

Perspectives for the conservation of rare species of the genus *Potentilla* L. (Rosaceae) of the flora of the Republic of Bashkortostan

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Abstract. The article presents the results of the primary introduction experience of rare species of the genus *Potentilla* L. (Rosaceae Juss.) of the flora of the Republic of Bashkortostan. There are 5 rare species in the collection: the Pleistocene relic species *Potentilla agrimonioides* Bieb., *P. arenosa* (Turcz.) Juz., *P. nivea* L., the South Ural endemic *P. eversmanniana* Fisch. ex Ledeb., the Ural endemic *P. kuznetzowii* (Govor.) Juz. These species are included in the Red Data Book of the Republic of Bashkortostan (2021). In the collection, each species is represented by one sample. The mobilization was carried out by seeds from natural populations. Species of the genus *Potentilla* were grown in monoculture in the introduction nursery of the Ufa Institute of Biology. Plants go through a full cycle of annual development of shoots and give viable seeds (except *P. arenosa*). According to the scale of introduction resistance proposed by N.V. Trulevich (1991), under cultivation in the forest-steppe zone of the republic, *P. agrimonioides* and *P. kuznetzowii* are resistant species, *P. eversmanniana* and *P. nivea* are weakly resistant, *P. arenosa* is unstable species.

1 Introduction

Species of the genus *Potentilla* L. (Rosaceae Juss.) are valuable useful plants. They are known as medicinal, melliferous, ornamental, fodder and technical plants [1-5]. Species of the genus *Potentilla* are studied in many botanical gardens (BG) and introduction centers of the Russian Federation [6-8]. Some rare species of the genus *Potentilla* are protected under cultivation conditions (ex situ) [6, 9-14].

The flora of the Republic of Bashkortostan (RB) contains 30 wild species of the genus *Potentilla* (Herbarium UFA) [15, 16]. Seven of them are rare and endangered species and are included in the Red Data Book of the Republic of Bashkortostan (2021) [16]. The primary introduction test of five rare species of the genus *Potentilla* from the regional Red List was carried out in the Botanical garden (Ufa) [16, 17]. These are the following rare species – the Pleistocene relic of South Siberian origin *Potentilla agrimonioides* Bieb. (rarity status category: 2 – species declining in numbers; endangered species status category characterizing the state of the species in its natural habitat: Vulnerable – VU); the Pleistocene relic of the

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Siberian flora *P. arenosa* (Turcz.) Juz. (3 – rare species; Near Threatened – NT); the South Urals endemic *P. eversmanniana* Fisch. ex Ledeb. (1 – endangered species; Endangered – EN); the Ural endemic *P. kuznetzowii* (Govor.) Juz. (1 – endangered species; Critically Endangered – CR); the Pleistocene relic of Arctic flora *P. nivea* L. (1 – endangered species; Critically Endangered – CR) [16]. The South Ural endemic species *P. eversmanniana* is protected at the federal level and included in the Red Data Book of the Russian Federation (1 – endangered species) (2008) [18].

These species belong to the priority rare species of the flora of the Republic of Bashkortostan (South Ural) that need special measures for their protection (conservation): introduction to protect the gene pool and obtain planting and seed material for reintroduction, artificial increase in the number of small populations, creation of artificial populations in similar environmental conditions.

The purpose of this work is to assess the success of the primary introduction and the possibility of protecting rare species of the genus *Potentilla* of the flora of the Republic of Bashkortostan under cultivation conditions in the forest-steppe zone of the region.

