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INTRODUCTION AND SELECTION OF *HIPPOPHAE* L. IN BELARUS

Introdukcja i selekcja rokitnika (*Hippophae* L.) na Białorusi

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Unique biochemical compositions of *Hippophae* berries, and first of all, big content of oil, and the possibility of using it as decorative and phytomeliorative plant explains topicality of studing its ecologobiological and physio-biochemical pecularities while introducing *Hippophae* in Belarus. Introducing the culture beyond its natural areas with the aim of getting a good crop of berries and production oil explains the hight interest to the culture.

Hippophae rhamnoides is examined as a polymorphic species. Two other kinds, described in "Flora of the USSR" are not encountered in our country.

By polymorphism we understand broad variety of morphological, physiological, biochemical and other characters and varied manifestation. A group of individuals which differs from others distinctly at least in one character, is a form. Variety form of *Hippophae* of different geographical origin, being isolated part of an area, represents a geographical race.

Hippophae is widely spread on the territory of the former Soviet Union: in the Caucasus, middle Asia, in a number of regions in Western Siberia, in Altai region, Tuva, Buryatiya, in Dunai delta, in Kaliningrad region. Typical for *Hippophae* is narrow ecology of growing in open species on sandy and pebbly river banks and sea shores. *Hippophae* grows mostly with mirica, willow or birch-tree, seldomly in thicket.

Hippophae rhamnoides in Belarus considered to be introducent plant. We looked at introduction as at the process of introducing and migration into the region where it didn't grow in local flora. It is a complicated process an it depends upon a number of factors. In our view, the most important of them is similarity of climates and a degree of plasticity.

Contemporary intermittent area, availability of fossil pollen in many internal regions of Europe testities to the fact that not long ago *Hippophae* grew inside of the internal regions of Europe. All these facts prove in favour of introducing *Hippophae* in Belarus. A huge polymorphism of the plant contrubutes to that process.

History of introducing of *Hippophae* dates back to 1930 and is connected with Central Botanic Gardens' Activity. Our institution is a scientific methodological center on *Hippophae* in Belarus. Species of different botanic gardens of the world are presented here. Intensive investigation work began with trial of the cultivars as: 'Vitaminnaya', 'Dar Katyni', 'Golden Cob', 'Maslichnaya', 'Novost Altaya' of the Institute of gardening in Siberia (c.Barnaul). The cultivars differ greatly and all of them are perspectivic.

The second trend is studying of the natural populations. There have been studied variety of forms of wildly growing *Hippophae* in Kaliningrad region, Dunai delta, Kabardino-Balcaria, Northen Azerbaijan, Mountaneous Altai. In a number of regions *Hippophae* has been studied for the first time. Received data testity to a huge polymorphism of a plant. In each region there were selected the most percious forms which were introduced to Belarus.

It was established that the forms from Kaliningrad region are the most promising for selection bacause having largest fruits and with a high content of vitamins. They take the second place by the quantity of oil after Dunaisky form. Thorns on shoots are encountered, but thorns are longer. Pedicles are not big, quantity in a bundle is average.

Dunai species (19) are the most oily and they take the second place by the size of berries and vitamin C content after Kaliningrad form. *Hippophae* of this region has many thorns and the most stunted.

Kabardinobalkarskaya forms are characterized by their large berries, high crop, but they are poorer in oil and vitamin C contents. There have been found forms without thorns and with long pedicles.

North Azerbaijan forms are characterized by closely situated berries, long pedicles, and high quantity of ß-caroten.

Hippophae of Mountaneous Altai has large berries and long pedicles. It has high crops with little thorns. Fruits are characterized by the lowest acidity (X = 1,5%) and a high content of ß-caroten. They are the most juicy. The content of oil is the lowest.

The most valuable forms are used fot selection.

Our aim at the first stage was to study ecological, physiological and biochemical pecularities of plant development in the conditions of our country, the problem of reproduction and studies of form varieties of *Hippophae* in natural conditions. Above mentioned investigations are necessary for successful introduction of *Hippophae*, creation of industrial plantations, introduction of the whole complex of agrotechnical measures for cultivation of the culture in the country. The main task was to work out valid recommendations for introducing *Hippophae* as a cultivated plant in Belarus.

There have been studied frost-resistance of *Hippophae* of different origin and depth of buds rest. Shoots and roots were studied in different weather conditions and by method of artificial freezing. It was stated that in our weather conditions *Hippophae* is considered to be frost - and winter- resistant plant. Peculations individual development of the plant show great adaptability of species. It is also explained by specific character of the climate. Climatic factors correspond to pecularities of individual development (average year to 5,4 °C, total precipitation 640 mm).

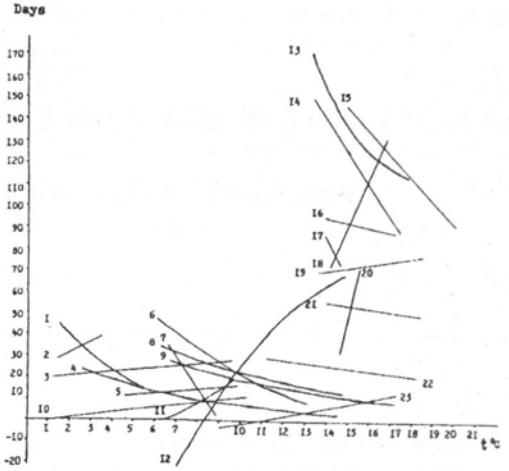

Fig. 1. Phenological development of *Hippophae rhamoides* L. in different vegetation periods in Central Botanic Garden of Belarus:

Periods: 1. Transition of average daily to from 0°C till bud swelling; **2.** Transition of average daily to from 0oC till flower bud swelling; **3.** From flower bud swelling till complection of flowering; **4.** From flower bud swelling till opening; **5.** From opening till the shoots growth; **6.** From bud swelling till leaf growth; **7.** From flower bud swelling till the beginning of flowering; **8.** From bud swelling till abundant flowering; **9.** From bud opening till abundant flowering; **10.** From flower bud swelling till the beginning of opening buds; **11.** From flower bud swelling till their opening; **12.**From leaf colouring till leaf falling; **13.** From appearance of the first leaves talling; **14.** From appearance of the first leaves till their colouring; **15.** From abundant flowering till fruit ripening (wild); **16.** From abundant flowering till fruit ripening (kinds); **17.** From abundant flowering till the beginning of fruit ripening (kinds); **18.** From the beginning of shoot growth till the complation of growth; **19.** From fruiting till reaching the normal size but being not ripen; **20.** From partial shoot woodening till their full woodening; **21.** From the beginning of shoot growth till their partial woodening; **22.** From abundant flowering till fruiting; **23.** From leaf opening till completion of leaf growth.

