

Perspectives for the Conservation of Rare Species of the Fabaceae Family of the Flora of the Republic of Bashkortostan Ex Situ

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Abstract. The article presents the results of the primary introduction experience of rare species of the Fabaceae family of the flora of the Republic of Bashkortostan (the RB), included in the Red Data Book of the Russian Federation (2008). The study of these species was carried out in the Botanical Garden in Ufa. Under cultivation conditions, 5 rare species of the Fabaceae family were tested: endemic of the Middle and Southern Urals *Astragalus clerceanus* Iljin et Krasch., *Hedysarum grandiflorum* Pall., Volga-South Ural endemic *Hedysarum razoumovianum* Fisch. et Helm, endemic of the European part of Russia *Medicago cancellata* Bieb., endemic of the Middle Volga and Trans-Volga regions *Oxytropis hippolyti* Boriss. These species are included in the Red Data Book of the RB (2021). According to a comprehensive introduction assessment under the primary introduction *O. hippolyti* is a very promising species, *A. clerceanus* and *M. cancellata* – promising species, *H. grandiflorum* and *H. razoumovianum* – unpromising species.

1 Introduction

The Red Data Book of the Republic of Bashkortostan (RB) (2021) [1] includes 26 rare and endangered species of the family Fabaceae Lindl. (genus *Astragalus* – 10 species, genus *Vicia* – 1, genus *Hedysarum* – 3, genus *Medicago* – 1, genus *Lotus* – 1, *Oxytropis* – 7, genus *Melilotoides* – 1, *Glycyrrhiza* – 1, genus *Ononis* – 1). Of these, 7 species are included in the Red Data Book of the Russian Federation (RF) (2008) [2]. These are endemic of the Middle and South Urals *Astragalus clerceanus* Iljin et Krasch., endemic of the North, Middle and South Urals *Astragalus permianensis* C.A. May. ex Rupr., endemic of the Volga and Trans-Volga regions *Astragalus zingeri* Korsh., *Hedysarum grandiflorum* Pall., Volga-South Ural endemic of *Hedysarum razoumovianum* Fisch. et Helm, endemic of the European part of Russia *Medicago cancellata* Bieb., endemic of the Middle Volga and Trans-Volga *Oxytropis hippolyti* Boriss. (Figure 1). Two species from this list are included in the IUCN Red List of Rare Plants of Europe [3, 4]. These are the endemic species *H. razoumovianum* (DD – Data Deficient) and *M. cancellata* (NT – Near Threatened). The species *H. razoumovianum* is included in Appendix I of the Berne Convention (2011) [5].

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The study in nature and in culture of species located at the border of the range is of particular interest. Species *A. zingeri*, *H. grandiflorum*, *O. hippolyti* are located in the RB on the eastern border of the range, *M. cancellata* – on the northern border of the range [1].



Hedysarum grandiflorum Pall.



Hedysarum razoumovianum Fisch. et Helm



Medicago cancellata Bieb.



Oxytropis hippolyti Boriss.

Fig. 1. Rare species of the Fabaceae family in natural habitats in the Republic of Bashkortostan

Rare and endangered species of the Fabaceae family of the flora of the RB are protected in situ (protection in specially protected natural areas, monitoring of some natural populations) and ex situ (cultivation in the botanical garden). One way to protect is to conduct experiments on the creation of artificial populations in situ and ex situ [1, 6-9]. Successful experiments were made to create artificial populations of *H. grandiflorum* and *H. razoumovianum* ex situ in the Natural Botanical Garden (Nature Monument "Gurovskaya Gora", Kushnarenkovsky District, RB) [1, 10, 11].

Under cultivation conditions, 5 rare species of the Fabaceae family were tested. The list of species of the Fabaceae family that were studied in the experience of primary introduction and their protection status according to the Red Data Book of the RF (2008) [2] and the Red Data Book of the RB (2021) [1] are given in Table 1. It should be noted that endemic and relict species of the Fabaceae family are studied and preserved in the Botanical Gardens of the Ural region [12-16, etc.].

The purpose of this work is to assess the success of the primary introduction and the possibility of preserving rare species of the Fabaceae family of the flora of the RB, included in the Red Data Book of the RF (2008) [2], under the conditions of cultivation in the forest-steppe zone of the region.

