (up to 241.8 mg/l00g).

In fruit-berry selection, much attention is given to the questions of cultivars plasticity and stability characteristics. It is important to know, both about cultivar's reaction to changing controllable conditions of growing, and its stability under unfavorable changing uncontrolled factors. Some plants give more stable crops, while other strongly react to changes of environmental conditions. Plasticity and stability of the cultivars are characterized by Eberhart and Russel Model (1966). They suggested two parameters: a regression coefficient on an index of changing environment conditions (place and year of growing) and variance of deviation of actual means of a sign from a regression line. Seabuckthorn fruitage stability is of the main interest to us, as they were selected in our conditions under unfavorable environmental change. The warmth providing factor for the vegetation period is an uncontrollable one, therefore cultivars' characters stability (for example fruits weight) is possible to consider as cultivars quality. Thus, we have selected big berry size form 37-89-321 (hybrid with Finnish male plant), which is characterized by high fruit weight stability.

The fruit quality is the second major parameter after resistance, which is assessed for its true value in the selection, for new seabuckthorn cultivars creation. In connection with wide use of hybridization methods in selection work, it was very important to know how size, weight, color, form, as well as biological active substances content are inherited in seabuckthorn progeny. By a dispersion analysis of weight dependence of hybrid fruits from crossed parent forms, it was found that in all cases, a degree of influence of pollinators on fruits' weight is higher in comparison with mother plants. However, this conclusion has appeared trust worthy only in case, when female plants were Finnish seabuckthorn.

CONCLUSIONS

As a result of seabuckthorn selection, carried out and introduction work under Arkhangelsk conditions, a conclusion was made about its sufficient resistance in the north Russia and its regular fruiting. At the same time, it was found that:

1. Seabuckthorn cultivars, introduced from other regions of the country are not adopted in Arkhangelsk conditions.

2. Successive seabuckthorn introduction to the north is impossible without selective improvement, directed to development forms with high winter hardiness in new region of growing.

3. Seabuckthorn breeding for frost tolerance will promote simultaneously the selection of regular and abundant fruitage plants.

4. We have selected the most worthwhile forms for the northwest of Russia. Their local progenies from open pollination and planed crossings were raised.

5. The most valuable seedlings with high resistance, large berry size, and stable crop were selected as candidates for the garden cultivars for the northwest zone.

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