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CHOSENIA ARBUTIFOLIA (SALICACEAE): LIFE STRATEGIES AND INTRODUCTION PERSPECTIVES

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Chosenia arbutifolia A. Skvorts. is a relict endemic of the Asian Pacific Coast adapted to flood activity of mountain rivers. The studies were executed in Russia in south and central areas of Magadan Oblast (the flood plains of the rivers Yana, Chelomdzha, Kolyma, Dukcha) and in the south of Primorsky Krai (the river flood plain Partizanka). The range, habitats, research history, and economic value of chosenia are described in the article. The species features of *chosenia*, distinguishing chosenia from willow are noted. Based on the analysis of biology and ecology of chosenia in the Russian Far East, three types of the species' life strategies have been distinguished and characterized: 1 – *secured anchoring of juveniles in substrate* during the colonization of pebble floodplains (up to 3–4 years old); 2 – *maximal manifestation of habitat-forming functions* during the period of active growth (from 4–5 to 25–30 years); 3 – *providing for the species' advancement* onto new pebble deposits *(*from 25–30 to 70–100 (120) years old). The experience of chosenia introduction in Russia (southern Siberia) and USA (Massachusetts) by sowing seeds and breeding of grafts with growth stimulants was analyzed. Due to ecological plasticity of the species and its specialized habitats, any unwanted chosenia invasions were excluded. Major reasons for the absence of chosenia from street plantings are analyzed and most perspective ways of its introduction are suggested. There are difficulties of the reception of the planting material in sufficient quantities in connection with quick loss germinating ability, high frailty of seedling roots, plants' inability for vegetative reproduction, high requirement for good drainage and moisture of substratum. An experiment with raising seedlings in stationary capacities with sandy-pebble substrate is essential for a solution of the given problems. These boxes should be placed directly in areas of natural chosenia habitats along the edge of flooded deposits.

Keywords: *Chosenia arbutifolia, ecology, biology, ontogenesis, life strategies, introduction, Russian Far East.*

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INTRODUCTION

Chosenia *Chosenia arbutifolia* (Pall.) A. Skvorts. is a highly ornamental plant, a relict endemic of the Eastern Pacific Coast, the only tree growing beyond the Arctic Circle. Names given to chosenia by local population depict its attractiveness and potential as an ornamental plant. In Nanay and Udege spoken languages, chosenia is named by Chinese names *leo-mo* and *zhuantianliu*, respectively (which means *willow piercing heaven*). In Japan they call chosenia *kesho-yanagi* (*beautiful willow*) or *karafato-kuroyanagi* (*Sakhalin black willow*).

Chosenia is a typical explerent: it has high light requirements, is very frost tolerant and indifferent to soil fertility. It is characterized by high annual productivity and explosive energy of seed germination. These qualities make chosenia a promising species for green industry (Kolesnikov A. I., 1974; Koropachinskii, 1983), particularly for the extreme north, where the assortment of trees and shrubs is very poor. However, chosenia is not used for urban plantings – neither in southern nor northern regions. It is usually missing from collections of botanical gardens, arboreta, and dendraria. While promoting chosenia for cultivation as a street tree, we have to

consider many examples across the world when plant introductions for the purpose of their cultivation as ornamentals resulted in uncontrolled invasions. This happened, for example, to box elder (*Acer negundo*), Siberian elm (*Ulmus pumila*), and others. Therefore, any concerns in connection with recommendation of a new plant as an ornamental are fairly justified.

To understand the reasons for failures with chosenia's introduction and exclude the scenario of its aggressive invasion, its ecology and life strategies in natural situations have to be carefully analyzed and characterized. The purpose of the article is to analyze the life strategies and adaptive potential of *Chosenia arbutifolia* at different stages of its ontogenesis. This is necessary in order to make realistic assessments concerning the prospects of chosenia introduction to cultivation.

GEOGRAPHIC RANGE AND NATURAL HABITATS

Chosenia has the greatest extent of geographic range from south to north – from the broadleaf forest zone of Honshu in southern Japan to the tundra in the lower reaches of the Anadyr and Lena rivers. Its natural range includes Hokkaido, North Korea, Northeast China, Sakhalin, and Kamchatka (Fig. 1).

The western limit of the range is east of Baikal Lake. Chosenia communities are intra-zonal: they don't extend outside river floodplains and reach the extreme north exclusively through river valleys. Along the right bank of the Lena River, chosenia extends beyond the Arctic Circle, while still retaining the tree habit. In the tundra zone of Chukotka, chosenia is the sole representative of forest-forming species and forms small groves, while carrying out functions of an edificator in pioneer communities.