Table 1. Conservation status of rare species of the Fabaceae family of the flora of the Republic of Bashkortostan, included in the Red Data Book of the Russian Federation (2008)

RBRF (2008)	RBRB (2021)		
Category and status	Rarity status category	Endangered status category	Category of protection measures taken*
<i>Astragalus clerceanus</i> Iljin et Krasch. – Endemic of the Middle and Southern Urals			
2a – species declining in numbers	3 – rare species	NT – Near Threatened	III
<i>Hedysarum grandiflorum</i> Pall. – Rare species, most of the range is in Russia			
3c – a rare species with a narrow ecological confinement associated with specific growing conditions	5 – recovered and recovering species	LC – Least Concern	III
<i>Hedysarum razoumovianum</i> Fisch. et Helm – Volga-South Ural endemic			
3e – a rare species with a limited range, part of which is located on the territory of Russia	3 – rare species	NT – Near Threatened	II
<i>Medicago cancellata</i> Bieb. – Endemic to the European part of Russia, Relict			
3a – a rare species, a narrow-range endemic;	2 – declining in abundance and (or) distribution species	VU – Vulnerable	III
<i>Oxytropis hippolyti</i> Boriss. – Endemic of the Middle Volga and Trans-Volga regions (Bugulmino-Belebeevskaya Upland)			
3a – a rare species, a narrow-range endemic;	3 – rare species	LC – Least Concern	III

Note: RBRF – the Red Data Book of the Russian Federation; RBRB – the Red Data Book of the Republic of Bashkortostan.

*Categories of the degree and priority of environmental measures taken and planned for adoption (conservation status): I priority – immediate adoption of comprehensive measures is required, including the development and implementation of a strategy for the conservation of flora and fungi and (or) a program for their restoration (reintroduction); II priority – the implementation of one or more special measures for the conservation of the taxon is necessary; III priority – enough general measures provided for by the regulatory legal acts of the Republic of Bashkortostan in the field of environmental protection, organization, protection and use of specially protected natural areas for the conservation of flora and fungi listed in the Red Data Book of the Republic of Bashkortostan.

2 Materials and Methods

The material for the primary introduction experiment was rare species of plants of the Fabaceae family, grown in the introduction nursery of the Ufa Institute of Biology of the Ufa Federal Research Center of RAS. The nursery was located on the territory of the South Ural Botanical Garden-Institute of the Ural Federal Research Center of the RAS (Ufa) until September 2020. Mobilization was carried out with seeds from natural populations (collectors: Muldashev A.A., Galeeva A.Kh., Elizaryeva O.A.) using the laboratory-greenhouse method of growing seedlings. The nursery occupies a levelled open plot with grey forest loamy soil. The species of the Fabaceae family were grown in monoculture in the introduction nursery. We used the plan of observation and description of rare and endangered plant species in the introduction experiment developed in the Main Botanical Garden of the Russian Academy of Sciences (Moscow) [17]. The prospects for cultivation

and reproduction in the conditions of the botanical garden of rare species of the Fabaceae family in the experience of primary introduction were determined according to the scale of a comprehensive introduction assessment by R.A. Karpisonova (1979) [18] with additions by L.I. Tomilova (1982) [19]. A brief description of the species and their distribution in the RB is given according to the regional Red Data Book (2021) [1].

3 Result and Discussion

Astragalus clerceanus is a perennial herbaceous plant with ascending or creeping stems. The plant height is 35-50 cm. In RB the species occurs on the western macroslope of the Southern Urals. Xeromesophyte, calcephilus, petrophyte. The species grows in crevices of limestone rocks, on limestone rubble and on primitive stony soils on rock shelves. Under cultivation conditions, 2 samples were tested. Plants pass through the whole shoots development cycle every year. This is a summer flowering plant. It blooms in July – August. Seeds ripen in August – September. Phenoritmotype is a spring-summer-autumn-green plant with a period of winter dormancy. Plants begin to bloom and bear fruit in the 1st-2nd year of development. The life cycle lasts 2-5 years. Propagated by seeds. Abundant self-seeding is observed, plants go beyond the cultivated area. The size of the plant does not differ from natural. The plant height is 20-40 cm. Plants are not damaged by diseases and pests. During the winter and spring period, the elimination of plants is 10-20%. This species is promising for cultivation.

Hedysarum grandiflorum is a perennial taprooted caudex-forming herbaceous rosette plant. Plant height is 25-40 cm. In the RB the species occurs in the Bashkir Cis-Urals (Bugulma-Belebeevskaya Upland, Pribelskaya Lowland, General Syrt) in 20 administrative districts, occurs in isolation in the Mesyagutovskaya forest-steppe. Mesoxerophyte, petrophyte, calcephilus. The species grows in stony steppes, on rubbly slopes on eroded, organic-gravelly and underdeveloped thin chernozems underlain by carbonate rocks (limestone, gypsum, etc.) and carbonatized sandstones. In the experience of primary introduction, 3 samples were tested. Plants pass through the whole shoots development cycle every year. This is a summer flowering plant. It blooms in June – July. Flowering is plentiful. Seeds ripen in August – September. Few fruits and seeds are produced. Phenoritmotype is a spring-summer-autumn-green plant with a period of winter dormancy. Plants begin to bloom and bear fruit in the 2nd-4th year of development. In the pregenerative period, a significant elimination of plants is observed. The pace of ontogenesis is accelerated, it is short in duration (2-4 years). Propagated by seeds. Self-seeding is not observed. Plant height is up to 35 cm. Plants are not damaged by diseases and pests. This species has a low degree of prospects for cultivation.

