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Overview of Sea Buckthorn Research in the Russian Federation and New Independent States (NIS)

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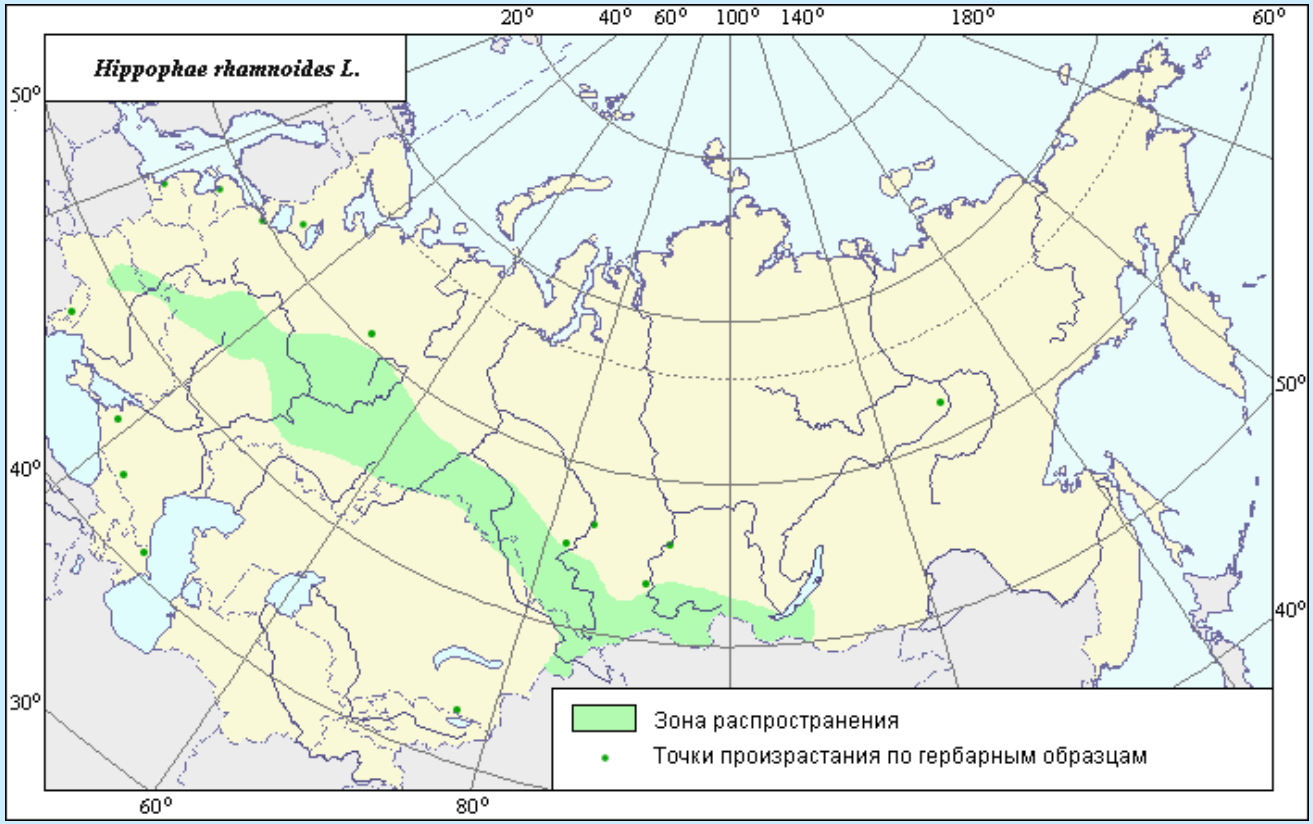
Table of content

- Sea buckthorn range in the Russian Federation and NIS
- New places of
- cultivation
- Genetics and breeding
- Biochemistry
- Utilization

Natural resources of Sea buckthorn in the Russian Federation and NIS

- **Sea Buckthorn grows naturally in Caucasus, Pamir, Middle Asia, number of regions in Western Siberia , Altai region, Tuva, Buryatiya, Danube delta, Kaliningrad Region** (Eliseev 1977, 1982, 1983; Trofimov 1978; Kondrashov 1979; Ermakov 1981; Imamaliev 1980, 1983; Koikov 1980; Korzinnikov 1980, 1981; Kabulova 1986; Golovatyi 1980; Avdeev 1985; Lebeda 1990; Besschetnov 1980, 2003; Chmyr and Besschetnov 1998).