Sandy-pebble spits and islands in floodplains of mountain rivers are ideal habitats for the settlement of chosenia (B. P. Kolesnikov, 1937; Pu-hwa, Zhong-wen 1987). Huge areas of spits and islands are formed within all territories featuring the monsoon climate during the tumultuous summertime floods caused by torrential rains and in the southern latitudes (Primorsky Krai and the countries of East Asia) also by typhoons. Regardless of geographic location within its range, chosenia and its communities pass through certain developmental phases, which can be attributed to regular floods and well-defined transformations of its habitats.

With chosenia's advancement toward north, sizes of its groves diminish to only several dozens of square meters. In valleys of rivers with small watersheds, chosenia community size decreases can be attributed to the reduction of warming and draining effect of the underflow, while in situations of steep thalweg grade and/or large watersheds the decline in grove size is due to constant shifts of alluvial deposits caused by devastating floods. Banks of largest rivers and their tributaries are prone to erosion even

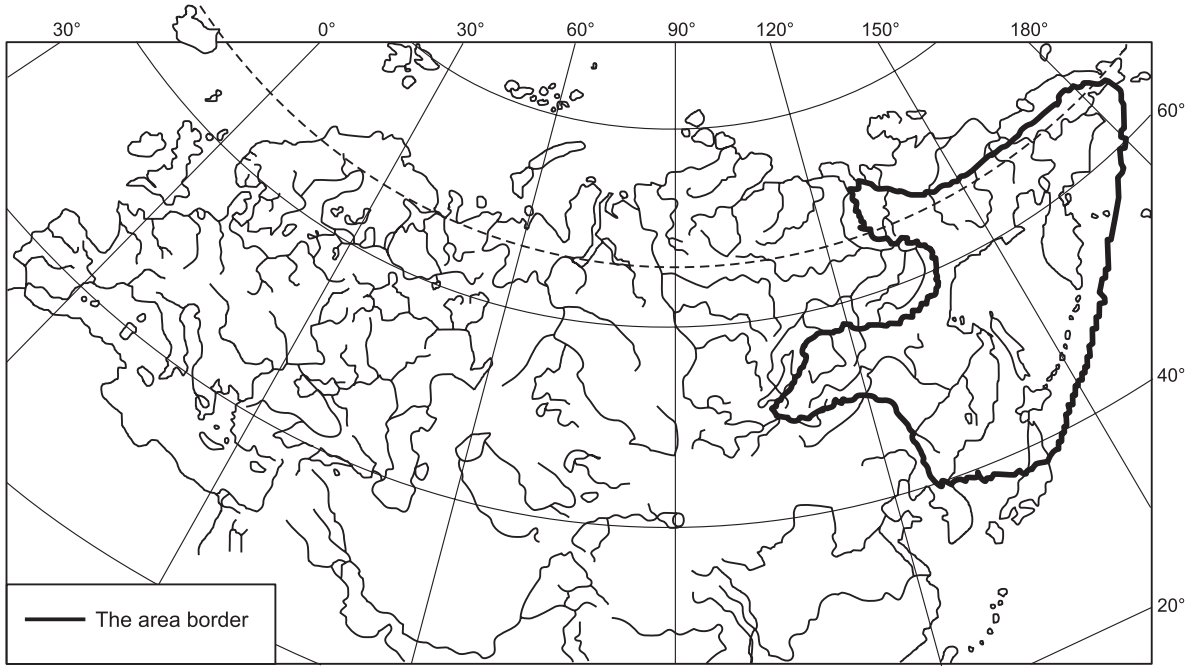

Fig. 1. Geographic range of *Chosenia arbutifolia* Skvorts. (Norin, 1958).