Hedysarum razoumovianum is a perennial tap-rooted herbaceous plant, the stems are erect, usually numerous. Plant height 20-40 cm. In RB it is mainly found in the Bashkir Cis-Urals on the Common Syrt and the Bugulma-Belebeev Upland, occasionally on the western spurs of the Southern Urals. Mesoxerophyte, petrophyte, obligate calcephil. The species grows in stony steppes, on gravelly and rocky ridges of hills, on eroded, organogenic-gravelly and underdeveloped thin chernozems underlain by carbonate rocks (limestones, marls) and carbonatized sandstones. In the experience of primary introduction, 3 samples were tested. This is a summer flowering plant. It blooms in June – July. Fruiting is not annual. Plants produce few fruits and seeds. Seeds ripen in August. The seeds are complete. Phenoritmotype is a spring-summer-autumn-green plant with a period of winter dormancy. The plant begins to bloom and bear fruit in the 2nd-4th year of development. The pace of ontogenesis is accelerated, it is short in duration (2-5 years). Propagated by seeds. Self-seeding is not formed. The size of the plant is smaller than natural. Plant height 15-25

cm. Plants are not damaged by diseases and pests. During the winter period, the elimination of plants is up to 50%. This species has a low degree of prospects for cultivation.

Medicago cancellata is a perennial herb. The rhizome is thick, the roots go deep into the soil. Stems with a woody base, numerous, strong, straight, densely leafy. Plant height 15-25 cm. In RB, the species was herbarized at 6 sites in the Bashkir Cis-Urals (Bugulma-Belebeevskaya Upland). Xerophyte, petrophyte, calcephyte. It grows in the steppes on open stony slopes, mainly on carbonated Permian sandstones and their destruction products. In the RB, it occurs exclusively in sandy steppes, on the tops of erosional cone-shaped remnants (shikhans). Prefers southern slopes. Grows in disturbed steppes with sparse herbage (no turf grasses). In the experience of primary introduction, 2 samples were tested. Plants pass through the whole shoots development cycle every year. This is a summer flowering plant. It blooms in June – July. Seeds ripen in August – September. Phenoritmotype is a spring-summer-autumn-green plant with a period of winter dormancy. The plant begins to bloom and bear fruit in the 2nd-4th year of development. Propagated by seeds. Self-seeding is not formed. Plant height is 15-25 cm. Plants are not damaged by diseases and pests. Winter-resistant, drought-resistant. This species is promising for cultivation.

Oxytropis hippolyti is a perennial tap-rooted caudex-forming herbaceous rosette plant. Plant height is 20-40 cm. In RB, the species grows in the Bashkir Cis-Urals. The main range of the species is located on the Bugulma-Belebeevskaya Upland. Xerophyte, petrophyte, calcephilus. The species is found in petrophytic, real and meadow steppes. It often grows in disturbed phytocenoses and on primary outcrops. This species is erosiophil and sometimes grows en masse on terraced slopes in forest plantations. It grows on organogenic gravelly and thin chernozem-like soils underlain by carbonate rocks. In the experience of primary introduction, 1 samples were tested. Plants pass through the whole shoots development cycle every year. This is a summer flowering plant. It blossoms in June – July. Flowering and fruiting are annual, plentiful. Seeds ripen in August – September. The seeds are complete. Propagated by seeds. There is a non-annual self-seeding. Self-seeding is viable. Laboratory germination of freshly harvested seeds is 80-100%. The phenological rhythm of development is stable. Phenoritmotype is a long-term vegetative spring-summer-autumn-green plant with a period of winter dormancy. Plants begin to bloom and bear fruit in the 2nd-4th year of development. Life cycle is 2-5 (7) years. Plant height is up to 40 cm. Diseases and pests are not damaged. Winter-resistant. This species is very promising for cultivation.

4 Conclusion

The introduction studies have shown the possibility of conservation and reproduction rare species of the Fabaceae family of the flora of the RB under cultivation conditions. According to the scale of a comprehensive introduction assessment (according to R.A. Karpisonova (1979) [18] and L.I. Tomilova (1982) [19], under cultivation in the forest-steppe zone of the republic, *O. hippolyti* is a very promising species, *A. clerceanus* and *M. cancellata* are promising species, *H. grandiflorum* and *H. razoumovianum* are unpromising species. It is necessary to continue studying the ecological and biological characteristics of rare species of the Fabaceae family under cultivation conditions. For the successful development of plants, it is necessary to create conditions that are as close as possible to the ecological and phytocenotic conditions of their natural habitats.

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