Sea Buckthorn (*Hippophae rhamnoides* L.) natural range on the territory of former USSR



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N. Terekhina (2004)

- Reduction of the Sea buckthorn range in Siberia.
- The Red Book of Irkutsk Region (1999).
- The Red Book of Buryatiya (1988).
- List of Rear and Threatened Plants of Tuva (1989).

New places of cultivation

- Sea buckthorn can be cultivated in almost all land zones of the Russian Federation.
- Sea buckthorn introduction in the middle zone of the European part of the country is successful (Eliseev, 1976).

- Resistance to new conditions of cultivation, first of all winter hardiness, is one of the main problems of sbt introduction to the **territories of temperate climate** (Vasilchenko 1970, 1977; Kondrashov 1980).
- SBT of Fenno-Scandinavian populations had appeared to be the most winter hardy for the conditions of **North of Russia** (Demidova 1989, 2003).

- Study of sbt winter hardiness in laboratory conditions (Igoshina and Lapteva,1987).
- The method of sbt shoots freezing for the selection of mail resistant forms (Yagovtseva and Lobanova,1986) .
- Winter hardiness study of different sbt cultivars in conditions of temperate climate by the use of artificial freezing (Fefelov, Selehov and Smertin, 2003-2006) .

- Development of spontaneous introduced sbt populations were studied by A.Kozhevnikov (2001) in **Ural**.
- The classification of introduced populations was done.
- Sbt variability under development of introduced populations and under secondary introduction was studied (Kozhevnikov, 2001).

- SBT population changeability in number of regions in **Belarus** has been studied.
- Different qualities of geographical races and numerous populations have been shown.
- Their stability and productivity under Belarusian conditions have been measured on the basis of studying the whole ontogenetic cycle (Garanovich 1995, 2003).

- Sbt introduction in Donbass (**Ukraine**) with continental climate and semiarid conditions was started in 1980.
- The lack of precipitations negatively influences on sbt yield and berry mass. The berry mass is on 10-30% less than during the years with enough quantity of precipitations (Mezhinskyi 2003, 2004).

Genetics and breeding

- Development of new cultivars for the plantations is of great importance (Khabarov, Panteleeva 1988***).***
- Sea buckthorn breeding in Altai Region was started in 1930s.
- The Siberian plant breeders are constantly enriching the sbt gene fund (P.Goncharov, 1995; Zubarev, 2005)
- The first sea buckthorn cultivars were created by scientists of the **Lisavenko Research Institute of Horticulture for Siberia (NIISS)** in 1964.

37 varieties of sea-buckthorn have been bred at the NIISS (Usenko et al., 2005).

- yielding of modern sea-buckthorn varieties range from 7,5 to 18,0 t/ha,
- mass of 100 berries – 62-120g (maximum 140 g),
- length of fruit stalk – 3-6 mm,
- content of oil – 4,0-8,0%,
- carotenoids – 15,0-48,0 mg/100 g,
- sugars – 5-10%,
- acidity – 1,0-1,9%.
- most of varieties are thornless (Zubarev Y., 2005).

SBT cultivars of NIISS selection (Luchezarnaya, Avgustina, Samorodok, Chuiskaya) (photo Y. Zubarev)

Breeding program on SBT in Russia

- block of productivity features, such as yielding, mass of berries, convenient habitués (for hand picking);
- biochemical block: high carotene and sugar content, oil, vitamin C;
- complex of technology aspects, mainly different ripening period (ultra early-ripening and extra late-ripening varieties), suitability for machine harvesting; processing;
- pest & disease resistance.

The successes in sbt breeding work in Siberia has been achieved owing to:

- the clearly formulated aim;
- the use of promising parent material;
- the use of effective methods of obtaining the breeding material;
- selection for the main economic-biological properties (Goncharov,1995).

- Siberian breeders proceeded from the fact that all varieties must be adapted to the conditions of zones of their expected popularization, that must be superior to all earlier varieties;
- New cultivars must be more resistant, productive and compare favourably with standard varieties in product quality (Goncharov, 1995).