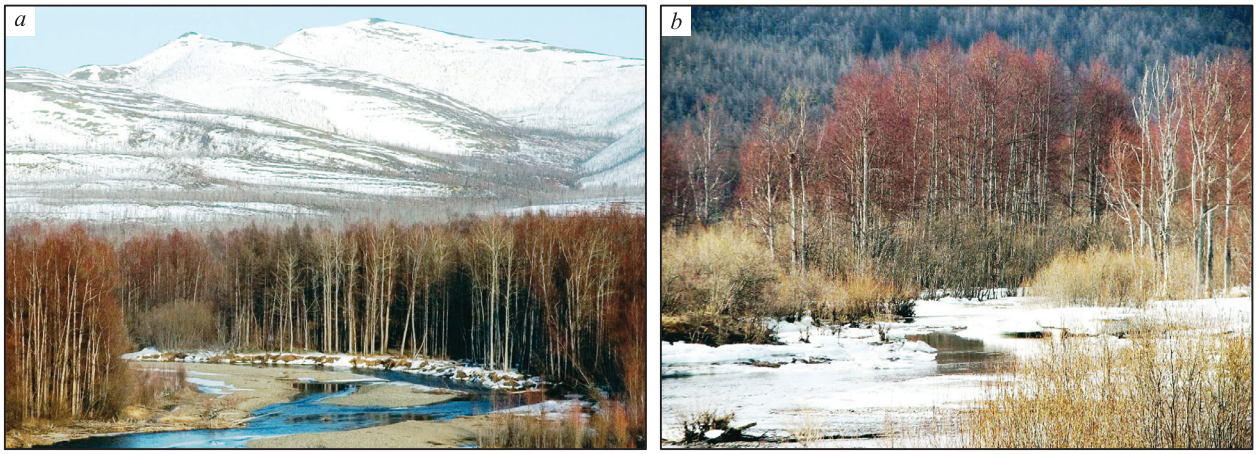

Fig. 2. *Chosenia arbutifolia* cenosises in the North (*a* – Kolyma River upper reach, Magadan Oblast; photo by A. Andreev) and in the South (*b* – Partisan river basin, Primorsky Krai).

outside the floodplains, as high as terraces. Due to its pronounced affinity to riparian habitats and islands, chosenia plays an exclusive bank-stabilizing and water-regulating role (Fig. 2).

While the processes of vegetation destruction and restoration take place simultaneously and continuously within any given stretch of a floodplain, the most important agent of vegetation restoration is chosenia. Vegetation of chosenia forests in floodplains with tempestuous flood activity remains at some stable, permanent dynamic stage. It is characterized by a complex age structure and high diversity of the function-defined organizational levels – from pioneer aggregations (on pebbles at stream sides) to complex communities (at intermediate and high floodplain levels).

The studies took place in southern and central Magadan Oblast (floodplains of the Yana, Chelomdzha, Kolyma, and Dukcha) and in the southern Primorsky Krai (Partizanka river floodplain), the Russian Far East.

THE HISTORY OF CHOSENIA STUDIES

Chosenia is unique not just due to the enormous south-to-north stretch of its range and not only because it grows closer to the Arctic Ocean than any other tree, but mostly due to a set of unusual characteristics that this tree has possessed. From any standpoint, chosenia is a species with amazing, sometimes even mysterious features, be it its ecology, or the introduction history, morphology, or trophic connections. Since the major part of chosenia's geographic range is within the territory of Russia, it has been mostly studied by the Russian scientists (Kolesnikov B. P., 1937; Sheludyakova, 1943; Skvortsov, 1957; Norin, 1958; Kozhevnikov, 1974; Moskaliuk, 1983, 1990, 2008; Dyuryagina, 1987; Mazurenko, Moskaliuk, 1989, 1991; Alfimov, Berman, 2006 and others) Much data have been accumulated on characteristics of the species and communities of *C. arbutifolia*.

Chosenia communities were very thoroughly described in southern Primorsky Krai by B. P. Kolesnikov (1937). He was the first one to make a connection between chosenia and the water regime of mountain rivers in Primorsky Krai. His monograph has not lost actuality until now.

The publication by V. A. Sheludyakova (1943) contains descriptions of chosenia forests in the western part of its area (Yakutia) and speaks about its importance for the local population. The author pays attention to the high food value of chosenia for domestic and wild reindeer, especially in the wintertime. There are also data on medicinal properties of chosenia: a decoction made from sprout bark has been used for treatment of cardiovascular diseases (Shreter, 1975).

A number of Russian scientists studied chosenia within the northernmost and northeastern parts of its area. They emphasized important environment-forming functions of chosenia groves in the Far North (Starikov, Dyakonov, 1955; Starikov, 1958; Norin, 1958; Kozhevnikov, 1974 and others). It is noted that the population in the Far North has always been using *C. arbutifolia* groves extremely carefully – only for most essential needs: boat building, manufacturing of household goods, home and bridge construction.

Researchers still continue to study chosenia with great interest. The life forms, environmental requirements, and primary productivity of chosenia communities within southern Magadan Oblast were reviewed by T. A. Moskaliuk and M. T. Mazurenko

(Mazurenko, Moskaliuk 1989, 1991; Moskaliuk, 1990). Biomorphological characteristics of *C. arbutifolia* seeds and juvenile plants were studied by G. Dyuryagina (1987). A. Alfimov and D. Berman (2006) studied age dynamics of chosenia forests in the upper and middle reaches of the Kolyma. They came to the conclusion that chosenia claimed any certain floodplain area through a few stages of settlement. This process is congruent with imminent transformation taking place in floodplains during floods. It demonstrates chosenia's high degree of adaptation to floods.