Ryc. 1. Rozwój fenologiczny rokitnika (*Hippophae rhamoides* L.) w różnych okresach wegetacji w Centralnym Ogrodzie Botanicznym na Białorusi:

Okresy:1. Zmiany średniej dobowej temperatury od O°C do nabrzmienia pąków; **2.** Zmiany średniej dobowej temperatury od O°C do nabrzmienia pąków kwiatowych; **3.** Od nabrzmienia pąków kwiatowych do zakończenia kwitnienia; **4.** Od nabrzmienia pąków kwiatowych do ich otwarcia;**5.** Od odwarcia do wzrostu kiełków; **6.** Od nabrzmienia pąków do wzrostu liści; **7.** Od nabrzmienia pąków kwiatowych do początku kwitnienia; **8.** Od nabrzmienia pąków do obfitego kwitnienia; **9.** Od otwierania pąków do obfitego kwitnienia; **10.** Od nabrzmiewania pąków kwiatowych do początku otwierania się pąków; **11.** Od nabrzmiewania pąków kwiatowych do ich otwierania; **12.** Od zabarwiania się liści do ich opadania; **13.** Od pokazania się pierwszych rosnących liści; **14.** Od pokazania się pierwszych liści do ich zabarwiania się; **15.** Od obfitego kwitnienia do dojrzewania owoców (dzikie); **16.** od obfitego kwitnienia do dojrzewania owoców (odmiany); **17.** Od obfitego kwitnienia do początku dojrzewania owoców; **18.** Od początku wzrostu kiełków do zakończenia wzrostu; **19.** Od owocowania do osiągnięcia normalnego rozmiaru ale nie dojrzłości; **20.** Od początku drewnienia pędów do ich pełnego zdrewnienia; **21.** Od początku wzrostu pędów do ich częściowego zdrewnienia; **22.** Od pełnego kwitnienia do owocowania; **23.** Od otwierania liści do zakończenia wzrostu liści.

Flowering takes place in the first decade of May simultaneously with bud opening and appearance of leaves. Fruits get ripened in the first half of August.

There have been counted the sums of temperatures above 0^{o}, 5^{o} and 10^{o}C for coming of all phenoperiods (eg, the sum above 0^{o} for bud openinig equals 170^{o}C, for flowering 250^{o}C, for fruit repening 1716^{o}, etc.). For the first time there were established durations of interphaze periods and their average day temperature which helped us to make phenological curves (Fig. 1). On their basis one can forecast dates of phenophases and take them into consideration while planning works on plantations and plant nursery.

Studies of shoot is very important for graft stocking up. As a rule in Belarus it takes place at the end of June, begining of July. Precisely at this period intensive plant growth comes to the end. The most intensive shoot growth takes place till the second decade of May. In some cultivars period of intensive growth is longer - till the middle of June. Differentation direction of embryonic knoll into generative, vegetative and mixed bud is determined both by endogenous factor and by weather-climatic factors. Warm weather with small precipitation in the second half of summer is favourable for forming of generative buds. The most important period in the annual cycle for the crop is spring. Pollen activity, process of fertilization and fruiting depend on conditions of generative buds ripening. Differentation of the most important parts of generative buds - pistil take place in spring, that is winter period of plant which is weakly differentiated. Perhaps this is one of the reasons of high crop of *Hippophae* (Fig. 2).

It was established that size of fruit, their mass and other morphological pecularities depend on the both endogenous factors and on climatic conditions. Humid and moderately cold weather contribute to increase of these indicators in comparison with dry and warm weather. Shoot growth is more intensive. Leaf size is bigger. But warm and dry weather contributes to increasing number of berries in a bundle, oil content, and acidity of berries increase, but content of ascorbic acid decreases. When season is humid and moderately cold more carotene and vitamin C are

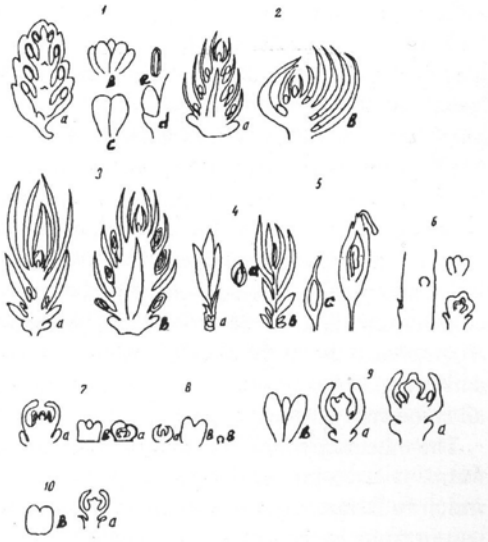

Fig. 2. Morphogenesis of generative buds of *Hippophae rhamnoides* L.:

1 - longitudinal cut of male bud 9.111 (a), exterior sight of bud (b,c,d,) anther (e); 2 - longitudinal cut of a male bud (a), a female bud (b), during swelling 23.111; 3 - longitudinal cut of a male bud before flowering 25.IV; 4. vegetative shoot from a male (a) and female (b) buds, fruiting (c) 13.V; 5 - fruiting 17.V; 6 - rudimentary male bud (exterior sight and longitudintal cut) 17.V; 7. a male bud 1.VI (a - longitudintal cut, b - exterior sight); 8. a female bud 1.VI (a - longitudintal cut, b - exterior sight); 9 - a male bud *.VII; 10 - a female bud 17.VIII.

Ryc.2. Morfogeneza wytwarzania pąków u rokitnika (*Hippophae rhamnoides* L.):

1- przkrój podłużny pąka męskiego 9.111 (a), zewnętrzna strona pąka (b,c,d), pylnik (e); 2 - przekrój podłużny pąka męskiego (a), pąka żeńskiego (b), podczas nabrzmiewania 23.111; 3 - przekrój podłużny pąka męskiego przed kwitnieniem 25.IV; 4 - pąk wegetatywny pędu męskiego (a) i żeńskiego (b), owocowanie (c) 13.V; 5 - owocowanie 17.05.; 6 - pąk męski 1.VI (a - przekrój podłużny, b - strona zewnętrzna); 9 - pąk męski VII; 10 - pąk żeński 17.VIII.

accumulated in comparison with cold and very humid season.

