The research of winter hardiness and seasonal development of some woody plants in East Kazakhstan

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Abstract. The article presents the results of research on the assessment of winter hardiness and seasonal development of some woody plants of East Kazakhstan flora in order to study the adaptation parameters of introducers to new soil and climatic conditions. Phenological observations made it possible to evaluate the prospects of the species and its further use in the culture of the region. The research team identified perspective tree-shrub introducers of East Kazakhstan natural flora and foreign origin for inclusion in the range of green construction.

Research and introduction into the culture for the practical use of economically valuable species of woody plants, as well as rational nature management is an integral part of the development program of Kazakhstan has the most important socio-economic and scientific value.

The nature of East Kazakhstan is diverse, as anywhere else in the Republic. The geographical position of the region in the continent center on the border of steppes, deserts and forests provided a rich set of natural conditions and a high degree of species diversity and uniqueness of the plant world. More than 2500 species of higher vascular plants grow on the territory of East Kazakhstan, among them valuable medicinal, fodder, food, decorative, melliferous and technical species. As a result, the region flora is the richest source for selection and introduction into the crop of plants that are useful for economically valuable traits. In this regard, research works aimed at identifying the useful potential of the region flora for national economic use and preserving the plant world gene pool in nature and culture are very relevant.

Between 2014 and 2019 research work was carried out aimed at studying winter hardiness and seasonal development of some woody plants in East Kazakhstan.

The main research objectives:

- Development of systemic and environmental principles for the intraducing mobilization of the gene pool of woody plants in East Kazakhstan and their implementation;
- Definition of requirements for ecological plasticity of introducers which are perspective for East Kazakhstan;
- Study of the adaptation parameters of introducers to new soil and climatic conditions.

The rich variety of climatic and soil conditions of the region, clearly defined zonality creates a high potential for enriching the natural dendroflora with new economically useful species from other...
botanical and geographical regions of the Earth, although natural conditions of the garden are rather harsh. The harsh continental climate and location in the Altai intermontane basin contributes to the short growing season, severe winters with unstable spring and autumn, which require longer research work to select promising introducers. Long-term observations of introducers showed advantage of species migration from the natural ranges of Siberia, the Far East, the temperate regions of North America and the mountain systems of Eastern Europe. This has made it possible today to create a sustainable collection of woody plants, consisting of 129 species from 22 families and 93 genera. Some species were included by us during the study, as shown in Table 1.

Table 1. New perspective introducers.

| №  | Registration number | Plant name                  |
|----|---------------------|-----------------------------|
| 1  | 274-03              | Genista germanica L.        |
| 2  | 369-02              | Spiraea japonica L. f. floroplena |
| 3  | 355-02              | Philadelphus cv. Жемчуг.    |
| 4  | 187-02              | Actinidia kolomikta (Rupr.) Lindl. |
| 5  | 352-02              | Kolkwitzia amabilis graebn. |
| 6  | 486-03              | Philadelphus pubescens Lois. |
| 7  | 235-90              | Pinus resinosa Ait.         |
| 8  | 435-03              | Philadelphus californicum Koern. |
| 9  | 466-99              | Rubus phoenicolasius Maxim. |
| 10 | 110-04              | Spiraea henryi Hemsl.       |

For all introducers, careful phenological observations are carried out to assess the prospects of the species and its further use in the region culture. Analysis of long-term observations made it possible to identify in 2013-2018 the introducers most adapted to the soil and climatic conditions of the region and having a practical orientation. Below is a brief analysis of their seasonal development in Altai and an assessment of the success of acclimatization.

Salix schwerini E. Wolf – A willow collection specimen was introduced from the Barnaul dendrological park. Its winter-hardiness is satisfactory. The non-lignified ends of annual growth have a tendency to freeze out every year, where in adverse winters the perennial shoots freeze out as well. Willow emerges from dormancy in mid-April. It is a fast-growing plant. Shoots start to grow from the first decade of May until the end of July, for about 74-110 days. Individual axial shoots grow until frost in September. The measurable annual growth is from 17 to 42 cm; shoots lignify by 75%. The given specimen first bloomed at the age of three. Due to the dark green foliage, it can be considered as a decorative plant, where it deserves widespread application in landscaping gardening.