Even in the USA, where chosenia does not grow naturally, articles dedicated to this species have been published during the last decade (Kadis, 2003, 2005; Del Tredici, 2005). I. Kadis (2003) depicts the history of chosenia taxonomic treatment. The species was initially described by the renowned Russian scientist and traveler of German descent Peter Simon Pallas in 1788, the time of active exploration of Siberia and the Far East by the Russians. Pallas described *C. arbutifolia* as *Salix arbutifolia.* Due to the fact that in *Flora Rossica* Pallas by mistake associated his description with an illustration depicting another willow, chosenia was later on repeatedly described by N. Turczaninow, E. Trautvetter, F. Meyer, A. Budishchev, and others under names *S. bracteosa* Turcz. ex Trautv. et Mey., *S. eucalyptoides* Meyer, *S. macrolepis* Turcz., and more. Just as local peoples, the researchers took chosenia for a willow. There are many similarities between chosenia and willows. Pioneers of Siberia and the Russian Far East as well as the Russian Kamchatka settlers called it a willow: *vetla* or *vetlovina*. The well-known Russian botanist V. Komarov confessed that he had taken chosenia for *S. acutifolia* Willd. and thus overlooked a new genus.

Chosenia was segregated in a separate genus by the Japanese botanist Takenoshi Nakai in 1920 (Nakai, 1920, 1924; Kadis, 2003). Initially Nakai also mistook chosenia for *S. acutifolia* Willd. Later he paid attention to the distinctive features of chosenia: stamens that are connate to bracts along the proximal one-third of their length; lack of nectariferous glands; anemophily. After T. Nakai, the majority of researchers acknowledged *Chosenia* as a separate genus of Salicaceae. However, the combination *C. arbutifolia* emerged only in 1957. Pallas' priority was restored by the leading Russian taxonomist A. Skvortsov. In the Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences (BIN), Skvortsov discovered the authentic herbarium specimen labeled by P. Pallas as *Salix arbutifolia.*

T. Nakai described chosenia in Korea. Choson is the Korean name for North Korea. It explains the origin of the name *chosenia* (Khokhryakov, 1985).

In the middle of the 19th century, the Western Union Telegraph Company attempted to build a telegraph line to connect North America with Asia via the Bering Strait. Information about this project is found in another article by I. Kadis (2005). George Kennan was the head of the Siberian expedition. According to his plan and under his management, thousands of chosenia trees were felled for telegraph poles in the lower reaches of the Anadyr river. Chosenia was the only suitable wood there. The project was ill-fated and never came to completion.

Not only the original properties of chosenia are reflected in each of these publications, but also its highly ornamental habit during any season and at any age. However, all attempts to introduce chosenia to cultivation have not been successful.

ECOLOGICAL REQUIREMENTS AND LIFE STRATEGIES OF CHOSENIA DURING THE ONTOGENESIS

To ensure the success of chosenia introduction in cultivation, it is necessary to take into account its life strategies, environmental and biomorphological features during different periods of ontogenesis. Three periods (stages) were distinguished in the ontogenesis of chosenia (Mazurenko, Moskaliuk, 1989; Moskaliuk, 1990): 1 – *active growth* (up to 25–30 years), 2 – *stabilization or productive invariance* (30–70 years), and 3 – *aging and die-back* (70–100 (120) years).

Several habits (ontobiomorphs) have been distinguished during the first stage of growth. They consecutively reflect changes in habitat. Floods, during which existing deposits are eroded and new ones are deposited, play a decisive role. Chosenia itself contributes greatly to the habitat formation.

During chosenia's first years, its strategy enables it to remain fixed in place under the pressure of the rapid water flow. Due to the need to settle on pebble floodplain deposits, the first ontobiomorph (at the age of 1–2) is an *orthotropic shoot* (Fig. 3).