At the moment of ripening 30%-50% of fruiting is preserved in comparison with number of flowers.

Single winter top-dressing with mineral fertilizers, $N_{100}P_{200}K_{100}$ contributes to fruit growth size and its quality by the moment of ripening. It has favourable influence on growth increase. In number of cultivars the oil content and vitamin C, increases but acidity decreases.

Soil and weather conditions in Belarus are favourable for all phases of development of generative buds of *Hippophae*. The plant gives high annual crops. It is a promising plant for the country horticultural production.

Ecological insistance of *Hippophae* to open species and much sunshine is connected with a

high content of pigment of photosynthetic apparathus. There are 2,93-4,36 mg chlorophyll per 1 g of dry matter. There were established cultivar specification and seasonal variability of chlorophyll content. Maximal accumulation of chlorophyll corresponds to maximal quantity of ascorbic acid in fruits (greenery phase), and also the highest water content in leaves. In cool and wet periods there is more pigment in leaves, and it has a favourable influence on crop. Correlation of chlorophylls a:b content (x=2,68) shows that *Hippophae* can endure only rather moderate darkening. The sort which endures shade most of all is the cultivar Maslichnaya.

The most important indicator of cultivars and forms is ascorbic acid content in leaves and fruits. In Belarussian conditions vitamin C content in fruits in the process of ripening is lower. Maximal content of ascorbic acid is noticed in the cultivar 'Vitaminnaya' (272 mg %), then in 'Dar Katyni' (256), 'Novost Altaya' (143), 'Maslichnaya' (128), 'Scherbibka-1' (122). The sort 'Vitaminnaya' has also big fruits. Accumulation of vitamin C is influenced by moderately warm weather with enough quantity of precipitation (Fig. 3).

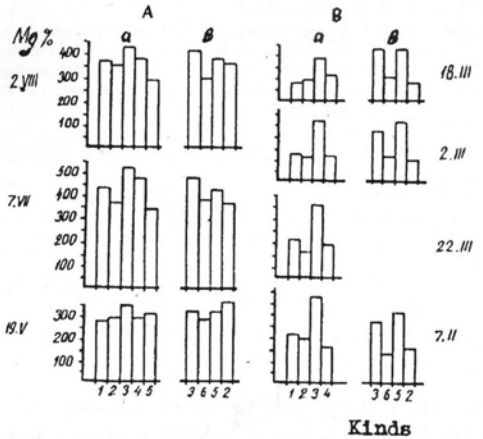

Fig. 3. Changes of ascorbic acid contents in leaves (A) and fruits (B) in different cultivars

'Novost Altaya' (1), 'Maslichnaya' (2), 'Vitaminnaya' (3), 'Sherbinca' (4), 'Dar Catuny' (5), 'Zolotoy pochatoc' (6), at the age of 11 years old (a) and at the age of 7 years old (b), and during vegetation

Ryc. 3. Zmiany zawartości kwasu askorbinowego w liściach (A) i owocach (B) u różnych odmian:

'Novost Altaja' (1), 'Maslichnaja' (2), 'Vitaminnaja (3), Sherbinca (4), 'Dar Catuny' (5), ' Zalotoj pachatok' (6) w wieku 11 lat (a), w wieku 7 lat (b) i w czasie wegetacji.

Demand of plant for moisture is characteristic for such physiological indices as intensity of transpiration and sucking power, which were studied for the first time. Sucking power of roots and leaves of *Hippophae* is about 30 atm (Fig. 4).

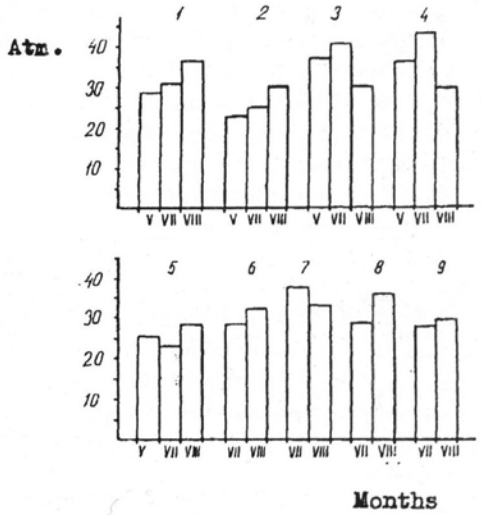

Fig. 4. Changes of suckling of *Hippophae* leaves during vegetation:

1-5 - forms 'Dar Catuny', 'Sherbinca', 'Novost Altaya', 'Maslichnaya', 'Vitaminnaya' 11 years-old; 6-9 - forms 'Dar Catuny', 'Maslichnaya', 'Vitaminnaya', 'Zolotoy pochatoc' 6 year-old.

Ryc. 4. Zmiany młodych liści rokitnika (*Hippophae*) w czasie wegetacji:

1-5 'Dar Catuny', Sherbinca', Novosta Altaja', 'Maslichnaja', 'Vitaminnaja' w wieku 11 lat; 6-9 odmiany 'Dar Catuny', Maslichnaja', 'Vitaminnaja', 'Zalotaj pochatoc' w wieku 6 lat.

Intensity of transpiration in the form of a chart looks as a curve with miltiple tops during a day with maxim of 12-13 hours for the majority of kinds (Fig. 5). High intensity of transpiration and sucking power of *Hippophae* showed ability to compete for moisture. It is explained by ecological pecularities of species, which was formed in sandy-pebbly deposits of river banks and seashores. In the conditions of Belarus the plant have a shortage of soil moisture and watering is necassary in these conditions. There were examined seasonal, daily and cultivars pecularities of above mentioned physiological indices.