- Sbt breeding was started in 1952 in the **Botanical Garden of Moscow State University** by T.Trofimov
- Sbt hybridization of geographically distant forms was taken as a principle in the breeding work there (Dolgacheva, Aksenova, 2001);
- 25 sbt cultivars were created, which successfully grow in different parts of European Russia, Baltic countries, Byelorussia, Ukraine, Armenia and Georgia.

- 23 high-yielding technological cultivars were created in **Nizhniy Novgorod State Agricultural Academy** by the use of distant ecological-geographic crossings and induced mutagenesis (Fefelov 2005).
- Influence of outside conditions on pollen formation, as well differences between mail forms on their possibility to develop pollen of high quality was found out (Kuznetsova et al., 2003).

- V.Kondrashov (1996) has selected the number of sbt cultivars suitable for cultivation on hard soils, even with oxygen deficit. He has selected group of cultivars which grow on such soils and give good crops (4 t/ha and more).
- **Caucasian sbt** geographical race has appeared to be the most **wilt resistant**, because of its genetical features - vigorous root system and long period of vegetation (Kondrashov (1996).

- Sbt grows in severe conditions of the Southern Urals near 30 years. Seven local cultivars were created including one male cultivar “Ural” (Il’ina and Il’in 2003).
- The cultivars could be recommended for wide use in fresh conditions and for further processing.

- Genetics research of sbt is going on in the **Institute of Cytology and Genetics** (Novosibirsk).
- Skuridin and Baginskaya (2003) have made a review on studies of sbt phenotype correlation (morphological correlation, biochemical correlation and combined correlation).
- The main stages of “male” fruits development are illustrated by Skuridin and Lobova (2001).

Polyploidy and chemical mutagenesis

- N.A. Borodina from **The Main Botanical Garden** (Moscow) has proved that it is possible to receive high adaptive to new growing conditions sbt plants by the use of polyploidy (1976, 1982, 1986).
- Studies on experimental mutagenesis in sbt have started at the **Institute of Cytology and Genetics** in 1959 (Privalov, et al. 2003; Privalov and Shchapov (1980).

- The sea buckthorn selection is going on in Azerbaijan in the Genetics and Selection Research Institute (Baku) and Institute of Genetic Resources of Azerbaijan Academy of Sciences: cultivars “Zarya-Dabat”, “Zafarani”, “Shafa” and “Tozlayan” which are suitable for the local conditions and could be suitable for Turkey, Bulgaria, Spain, Portugal and southern part of China (Imamaliev 1983. 1991).

- Unique natural sbt population growing in **Ukraine** have been studied by A.Lebeda from **Central Botanical Garden** (2001).
- The sbt breeding is provided in the **Don Branch of the Horticultural Institute Ukraine Academy of Sciences**.
- The cultivar “Solodka Zhinka” (Mezhenskyi, 1999, 2004):

  15,8-21,9 % of dry matters,

  6,4-6,8 %, of sugar,

  1,5-1,8 % of organic acids,

  31,7-35,2 mg/100 g of ascorbic acid,

  128,3 mg/100 g of carotenoids.

- **Central Botanical Garden of Belarusian Academy of Sciences** provides sbt breeding work (Garanovich 1995).
- Number of hybrids with big fruits (60-70g), with high content of ascorbic acid, carotenoids (18 mg/100g), low acidity are obtained.
- A wide diversity of variability is obtained using chemical mutagens.

Biochemistry: oil content

- The highest index of oiliness **(12,5 – 18,0 %)** - in **West Pamir and Pamir – Altai sbt**. **26 – 34 % in calculation to dry weight** (Glazunova, Gachechiladze, et al., 1991; Korovina et al., 1993; Eliseev, 1976) **up to 28 – 43 % to dry weight** Avdeev, Kreknina (1987).

- 10 – 12% oiliness of dry substances to 21 – 37% - in **Zakavkazye**, in river valleys of Choroh (**Adjaria**), Bzyb' (**Abkhazia**), at the basin of river Sevan (**Armenia**) (Fefelov, Korovina et al.,1993).

Carotenoids content

- The most profound research of carotenoid complex content in sbt fruits was carried out by Kudritskaya (1990, 1991).
- The **lowest carotene content** (0,1 – 1,7 mg%) - in **North Azerbaijan, Chechnya, Ingushetia, Kabardine- Balkaria, Armenia, Adjaria** (Eliseev et al., 1976; Korzinnikov et al., 1983; Muraviova and Lagazidze, 1985, Fefelov, 1987).