Chosenia has explosive energy of germination and high annual accretion. Due to these properties, any species-explerent (a pioneer plant) is able to promptly seize unoccupied land and flourish, sometimes during a long period of time. Seeds germinate within 7–10 days upon dispersal (Dyuryagina, 1987), and a carpet of seedlings forms within several days at low floodplain levels – areas that become submersed with a slightest rise of water. The

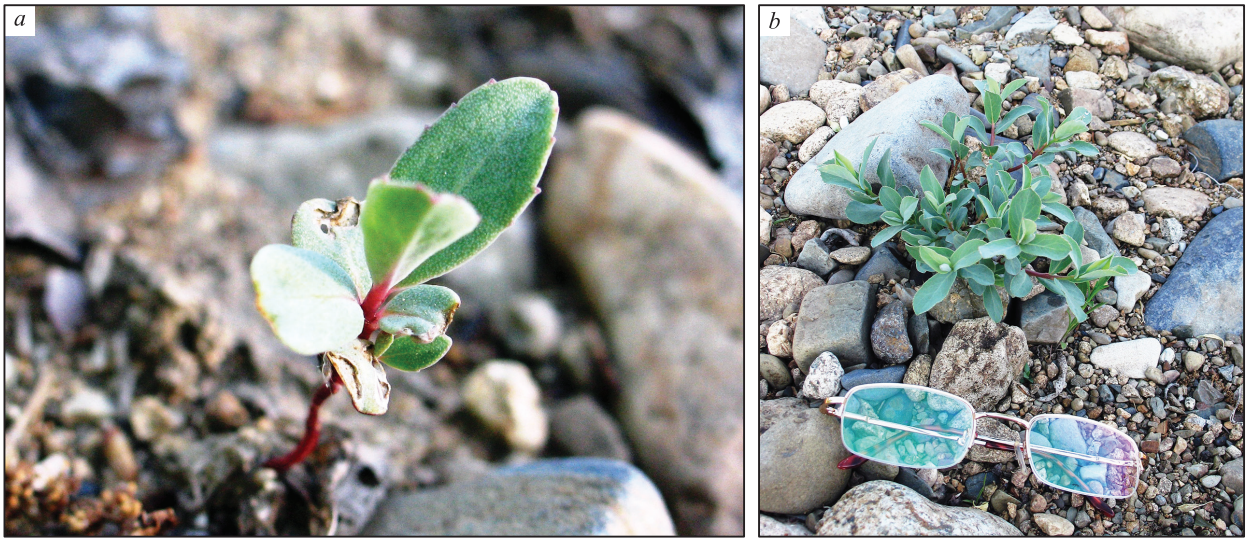

Fig. 3. Early ontobiomorphs of the chosenia: *a* – chosenia self-seedling at the beginning of the second summer season; *b* – a tuft-like (rosette-like) growth form of juveniles.

Fig. 4. In 3–4-year-old chosenia obtains a shrub-like growth form.

Fig. 5. 4–5-year-old shrubs of chosenia take active part in soil formation producing a fertile habitat.

light-weight, mobile seeds of chosenia quickly lose their viability – just like any willow seed. Their ripening time is concurrent with the beginning of river flood season. Those seedlings that have not managed to root in substrate on time are washed off. Many seedlings also germinate on alluvial deposits beneath the forest canopy. The seedling carpet there is short-lived due to shading and poor drainage.

Immediately after the appearance of cotyledons, plants begin to actively form their root system consisting of surface roots and a taproot. The total length of roots during this period is 2–3 times as large as that of above-ground plant parts. These long roots provide firm fixation of plants in pebble deposits. During the first year and at the beginning of the second one, the height of above-ground parts is not more than 10 cm. Then plants that have not been washed away activate their growth and increase the number of shoots. Starting from this time, the seedling habit is a *rosette* (Fig. 3*b*). Shoots are pressed tightly to the substrate surface between stones and do not impede the flow of water. Cotyledons and first true leaves of seedlings and rosettes formed in conditions of high insolation on pebble deposits are of xeromorphic type.

During their third year, young plants start producing virgate shoots that grow swiftly from the

Fig. 6. A protective wax bloom could be easily removed (the spot in center).

root collar. Plants can thus add up to 1 m in height within a year. These shoots expand in different directions, so that by the end of the third summer rosettes become compact shrubs, their height 0.7–0.8 m. Plants attain a *typical shrub-like habit* (Fig. 4).

In 5–6 years, the height of shrubs reaches 2.0–2.5 (3.0) m, their crowns forming continuous thickets. In case plants densely populate the area from the very beginning, the shrub-like phase may be skipped.

Once chosenia plants are firmly rooted, the strategy of the species changes, and its ecological functions dramatically increase. Young plants effectively trap alluvium silt and plant litter (Fig. 5).

During floods, shoots largely die back, often times down to the roots. Numerous new virgate shoots are produced to compensate for the loss, each new generation of shoots growing more vigorously than the previous.

Replacement shoots are covered by protective glaucous wax, which can be easily ribbed off exposing the glossy surface of the bark (Fig. 6).