Malus sargentii Rehd. – The given species is characterized by unstable winter-hardiness. During the cool growing seasons and severe winters, the apple tree freezes to the level of snow cover. In moderate winters, the small part of the annual growth freezes out. The duration of the growth period is dependent upon weather conditions of the summer period. During adverse weather conditions, the apple tree grows until the end of August for about three months, where it does not have time to lignify. The annual growth is about 3-5 (12) cm. The first flowering occurs at the age of 11.

Abies holophylla Maxim. – On the winter-hardness scale, it scores between 1-3. It starts vegetating from the first half of May. Shoots start growing from the second decade of May to the third decade of July, within 62-64 days, and then ripening takes place in August. It does not bloom. Due to its winter-hardiness and slow growth, the cultivation is unpromising.

Lonicera ruprechtiana Regel – It is winter resistant plant. After overwintering, slight freezing-off of the endings of annual growth is characteristic. Honeysuckle comes out of dormancy at the end of April. Linear growth lasts for 40 days and is observed from mid-May until late June. Shoots lignify in the second half of July. It blooms and bears fruit from the age of 5. Further tests are required to clarify the prospects of use.
Securinega suffruticosa (Pall.) Rehd. – It is low resistant to winters. Annually, the plants of this bio group freeze to the level of snow cover. It is characterized by the slow emergence from the dormancy state that occurs during the second decade of May. Shoots start growing from the end of May until the first autumn frosts. Its shoots get lignified by 50%, and it blooms and bears fruit from the age of four.

Corulus heterophylla Fisch. ex Trautv. – Its winter-hardiness is satisfactory. Every year the ends of the annual growth get damaged, and in severe winters small parts of the perennial shoots get frozen out. Linear growth takes place for about two months from mid-May. Shoots have time to fully lignify by the end of July. The observed specimen came into the generative stage at the age of 5. It has limited usage, where it can find its use in the green construction under the canopy of trees.

Robinia pseudoacacia L. – The plant is characterized by its unsatisfactory winter-hardiness. The main part of the annual growth gets damaged annually. In severe winters, individual specimens of acacia freeze to the level of snow cover. Characterized by fast growth, where its shoots grow intensively from the third decade of May until the first frosts of September. Prolonged period of growth prevents lignification of axial shoots. The cultivation of this plant is recommended in the regions of mountain-steppe zones.

Quercus rubra L. – Plants have been growing in the garden since 1978 (figure 3). It is relatively hardy to winter season. After overwintering, parts of annual growth freeze out. However, sometimes the unfavorable autumn-winter periods lead to the freezing of parts of the perennial shoots, up to the level of snow cover. Shoots grow approximately two months, from the third decade of May until early August, having fully lignified before the beginning of autumn. Due to the weak and unstable winter hardiness, the given specimen is not applicable for wide practical application.

Pinus banksiana Lamb. – There are two bio groups in the arboretum. The oldest group has been cultivated since 1954, germinating from seeds of unknown origin. It does not exhibit any visible signs of winter season damages. The growth of shoots ends by the end of August, where they completely lignify in the second half of August. The generative phase of development begins early, at the age of six. Moderate fruiting is observed from the age of eight. This species may well be recommended for use in the region, being the hardiest among North American species, but possess no advantage over locally cultivated pines.

Tilia neglecta – Linden unnoticed. Not winter hardy enough. Annually damaged from the level of annual to part of perennial shoots, depending on the characteristics of the autumn-winter period. Linden leaves rest in the first days of May. Shoots grow from the end of May to the third decade of July, within 1,1-2 months. Shoots lignify by 100/75% at the lateral and axial growth. Due to insufficient winter hardiness for breeding and practical use in the culture of the region it is unpromising.