Comparative analysis of agrochemical and mechanial qualities of soil in the botanic gardens, and some natural plantations of *Hippophae*

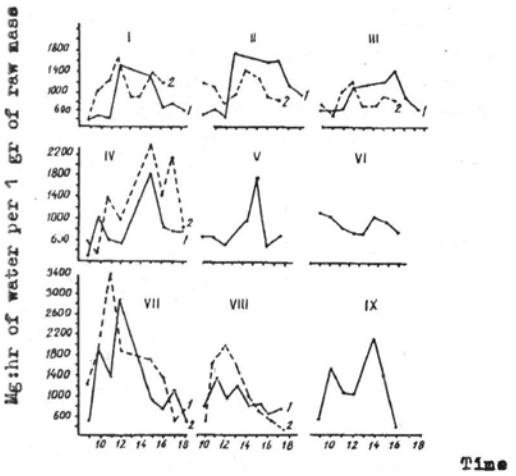

Fig. 5. Changes of transpiration intensivity of different forms of *Hippophae* during twenty four hours:

I - 'Dar Catuny'; II - 'Maslichnaya'; III - 'Vitaminnaya'; (1 - 11 years-olds, 2 - 6 year-old); IV - 'Sherbnica' (1), 'Novost Altaya' (2) 11 years-old; V - 'Zolotoy pochatoc' 6 years-old; VI - seedlings; VII - *Taraxacum officinale* (1), *Trifolium pratense* (2); VIII - *Aronia melanocarpa* (1), *Convolvulus arvensis* (2); IX - *Chenopodium album.*

Ryc. 5. Zmiany intensywności parowania u różnych odmian rokitnika (*Hippophae*) w czasie 24 godzin:

I - 'Dar Catuny', II - 'Maslichnaja', III - 'Vitaminnaja' (1-11-letnie, 2 - 6-letnie), IV - 'Sherbnica'(1), 'Novost Altaja' (2) 11-letnie; V - 'Zolotoj pochatok' 6-letnie; VI - kiełki; VII - *Taraxacum officinale* (1), *Trifolium pratenze* (2), *Aronia melanocarpa* (1), *Convulvulus arvensis* (2); IX - *Chenopodium album.*

showed their suitability for growing this olant. But soils need more lime and watering.

While introducing *Hippophae* in Belarus we studied its resistance to diseases and pests. It was stated that the most widely spread pest is *Hippophae* plant-louse. The cultivar 'Tsherbinka-1' suffers mostly; 'Vitaminnaya' and 'Maslichnaya' are rather resistant. Dry and warm weather contributes to pest spreading. Quite effective is treating of bushes with 0,2% solution of antio. Among the diseases the most widely spread is *Fusarium* wilt, which demages plantations essentially. It was established that diseases and pests evoke disturbance of such physiological processes as intensity of transpiration or synthesis of ascorbic acid.

Spreading of *Hippophae* in Belarus is limited by shortage of planting material. We studied and selected the most effective ways of vegetative and seed reproduction of *Hippophae* in Belarus.

Seed reproduction is available for planting trees and shrubs; for creating afforestation belt and etc. *Hippophae* seeds have high sowing qualities in our conditions, but the period of sprouting is delayed. We worked out rational methods of increasing germination ability of *Hippophae* and methods of improving quality of seedlings. It was established that soaking of seeds in water for 7 days can replace stratification. Seeds swell, begin to sprout and while sowing in the soil give good shoots.Treatment of seeds with solutions for stimulating growth of germinating power with macro and microfertilizers and with a number of other chemical substances will raise germinating ability of seeds.

For cultivation of plants under plastic the following conditions should be recommended: fertilizers of $N_{80}P_{150}K_{100}$ in substrat before sowing, top-dressing of one-year seedlings with $N_{100}P_{250}K_{100}$, liquid top-dressing with ammonia nitrate (20 g/m^2), putting microfertilizers, tilling of roots before planting with IAA, IBA, esculetin during 8 hours, non-root tilling of growth points with solutions of microelements and stimulators (IAA - 0,05%, K-IAA - 0,02%, a-NAA - 0,02%, etc.). While growing seedlings one should use herbicides in doses of 30 kg/hec. THA and 1-2 kg/hectare 2,4-D twice a season on fallow field, and also 1 kg/hectare of simazin on experimental plot. Agrotechnical methods have a favourable influence on *Hippophae*.

Autumn sowing (Fig. 6, 7) is recommended in polyethylene houses. We studied morphogenesis of seedlings (Fig. 8). Influence of greenhouses on seedlings is the following: their height is increased more than twice, there is a priority development of seedlings. There appear more shoots, and much earlier, decreases the period of seed sprout. Stimulating effect is preserved during some subsequent years of growing in the open air and it is very important for formation of standard plant. Seedlings are only 80 cm high. The reason for that are better conditions of microclimate in greenhouse.

Priority substract for growing seedlings of *Hippophae* is mineral soil.

The most efficient way of *Hippophae* reproduction for gardenining is green graft in conditions of artificial mist. It was established that the

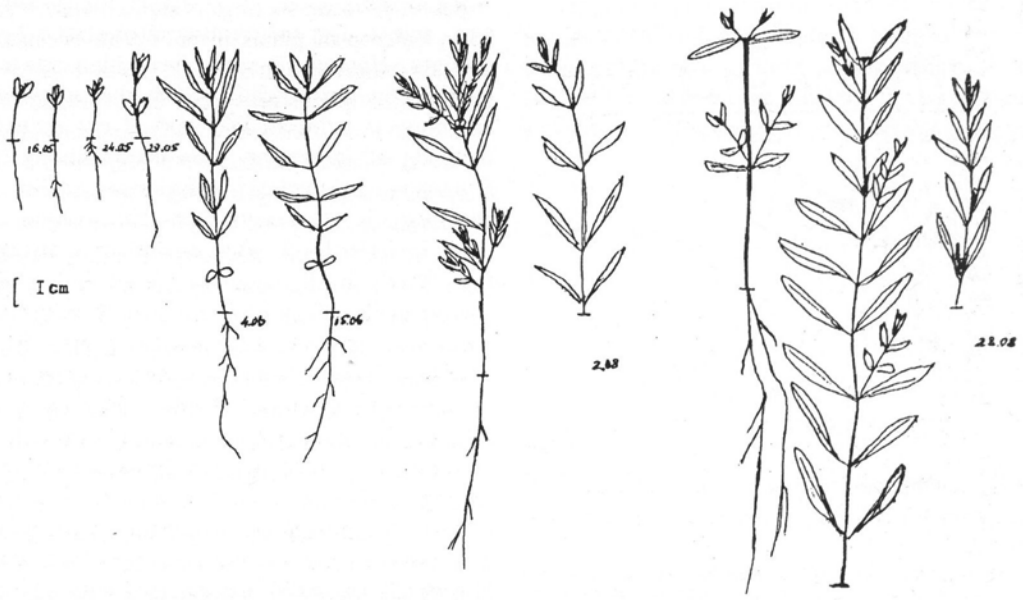

Fig. 6. Morphogenesis of *Hippophae* seedlings in the greenhouse (autumn sowing).
Ryc. 6. Morfogeneza kiełków rokitnika (*Hippophae*) w szklarni (siew jesienny).