After thicket formation, the risk of sun scorch is over, and the glaucous bloom disappears. The bark on older shoots becomes greenish-grey, while the youngest retain the cherry red to bright brown color.

Chosenia thickets with their multi-colored bark are very attractive both in winter and summer. In

Fig. 7. A shrub-tree habit of chosenia, 6–8-year-old.

Fig. 8. A cone-shaped tree (12–15-year-old). Dried shoots («muffs») around trunk bases are typical for chosenia.

summer large narrow-lanceolate bluish-green leaves add to the bright bark colors. Chosenia would look even more beautiful against the faded background of an urban landscape. As fertile soil accumulates, chosenia thickets part with the realm of high flood influence and at the same time the typical shrub-like habit is being replaced by the *shrub-tree habit*– intermediate between that of a tree and a shrub (Fig. 7).

This stage lasts from 6 to 10 (12) years. Growth of lateral vigorous shoots gradually slows down, and a leader starts dominating and forming the

Fig. 9. Typical 45–50-year-old chosenia tree.

Fig. 10. 70–80-year old chosenia tree.

Fig. 11. Senescent trees are dying gradually from the top and still fruit.

Fig. 12. 90-year-old chosenia tree with burls on lower trunk (Dukcha river, northern Priokhotye).

trunk. Even though the leader dies back over each winter, the trunk gradually becomes larger – up to 110–120 (150) cm DBH. Its crown having been formed, chosenia becomes a typical tree. Its height rapidly increases due to accretions to 50–70 cm and more per vegetative season.

Meanwhile, lower laterals lag behind more and more and soon die off, though they don't fall off. Dried shoots of various sizes stick out in all directions around the base of the trunk, forming a dense brush, a kind of a «muff» (Fig. 8). Solitary trees have thicker «beards» than those in groves, as lateral shoots in solitary trees survive longer. These «muffs» may remain at lower trunks for a very long time, sometimes until the old age. This phenomenon is specific only for chosenia, especially those trees forming sparse communities. This feature is going to simplify the care for cultivated chosenia in urban locations and also make it possible to grow chosenia in dense wind shields or hedges masking unsightly objects.

The next and final phase of active growth corresponds to an ontobiomorph of a cone-shaped tree. It is typical of 12 to 25 (30) year-old plants. Once chosenia reaches the age of 11–12, it stops growing as a shrub and starts producing fruit. During this phase, only tips of twigs die off, and the height annually increases up to 80–100 cm. At the age of 25–30 chosenia becomes a tree.

After 30 years chosenia forest stands enter a period of stabilization, that is, production invariance. Trees reach their height limit: 23–25 m in the north of the range and 28–32 m in the south. During the age period from 40–50 to 70–80 years old, annual accretions remain relatively constant. Crowns of trees intensively branch out, and skeletal limbs become ever larger. The branches bear a mass of thin flexible twigs with abundant catkins at the time of fruiting. Dry twigs of «muffs» are the only reminder left of the shrub-like growth form at an early age, though sometimes even the «muffs» can be absent (Fig. 9).

The trunk bark of adult trees is distinctively light grey, shaggy, exfoliating in long thin ribbons, thus reminiscent of honeysuckle bark (*Lonicera edulis*, *L. maackii*, *L. praeflorens,* and others). This morphological feature, along with bright cherry-burgundy-brown color of young shoots in spring, improves frost resistance of adult trees and protects the cambial layer of trunks and limbs from cold (Shamurin, 1966; Savile, 1972).

The final period of chosenia's life, the period of aging and dying may last for quite a long time – from 60 (70) to 100 (120) years (Fig. 10).

The die-back starts out rather slowly from the crown summit in the downward direction (Fig. 11).

Spectacular burls appear at the lower trunk, in place of dry shoot brush (Fig. 12). While processes of aging and dying of above-ground organs accelerate from year to year, the bark color of annual shoots in an aging tree, remains burgundy-brownish during the winter and early in spring, a multitude of catkins hanging down from twigs in summer.

The strategy of mature and senescent trees is to guarantee colonization of new areas by the species. In natural settings, while situations are constantly shifting from xeric to hydric and back to xeric, chosenia spreading and its preservation as a species is totally dependent upon sufficient seeding into appropriate habitats, that is, onto newly formed pebble beaches. This is attained by producing abundant seed crops yearly. This feature constitutes the species' adaptation to the unpredictable character of floods.