Salix caspica Pall. – Willow Caspian. Winter hardness is satisfactory. Every year the ends of non-woody shoots of annual growth freeze. In severe winters, a small part of the perennial shoots freezes. In mid April comes from period of rest comes from mid-April. Shoots grow from early May to the first frosts of autumn. It blooms and bears fruit from the age of four. Flowering occurs shortly after the leaves bloom, for one week in the second half of May. It is suitable for use in green construction of the region.

Ribes americanum Mill. – Currants American currants. The plants are grown from seeds obtained from the United States in 1965. Winter hardy. After overwintering part of usually freezes not lignified shoots annual growth. In severe winters separate multi-year shoots also freeze. Currants go out of rest in the third decade of April. Shoots grow for 2.6 weeks from mid-May to the first decade of August. Axial shoots do not have time to fully lignify by the beginning of the winter period. It blooms and fruits from the age of five. It can be recommended for decorative and fruit-berry purposes in the forest-steppe zone of East Kazakhstan.

Cotoneaster horizontalis Decne. – Dogwood horizontal. Its introduction into the mountain-taiga zone of the Ore Altai became possible due to the creeping form of growth, when the entire vegetative part of the winters under the thickness of the snow cover. But, despite this, even in mild winters part of
the annual growth Freezes. In the introduced population of dogwood horizontal specimens grown from seeds of Czechoslovakia and Ireland in 2000 grow. Shoots start to grow in the third decade of May and grow until the first frosts of autumn. The first flowering was observed in specimens of Irish origin at the age of seven.

Caragana fruticosa (Pall.) Bess. – Karagana shrub. Species included in the flora of the Rudni Altai, and, therefore, the most adapted to the soil and climatic conditions of the region. Naturally grows on the territory of the arboretum, reaching 1.2–2.2 meters in height. It vegetates from the end of April to the first days of October, about 165±6 days. Hardy. Shoots lignify completely in early August. It is quite suitable for landscaping slopes and hedge creations.

Syringa vulgaris L. cv. Casimir Perrier – Casimir Perrier-lilac ordinary grade Casimir Perrier. Plants in the biogroup reached 2.2–2.8 meters in height, forming a multi-stemmed Bush. Hardy. Despite the early end of growth processes and aging of shoots, annually a small part of the annual growth and flower buds in the upper part of the crown freezes. Shoots start to grow from the first decade of May to the end of June, for 34–48 days. Mass flowering occurs in June, lasting 1.5–2 weeks depending on the nature of the weather. The variety is quite suitable for use in the garden and Park construction of settlements in the region.

In developing effective methods of introducing mobilization of woody, rare and endangered plants, flower-decorative introducers and fruit and berry cultivars, 129 species of plants were involved in the introduction experiment for the entire research period:

- Perspective for East Kazakhstan due to ecological plasticity among tree introducers are taxa whose species range or population are ecological and climatic close to the introduction area: plants of Siberia, the Far East, temperate part of North America and the mountainous region of Eastern Europe. The most perspective is the introduction of ornamental herbaceous species of foreign and natural flora of East Kazakhstan by phytocenotic complexes. Of fruit and berry crops, high resistance to climatic stressors under local conditions is characterized by breeding varieties of the Research Institute of Horticulture in Siberia (Barnaul) and the Urals (Chelyabinsk).

- The research of adaptation parameters of introducers to new soil and climatic conditions showed that the limiting factor in the introduction of plants in East Kazakhstan are sharp changes in temperature and humidity during the year, season, and day, as well as a limited frost-free period. The study of winter hardiness and seasonal rhythm of the introduction of introduced species showed that the weather and climate conditions of the reporting period were quite favorable for the growth and development of all groups of introduced species in the collections.

- The perspective tree-shrub introducers of East Kazakhstan natural flora and foreign origin for inclusion in the range of green construction are highlighted.

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