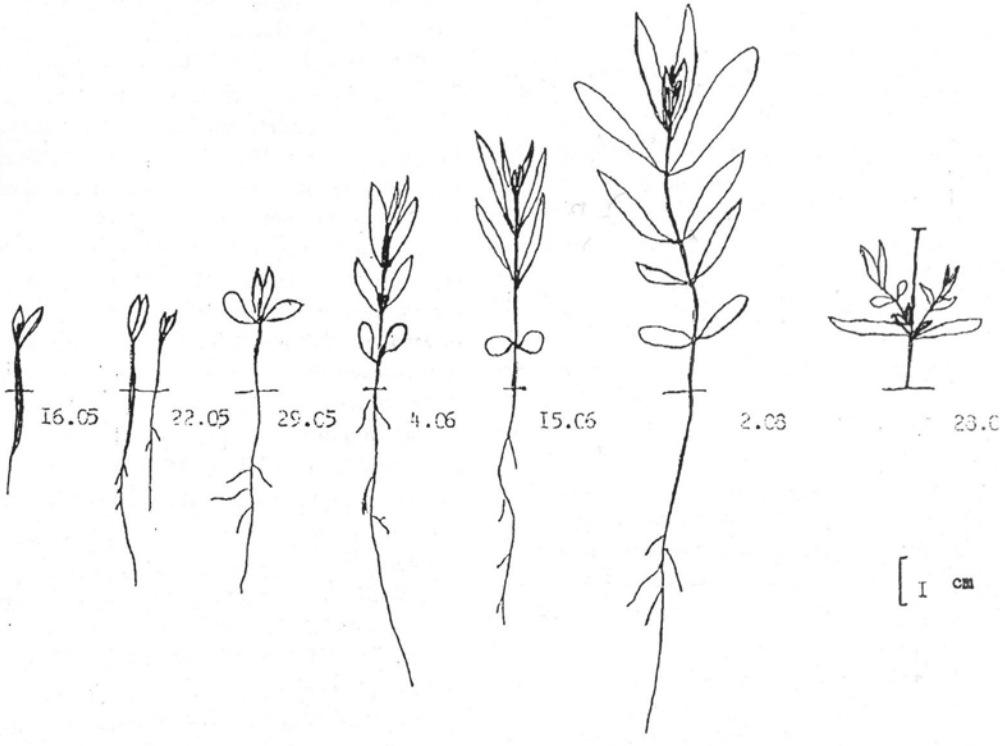

Fig. 7. Morphogenesis of *Hippophae* seedlings in the open soil (autumn sowing).
Ryc. 7. Morfogeneza kiełków rokitnika (*Hippophae*) na polu (siew jesienny)

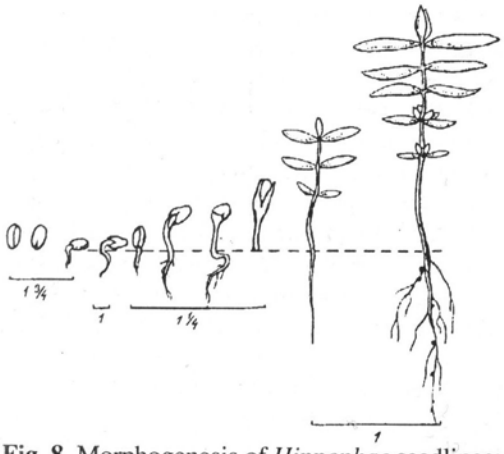

Fig. 8. Morphogenesis of *Hippophae* seedlings: shoots - 15.V; the third leaf pair - 19.V; the fifth leaf and tuber - 17.VII; the ninth leaf pair - before 1.VIII.

Ryc. 8. Morfogeneza kiełków rokitnika (*Hippopha*):

kiełki - 15.V; trzecia para liści - 19.V; piąty liść i korzeń bulwiasty - 17.VII; dziewiąta para liści - przed 1 VIII.

best time for stocking up grafts is the phase of completion of intensive shoot growth - the beginning of woodeninig (the end of June-beginning of July). Grafts are of 12-15 cm long with 10-15 between budles and a bud on top. They are planted 6x4 cm or 4x7 cm deep. Taking roots lasts about 15 days and average is 80% (in ordinary greenhouses it is lower). Optimal air temperature for taking roots should be 22-27°C. Relative humidity should not be lower than 90%. We studied influence of stimulators of taking roots on its increase. The best of them are IBA (50 mg/l), IAA (100mg/l), a-NAA (50mg/l) during 16 hours. Rooting is 100%. The best cultivars for taking roots are grafts of male trees, especially for 'Zolotoi pochatok', 'Scherbinka-1', 'Novost Altaya', 'Vitaminnaya', 'Maslichnaya', 'Dar Katuni'.

We studied the taking roots of *Hippophae* in relation to the measure of woodening of shoots with the aim of clearing out optimal time for stocking up the grafts, influence of light on taking roots of grafts during spring and summer grafting.

It was established the possibility of grafting in plastic pots (7,5x14 cm).

It's reasonable to reproduce *Hippophae* with wooden grafts and it makes possible to do it in spring, there is no need in artificial mist, and the time of growing sedlings is shortened to 1 year. But outcrop of plants in only 60% because of poor taking roots. It's much easier to continue growing of plants on special open plots of land which are equipped with big dispersive machines (PBO-8). The plant height after growing grafts for one year is 60 cm, rooting - 80%.

With the development of agrotechnique and methods of accelerated reproduction the improved technology of growing *Hippophae* is in containers. With this aim there were studied pecularities of growth of root system and above the ground part of a plant. Phenological observations were made. We studied water regime, influence of stimulators, and others It's efficient to grow grafts in containers with heating (table).

Table 1. Influence of conditions of cultivation on the growth of two-year plants of *Hippophae rhamnoides* L. in containers

Tabela 1. Wpływ warunków uprawy na wzrost dwuletnich roślin rokitnika (*Hippophae rhamnoides* L.) w pojemnikach.

Way of watering	Height cm	Length of roots cm	Diameter of root neck cm	Mass g overhead part	Mass g roots
open soil					
Watering of the bottom	54,4	47,0	8,0	8,2	8,7
Watering by rain	52,1	43,6	6,9	6,8	5,7
Without watering	35,8	40,3	5,8	3,1	2,7
the greenhouse					
	71,7	48,4	7,2	9,3	5,9

We studied influence of different kinds of planting of *Hippophae* on its growth and development. We covered soil with sawdust or turf.