PROSPECTS FOR INTRODUCTION

A combination of attractiveness during major part of the life cycle (for 50–70 years) and tolerance to environmental stresses, especially to cold, is indicative of chosenia's good potential for employment in the green industry of the Northern Hemisphere and particularly that of extreme Northeast Asia. This species demonstrates unique life strategies and narrow ecological specialization formed under the influence of frequent mountain river floods during the warm season. This excludes an unwanted invasion of chosenia. Yet the same qualities of chosenia in conjunction with its biological specificity create serious difficulties with the introduction. For a successful introduction of chosenia, it is absolutely necessary to create ecotopes identical to the natural ones.

Chosenia would look particularly nice as a specimen tree (Kolesnikov, 1974); therefore, there is no need for creating large areas with conditions suitable for chosenia, that is, with well-drained substrate. Therefore, creating a suitable habitat in any town is a quite realistic goal. Well-drained areas can be constructed on river embankments or else on city squares and in gardens – as long as the design provides for fountains or other sources of running water.

Problems associated with biological/biomorphological features of chosenia are much more difficult to overcome. A quick loss of seed viability, low potential for vegetative reproduction, and development of a powerful taproot along with anchor

roots – these are characters that constitute major problems for the introduction of chosenia. Due to a very complex architectonics of roots, it is impossible to transplant chosenia directly from natural habitats.

The two practical methods of chosenia propagation are growing from seed and softwood cuttings. Some success in propagation from cuttings with growth stimulators has been reported by Puhwa and Zhong-wen (1987) and Del Tredici (2005). A scientist from the Arnold Arboretum of Harvard University, P. Del Tredici experimented with cuttings treated with two different growth hormones. The cuttings were taken from young plants (3 years old), which made them relatively more capable of rooting (20–26 % rooting rate). Chosenia vegetative propagation studies are not yet much widespread though should be considered quite promising. It is necessary to continue the search for more effective rooting hormones.

P. Del Tredici had never observed chosenia prior to his experiments with sowing. He was amazed by the explosive energy of seed germination and subsequent fast growth of seedlings. At the same time, he noted large difficulties with the collection and transportation of seeds from Japan to the United States. Of the two parcels he received, one spent seven days in the mail and the other about three weeks. Apparently, only the seeds from the former parcel germinated. The seeds were sown in coarse washed sand, and the researcher noted extraordinary fragility of seedlings. In two years those seedlings that had been successfully potted and grown on were planted to a nursery. A total of nine plants was produced. In the spring of 2004, at the age of six, the young plants reached the height of 8–12 feet (1.8–3.6 m). Eight of them flowered for the first time and produced viable seeds in June of that year. These seeds had the same germination energy as the parent plants. Considering his own results of propagation from cuttings and seed, P. Del Tredici concluded that, while the latter method was more promising, the problem of getting planting stock of chosenia was generally solved.

In Russia (Novosibirsk) an attempt to use seedlings and juvenile plants of chosenia for introduction was undertaken at the Central Siberian Botanical Garden, Siberian Branch Russian Academy of Sciences (Dyuryagina, 1987). The method in essence consisted of germination of fresh seeds on moss in metal containers with glass lids and subsequent keeping the seedlings under regulated conditions (at certain air temperature and substrate humidity) in a greenhouse till the emergence of 5–7 true leaves. Then the plants were planted outside. The author of the experiment emphasized high seedling survival rate (up to 85 %), though noted multiple complexities, difficulties with creating optimal conditions for chosenia seedlings and found the whole process very labor-intensive. She also noted that the slightest motion of the substrate resulted in breaking the fragile roots, and therefore it was preferable to use damp moss as the substrate and by no means sand. For normal root development, the substrate had been saturated with oxygen, which is delivered in natural habitats by the running water.

Taking into account these results and the general advantages of propagation from seed, the effort must be directed toward simplifying of the process of obtaining seedlings and using all possible precautions during the transplanting to the permanent spot. One may try to approach these tasks as follows.

Right before the seed dispersal (from mid-July in Primorsky Krai to the start of August in Magadan), set up wood or metal containers with sandy-pebble mix near the water margin on the river beach, in places where there is plenty of chosenia seedlings. The bottoms and walls of the containers should be perforated for ready water drainage. Upon seed germination and rooting of seedlings, the containers are to be moved to a permanent location (a nursery). Thanks to chosenia's rapid growth, the propagation and growth costs will be paid off quickly.