Carotenoid content is the highest in red fruit and the lowest in yellow fruit.

- maximum carotenoids content in red-fruit of sbt half-sibs is twofold that in their yellow counterparts, being 28,3-30,3 mg% and 14,0-14,4 mg% respectively (Privalov et al., 2003).
- Orange fruit is intermediate between red and yellow (19,1-20,0 mg%).

Ascorbic acid content (vitamin C)

- **The lowest ascorbic acid content**: **Kabardino-Balkaria, Checheno-Ingushetia, Armenia, Adzharia, Abhazia, Northern Azerbaijan** differ by 6-40 mg%; in some forms to 50-100 mg% (Shapiro, 1980; Fefelov, 1987; Eliseev and Fefelov, 1980; Imamaliev, 1991).
- **The highest ascorbic acid content**: **Kirgiziya** (Malena 1982; Maisuradze and Malena 1988); **Western Pamir** – till 807 mg% (Ikramova et al. 1977); in **Buryatiya** – 350-525 mg% (Sokratova 1991; Kalinina & Panteleeva 1978): in **Altai** (bank of the Chuya river) – 313-453 mg% (Malinovskyi et al. 1971).

- Ascorbic acid content in sbt **NIISS cultivars** is presented in Panteleeva (1993), Shishkina et al. (1985), Eliseev et al. (1985) Kruchkov et al. (1986) papers and others.
- Variety “Vitaminnaya” is characterized with high content of vitamin C: in average 120 mg% (max – 175 mg%).

- The high content of vitamin C (75-185 mg%) in Altai cultivars was observed in the Russian North (Demidova et al., 1989).
- The high content of vitamin C characterizes “Omskaya-27” (196 mg%), crated by Kondrashov (1986);
- “Azhula”, “Ayanga”, “Stepnaya”, “Baikalskyi Rubin” (180-200 mg%) and “Soyana” (till 233 mg%) of Buryat Fruit-Berry Station (Zakharova & Bairanova 1993).
- Content of vitamin C in leaves is in 2,6 times higher than in fruits (Karanyan, 2006)

Individual variability range for **sugar content** in wild sbt fruit during the period of their biological ripeness varies from one distribution area to another, being from 0.6-1.2% in **Azerbaijan** (Imamaliev 1985) to 9.5% in the **Altai** territories (Kalinina, Panteleeva 1978) and up to 12,4% in the **Irkutsk Region** (Eliseev, Mishulina 1970).

Flavonoids composition in sbt shows significant variability.

- **Flavonoids** in sbt are presented by **catechins, leucoantotsians, flavonols**, in less degree, by **flavones**; antotsians are practically absent. **Chlorogen** and its isomers, **coffee, quinic and gallic phenol-acids** were found in the sbt fruits (Solonenko and Shishkina 1989, Shapiro 1980, 1989).

- Gachchiladze (1984) has discovered **flavonoids** content in sbt fruits of **Western Pamir** as 118-854 mg%/.
- The common content of **poly-phenols** in the sbt fruits of **NIISS (Barnaul)** selection is 107-269 mg% (Shishkina et al., 1985);
- in sbt fruits of **Buryatian selection** – 117-400 mg% (Markova 1998).

Sea buckthorn utilization

- Biisk Vitamin Enterprise in 1953 (Koshelev, Ageeva, 2004).
- “Altaivitaminy” is the main sbt processor of medical, food and cosmetics products in the RF (Koshelev, Ageeva, 2006).
- Sbt is being widely used in the Russian traditional medicine (fruit juice, seed oil, plant extract etc.) (El’denant 1998).

- Antiviral drug “Hiporamin” and its production methodology have been developed (Shipulina et. Al. 1996, 1997,1999).
- Establishment of the specific chemotherapeutic action of “Hiporamin” on various experimental models of virus infection has been done (Tolkachev and Shipulina 2003).

- Chemical – technological research of SBT use in food industry for making preserves with heightened amount of biologically active substances (Filimonova, 2001; Zubarev,1998, 2000).
- Study of sbt fruits suitability for processing of juices, syrup and jam was started in the Ural State Agricultural Academy in 2002 (Evtushenk and Kirsanov, 2003).
- Nearly 150 recipes of SB fruits usage in home cookery were presented by Eidel'nant (1998) and 400 recipes in Shishkina's book (2000).

Thank you for your attention!