There were worked out "Recommendations on growing grafts, making plantations and using *Hippophae* 'Krushinnaya' in conditions of Belarus". They were adopted by the Ministry of Agriculture. It was shown economic efficienty of technology of growing seedlings with the help of installation of artificial mist.

In a number of collective and state farms there were organized plantations of *Hippophae* with the total area 100 hectares.

Hippophae is a perspective plant for introducing it in Belarus. It can be successfully grown on industrial plantations for producing oil and food products in all regions where *Hippophae* was introduced. The plant can be used in afforestation belt on peatbogs of Polesje and as fixing plant in fishing ponds and as a decorative plant.

Research work showed that conditions of Belarus one can grow all contemporary cultivars of *Hippophae* being resistant and giving annual abundant crops. In local conditions fruit mass is lower in comparision with Altai region, where they originated. The most favourable cultivar of *Hippophae* according to its stable crop, high resistance is 'Maslichnaya'. 'Maslichnaya' has the fruit to ripen in local conditions, other are 'Zolotoy pochatok', 'Vitaminnaya' and 'Dar Katyni'. But the difference in time of fruiting is about one week. It was established that the most perspective cultivars for cultivation are 'Vitaminnaya', 'Dar Katyni', 'Zolotoy pochatok', 'Novost Altaya' (selective kind from Siberia). bacause of good stability and high yield ('Zolotoy pachatok' - about 11 kg from 6 year-old bush), and also the cultivar 'Tsherbonka-1' (Nizhegorodsky Scientific Institute), which is short, frost hardy, and has big fruits.

By its biochemical composition there appear free from pollination forms Az1, Az2, 207, 56k, 80k, 1739-37. The form 207 is characterized by stable content of ascorbic acid (up to 288,51 mg%), Az1 - by oil (up to 4,0%) and ascorbic acid (up to 311,10 mg%). Form 207 has red fruit and ripens early. Forms 80 zh and 56k have high yield, form 56k has red fruit colour.

Therefore it is important to continue introduction and studies on *Hippophae* in different regions of Belarus.

Forms recived from free pollination of this or that kind are perspective *Hippophae* selection. 9 forms from 'Maslichnaya' cultivar have biger mass of fruits.

Experiments on new cultivars from Siberia such as 'Yantarnaya', 'Obskaya', 'Obilnaya', 'Samorodock', 'Prevoshodnaya' showed good perspective of introducing them into Belarus. Mass of fruits is much bigger (100 berries weight about 67,8 g). Carotene content is about 14 mg%, ascorbic acid content about 177 mg%. Most of new cultivars can be harvested by machines. They can be divided into 2 groups: technological for oil production and eatable (with a high content of sugar and low acidity).

In Moscow Botanic Gardens there were selectd the following cultivars of *Hippophae*: 'Aromatnaya', 'Botanicheskaya', 'Vorobjovskaya', 'Radostnaya', 'Padarok sadu', 'Perchick'", 'Solnechnaya', 'Trophimovskaya', 'Krasnoplodnaya', 'Moskvichka' which are characterized by big mass of fruits (62 gr), oil content - 6,11% and high resistance to frost.

There were selected new cultivars of *Hippophae* in the Michurin Institute of Horticulture such as ,Podarok Chernozemju', 'Gordost', 'Ogonyok', 'Vostochnaya Krasavitsa', 'Syurpriz', 'Pamyati Indiry Gandi', 'Solnechny Dozhd', 'Ulibka', and others.

There were studied cultivars from Novosibirsk such as 'Zyryanka' and 'Talitskaya'.

So, we can recommend a number of *Hippophae* cultivars of different origin. The most oily cultivars are 'Samarodok', 'Zlotistaya'" (6,4%), 'Yantarnaya' (7,0%), 'Velican' (7,3%). The best cultivars with the low number of thorns are 'Velikan', and 'Prevoshodnaya'. 'Yantarnaya', 'Zolotistaya Sibir', 'Panteleevskaya', 'Luchezarnaya' have high content of carotene.

There were studied ecological and biological pecularities of 5 climatic types of *Hippophae* (Baltic, Siberian, Dunai, North Caucasus, South Caucasus) and perspective for their selection. We studied the morphological characteristics of seeds, morphogenesis of seedlings and shoots. There was given a comperative evaluation of population in onthogenetic cycle.

There were studied pecularities of adaptation of different climatic types in F2. There were given comparative evaluation of population in full ontogenetic cycle. The seeds of different forms of local reproduction (in F2) were studied. It was supposed that differentiation inside species has genetic origin. Morphological characteristics of seeds from different climatic types and the biology of sprouts were also studied. High energy of sprout is characteristic for the

seed from Dunai climatic type (72-80%). Energy of sprout of Siberian climatic type is 86%, but it ranges from 56% to 86%. Baltic type has 66-76%. Caucasian seeds have sprouting energy 4-30%.

All the specimens have high germination power. Lab germinating ability was 90-100% for all climatic types. Significant differences were shown in the period of seed sprout. It was prolonged in the North Caucasian type. For the Baltic type it was completed by the end od the second decade. Dunai, Siberian, South Caucasian type - in the middle of the second decade.

Field shoots had their own pecularities. There was examined morphological growth of seedlings. Significant difference was noted in terms of the growth beginning and its intensity. Species of Siberian climatic type began to grow early, and it can be the cause of their perishing in unfavourable spring period. The Baltic seedlings begin growing much earlier than the southern ones. Dunai species and Caucasian species start growing later, but very intensively.

What concerns maximum height of seedlings the succession is the following: Baltic - 185 mm, Dunai - 140 mm, South Caucasian - 109 mm, Siberian and North Caucasian - 91 mm.

Dynamics of root growth repeats that one of above the ground parts of the plant. At the initial stage the most extensive root growth of Baltic climatic type is observed. In my opinion it's good from the point of view of securing the plant in the soil. Roots of Siberian climatic type grow steadily intensively. In this way they differ from other types by better adaptability to the cold climate.

Special attention should be paid to analysis of hypocotyl growth. At the beginning of growth its length is almost equal to the length of roots. The only exception is Dunai climatic type, whose hypocotyl of seedlings is very small (Fig. 9).