The suggested approach to chosenia propagation appears to be realistic, as solitary chosenia's have been encountered in atypical anthropogenic habitats, such as mine dumps, mineralized areas deprived of soil and vegetation, or power lines in river valleys. Occasionally, within chosenia's natural range, one may observe its natural regeneration in urban situations: around homes, wherever rain water accumulates upon dripping from roofs, on piles of sand and gravel left behind after construction, etc. In all cases plants originate from seeds that germinate on a coarse sandy-pebbly substrate. Chosenia seed dispersal and appearance of a multitude of young plants coincide with the season of heavy rains in the monsoon climate. [Seedlings may turn directly into trees omitting a shrub phase.]

In areas with pronounced monsoon climate, one may expect chosenia thrive wherever interception of the atmospheric precipitation occurs, provided that «solid» ground is replaced by some well-drained coarse substrate (crushed stone will do) in a volume sufficient for normal growth of an adult tree.

CONCLUSIONS

Three types of life strategies have been segregated in the ontogenesis of *Chosenia arbutifolia,* a relict endemic of the Asian Pacific Coast. Formed as a result of the species' evolutionary adaptation to flood activity of mountain rivers in the monsoon climate, the following strategies replace one another during the ontogenesis: 1 – secure anchoring of juveniles (3–4-year-old and younger plants) in substrate during colonization of pebble floodplains; 2 – maximal manifestation of habitat-forming functions during the period of active growth (from 4–5 to 25–30 years), during which trees leave intensive flood areas; 3 – providing for the species' advancement onto new pebble deposits (from the moment of productivity invariance achievement, i. e., from 25–30 years old, until the end of the life cycle, that is, to 70–100 (120) years old).

Due to ecological plasticity along with specific character of habitats, an unwanted invasion of chosenia can be safely excluded, which opens a good prospect of chosenia employment as an ornamental tree, particularly for the extreme Northeast Asia region.

Taking into consideration the specificity of chosenia life strategies at each stage of ontogenesis, success with chosenia plantings may be achieved through implementing the following essentials:

1. Creating a well-drained habitat where constant replenishment of nutrients and sufficient moistening of the root volume have to be provided.

2. Abandonment of attempts to transplant any established seedlings older than 3 years or undergrowth from natural communities.

To achieve sufficient production of planting material from cuttings, the search for efficient growth stimulants must be continued.

Considering high fragility of seedling roots, it is necessary to ensure complete immobility of root systems during transportation of planting material to places of permanent growth. Conducting an experiment with raising seedlings in stationary containers filled with sandy-pebbly substrate may turn out important for the solution of the problem. The containers should be placed directly within areas of chosenia natural habitats, along the water front on river banks.

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COMPETING INTERESTS

The author declare that she has no competing interests.

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CHOSENIA ARBUTIFOLIA (SALICACEAE): ЖИЗНЕННЫЕ СТРАТЕГИИ И ПЕРСПЕКТИВЫ ВВЕДЕНИЯ В КУЛЬТУРУ

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Чозения толокнянколистная *Chosenia arbutifolia* Skvorts. – реликтовый эндемик Тихоокеанского побережья Азии, адаптированный к паводковой деятельности горных рек. Исследования выполнены в южных и центральных районах Магаданской области (поймы рек Яна, Челомджа, Колыма, Дукча) и на юге Приморского края (пойма р. Партизанка). В статье описаны ареал, история изученности и хозяйственное значение чозении. Отмечены видовые признаки, отличающие чозению от ив. На основе анализа эколого-биологических особенностей выделены и охарактеризованы три жизненные стратегии чозении на российском Дальнем Востоке: 1 – прочного закрепления ювенильных особей в субстрате в период заселения галечниковых пойм (до 3–4 лет); 2 – максимального проявления средообразующих функций в период активного роста особей, обеспечивающего их выход из зоны активной паводковой деятельности рек (с 4–5 до 25–30 лет); 3 – гарантированного расселения на новых галечниковых отложениях (с 25–30 до 70–100 (120) лет). Проанализирован опыт интродукции чозении в России и США (штат Массачусетс) семенным способом и черенкованием с применением стимуляторов роста. Рассмотрены основные причины отсутствия чозении в озеленении городов. К ним относятся сложность получения посадочного материала в достаточном количестве в связи с быстрой потерей всхожести семян, высокой хрупкости тканей ювенильных особей, невозможности размножения растений вегетативным способом, высокая требовательность к дренажу и влажности субстрата. Для решения данной проблемы предлагается провести эксперимент по выращиванию сеянцев в стационарных емкостях с песчано-галечниковым субстратом, устанавливаемых непосредственно в местах естественного произрастания чозении по кромке заливаемых отложений.

Ключевые слова*: Chosenia arbutifolia, экология, биология, онтогенез, жизненные стратегии, интродукция, Дальний Восток России.*

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