At the begining the most active growth is observed in the underground part of hypocotyl of the Baltic climatic type which creates a certain kind of young plants from environment. Hypocotyls of the Caucasian types grow longer in their above ground part, however their maximal growth is below the Baltic types. Hypocotyl of Siberian type remins in the underground position longer than in the other species. But the cause of

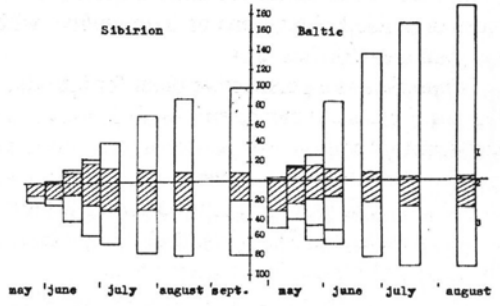

Fig. 9. Dynamics of *Hippophae* seedling development of different climatic types:
1 - shoot, 2 - hypocotyl, 3 - root.
Ryc. 9. Dynamika rozwoju kiełków rokitnika (*Hippophae*) z różnych stref klimatycznych:
1- kiełki, 2 - zawiązki łodygi, 3 - korzeń.

it is another one - it is reaction of adaptability. Dunai species occupy intermediate place between Baltic and Caucasian types.

Such indices as length and width of leaves poin out to defintie deifferences among climatic types. There are differences in time of growth of different buds and in their size.

So, by the early intensive growth above the ground of the plant with the heighest seedling, dynamics of development of hypocotyl and other characters one can prove the best adaptability of a plant to local conditions of the Baltic climatic type.

Only selective work by growing of resistant cultivars for specific conditions of Belarus can be the basis of sea buckthorn home breeding. At present time the breeding fund of cultivars and hybrids number 138. In the capacity of parent plants are taken cultivars from Research Horticulture Institute of Siberia, Botanical Gardens of Moscow State University and Nizhegorodsky Agricultural Institute. As pollinators are taken forms of Danube. N. Caucasus, S. Caucasus, Altaian, Baltic, E. Siberian climatypes and cultivar Alie.

Promising forms of 'Obskaya', 'Samarodoc', 'Trophimovskaya' cultivars give 600-700 g yield per 100 fruits. Hybrids with Caucasian climatype on cultivars of 'Zolotistaya', 'Luchesarnaya' and 'Alei' also have high fruit yield.

Using Caucasian climatype with such hybrids of cultivars as 'Dar Catuny', 'Obskaya', 'Oran-

zhevaya', 'Samorodok' and especially cultivar 'Zolotoy pochatoc', distinguished by high content of ascorbic acid, were obtained on the basis of cultivar 'Aromathnaya'.

'Dar Catuny' with Danube climatype is distinguished by high content of carotenoids (to 18.0 mg%).

Comparatively low acidity have hybrids of cultivars 'Aromathnaya', 'Botanicheskaya', 'Vitaminaya', 'Zolotoy pochatok'.

Caucasian climatype and cultivar 'Alei' gave an increase of fruit dimension.

A wide range of variability was obtained using chemical mutagenes: EI, DES, NEU, DMS, NMU. The number of versions reaches 462. Seeds of cultivars and number of populations were treated.

Many mutant forms of cultivar 'Zolotoy Pochatoc' increased their fruit yield in comparison to initial forms. 121-86 (NMU) form cultivar 'Sherbinca' was also distinguished. Mass of 100 fruits was 81,4 g (in comparison to control 46,0 g).

Biochemical structure of fruits is of great lability. 4 mutant forms out of 5 originated from cultivar 'Zolotoy pochatoc' have the content of dry matter 3-5% below the control, also 3 from 7 cultivar 'Maslichny, 2 from cultivar 'Prevoskhodny', 4 fom 8 of 'Sherbinca'.

The high content of ascorbic acid have mutants 17-86 (NMU) of cultivar 'Maslichnaya' - to 132 mg% (control - 51,1) and 121-86 to 161,33 mg%. 65-86 (NEU) mutant of cultivar 'Prevoskhodny' - 145,54 mg% (control - 138,6 mg%). Mutant 51-86 (NDMU) has the content of ascorbic acid 247 mg% (control - 64 mg%) and essentially exceeded the initial cultivar 'Dar Catuny'. High content of ascorbic acid have mutants 84-86 (EI), 29-86 (NMU) of cultivar 'Novost Altaya', munant 91-86 (DES) of cultivar 'Zolotoy pochatoc' and also mutamt of cultivar 'Obskaya.

High content of carotenoids have mutants 110-86 (EI) of 'Obskaya' - 8,87 mg% (control - 6,56 mg%) and especially forms derived from cultivar 'Yantarnaya' - to 9,93 mg% (control - 6,42).

As a result of a complex study of mutant forms in the capacity of candidates may by proposed the following forms: 84-86-1 (EI) on the basis of cultivar 'Novost Altaya'. It is distinguished by high productivity and by high content of ascorbic acid. This form has lack of thorns and early ripening time (beginning of August). Form 83-86-3 is distinguished by high productivity. Quality like these possess forms 111-86-2 (DES) and 83-86-1 (EI). They have round fruit of a golden colour. All of them are recived on the basis of seedlings of Azerbaijan climatype forms.

Highly productive are forms 129-86-1, 123-86-3 on the basis of cultivar 'Vitaminnaya', they also have quite good biochemical structure.

On the basis of cultivar 'Dar Catuny' was recived productive form 46-83-3 (NDMU). Many productive forms gave cultivar „Zolotoy pochatoc" and especially 91-86-1 (DEC). It is rich in ascrobic acid (263,9 mg%). Good productivity on cultuvar, originated from cultivar 'Maslichnaya' has form 39-86-2 (NDMU). Many good qualities has mutant 59-86-3 (NEU) on the basis of cultivar 'Obskaya'. It is recived a number of well-grown fruted forms: 129-81-6 'Vitaminnaya', 102-86-1 'Zolotoy pochatok' (DMS), 65-86-1 'Prevoskhodnaya' (NEU). Mass of 100 fruits is more than 50 g. In this respect especially perspective are: 46-86-3 from 'Dar Catuny' (NDMU), 77-86-7 ('Yantarnaya', NEU). The latter has mass to 75, 4 g per 100 fruits.

Perspective species are reproduced, and further evaluation of selective fund is being done.

The main objective of introducing *Hippophae* in Belarus is production of *Hippophae* oil and food products from fruits. The complex of work for introducing *Hippophae* in Belarus can be presented on a scheme (Fig. 10), where one can differentiate 5 levels: search and study of the material; studies of original forms and kinds in Belarus and selection of the most perspective forms; reproduction of selected forms and kinds and mastering of growing technology of seedlings; introduction into practice; selection in conditions of Belarus.

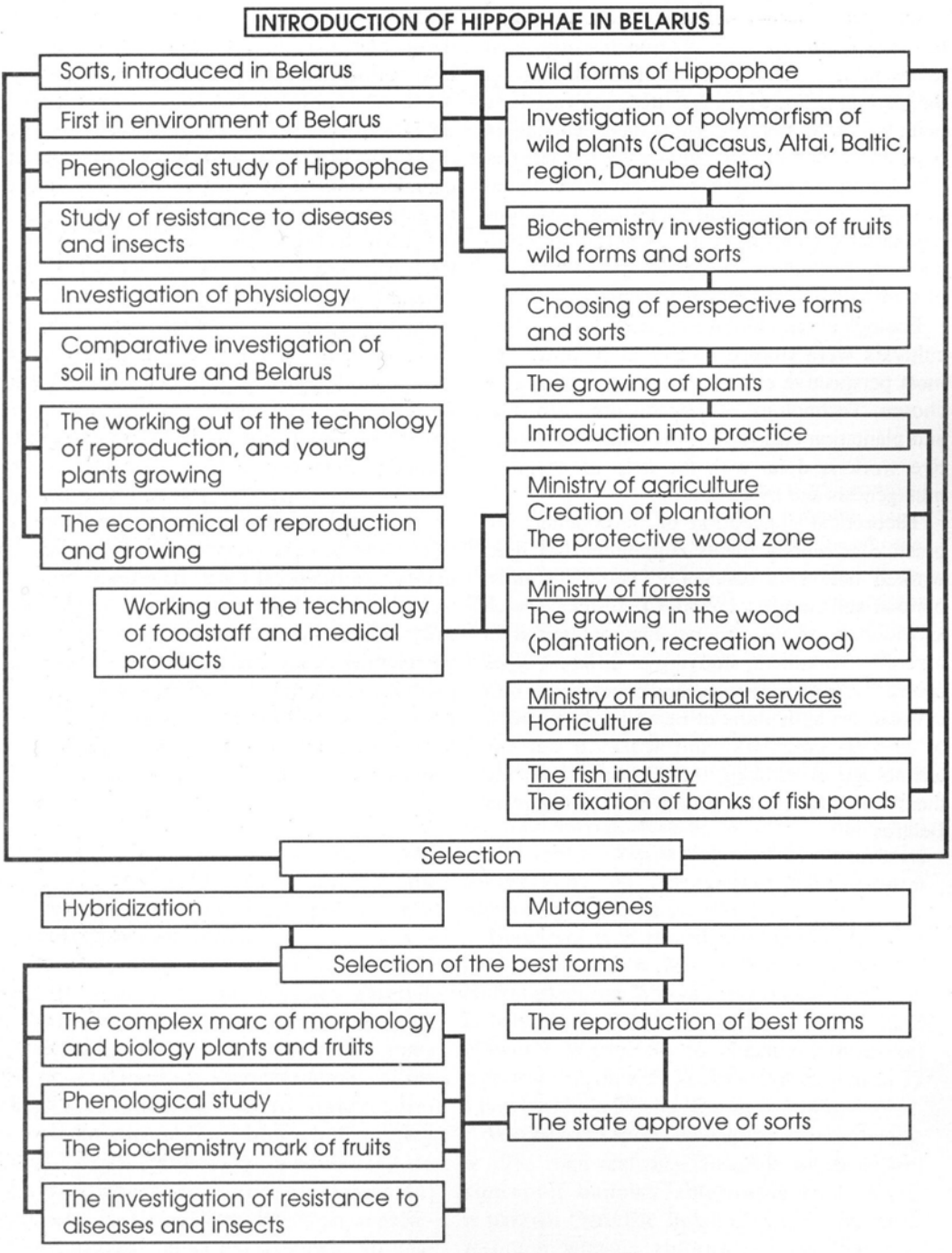

Fig. 10. Phases of introduction *Hippophae* in Belarus.
Ryc. 10. Fazy wprowadzania rokitnika (*Hoppophae*) na Białorusi.

SUMMARY

Objective causes of introducing *Hippophae*, as medical, decorative or phytomeliorative plant are examined. Theoretical prerequiste of growing the plant in Belarus in intermittent and vast areas is its big polimorphism. There has been studied population variability of *Hippophae* in a number of regions. There have been shown different qualities of geographical races and numerous populations, measure of their stability and productivity in Belarussian conditions on the basis of studing the whole ontogenetic cycle.

Ecological and biological peculiarities of the cultivars were studied detaily in Belarus. The most perspective cultivars for the country were chosen. Technology of reproduction, growing, and plantation cultivation was improved. Selective work is done with the help of chemical mutagenesis and hybridization.

Theoretical conception of introducing into practice of woody plants *Hippophae* has been worked out. This conception being the most optimal and complex includes five steps: search and studies of the original material found in natural environment; studying of different types and cultivars of *Hippophae* and choosing the best cultivars for agriculture of Belarus; reproduction of chosen cultivars; and working out the technology of growing the plants; introducing them into practice, selection of *Hippophae* in Belarus.

STRESZCZENIE

Celem badań było wprowadzenie rokitnika (*Hippophae rhamnoides*) do uprawy na Białorusi jako rośliny leczniczej ozdobnej lub o właściwościach fitomelioracyjnych. Teoretyczną podstawą do uprawy tej rośliny w różnych rejonach Białorusi jest duży polimorfizm gatunku. Badane były różne populacje odmian i form lokalnych rokitnika pochodzących z wielu rejonów byłego Związku Radzieckiego: Kaukazu, Azji Środkowej, Zachodniej Syberii, Ałtaju, Tuwy, Buriacji, delty Dunaju oraz rejonu Kaliningradzkiego. Stwierdzono znaczne zróżnicowanie w rozwoju ontogenetycznym oraz w produktywności różnych odmian i form lokalnych w czasie uprawy na Białorusi. Na tej podstawie wybrano najbardziej przydatne odmiany. Przy ocenie brano pod uwagę plon owoców, zawartość oleju, kwasu askorbinowego oraz karotonoidów. Wykonane były prace selekcyjne w celu otrzymania najlepszych do uprawy na Białorusi form. Inne prace polegały na krzyżowaniu różnych form oraz uzyskiwaniu indywidualnych mutantów. Na podstawie wieloletniej oceny zostały wybrane najbardziej produktywne formy o wysokiej zawartości oleju i kwasu askorbinowego. Autor opisał także 5-stopniowy schemat introdukcji rokitnika do warunków białoruskich.