2 Materials and methods

The material for the primary introduction experiment was rare species of plants of the genus *Potentilla*, grown in the introduction nursery of the Ufa Institute of Biology of the Ufa Federal Research Center of Russian Academy of Sciences (the territory of The Botanical Garden, Ufa). Mobilization was carried out with seeds from natural populations (collectors: Muldashev A.A., Elizarieva O.A.) using the laboratory-greenhouse method of growing seedlings. In the collection, each species is represented by one sample. The nursery occupies a levelled open plot with grey forest loamy soil. Species of the genus *Potentilla* were grown in monoculture in the introduction nursery. We used the plan for observing in the introduction experiment of rare and endangered plants, developed in the Main Botanical Garden of the Russian Academy of Sciences (Moscow) [7]. The resistant of rare species of the genus *Potentilla* under the conditions of the primary introduction experiment was determined according to the scale of the introduction assessment by N.V. Trulevich (1991) [7], which has been sufficiently tested in the study of rare plant species in botanical gardens.

3 Results and discussion

3.1 *Potentilla agrimonioides* in introduction experiment

Potentilla agrimonioides is a tap root herbaceous perennial plant. The plant height is 10-30 cm. Hemicryptophyte [19].

It is Anterior Asian-South Ural-South Siberian mountain-steppe species distributed in the Caucasus, Iran, the Southern Urals, and Southern Siberia [20, 21]. In RB it occurs in 12 localities [16].

Mesoxerophyte. Petrophyte. It grows on steppe rocks, in stony steppes [19]. It settles on basic rocks of different composition [21]. It occurs with low constancy in the hyperpetrophytic steppes of the forest-steppe zone of the Trans-Urals, confined to rocks of metamorphic origin: granites, jaspers and hyperbasites; with such characteristic species as *Artemisia frigida*, *Aster alpinus*, *Dianthus acicularis*, *Orostachys spinosa*, etc. [22].

The species has been studied in introduction since 2017. The plant height is 15-35 cm (Figure 1). Plants have 2-5 generative shoots. Plants pass through the whole shoots development cycle every year. The habitus of plants in culture is preserved. The species reproduces by seeds. Their seasonal rhythmotype is spring-summer-autumn-green. Plants

bloom in the second year of development. The flowering period encompasses May. According to the flowering time (flowering period), this is a late spring plant, according to the duration of flowering – medium-long-flowering (up to 20 days). Seeds ripen in June. Seeds are full-fledged. Self-seeding is not observed. It remains in culture for three or more years. The species is resistant.



Fig. 1. *Potentilla agrimonioides* in the introduction nursery (budding, May).

The species was tested at the Botanical Garden of the Chelyabinsk State University (Chelyabinsk) and recommended for the design of urban public areas [23].

3.2 Potentilla arenosa in introduction experiment

P. arenosa is a tap root herbaceous perennial with a multi-headed caudex. The plant height is 20-30 cm.

It is South Siberian species found in the Urals (Middle and Southern), in Western and Eastern Siberia and Mongolia (north) [19].

In RB, it is distributed only in the mountains of the Southern Urals, mainly on its eastern macroslope. In RB, the species is near the southern and western borders of the range [16].

Mesoxerophyte. Petrophyt. It grows on steppe rocks, in stony steppes [19]. In RB it occurs on rocks, stone outcrops, less often in strongly stony petrophytic steppes almost exclusively on peaks, often in the form of rock outcrops and ridges, ridges. Almost all habitats of this species are associated with volcanic rocks. It grows on fine earth or organogenic gravelly soils [16].

The species has been studied in introduction since 2015. Plants in the first year of life reach an immature state, vegetate for one season, after winter do not grow back. The species is unstable (Figure 2).



Fig. 2. Young plants *Potentilla arenosa* (seedling).

The species has been studied in introduction in The South Ural Botanical Garden-Institute of the Ufa Federal Research Center of Russian Academy of Sciences (Ufa). Plants grow in open ground on the site of the Laboratory of wild flora and the introduction of herbaceous plants [14, 24].

The species has been studied in introduction since 1979 in the Yakutsk Botanical Garden (Yakutsk) [25]. The introductory assessment is a highly resistant species.

3.3 *Potentilla eversmanniana* in introduction experiment

P. eversmanniana is a tap root herbaceous perennial plant with a multi-headed compact caudex. The plant height is 20-35 cm.

The species has a disjunctive range. The species occurs in the Southern Urals and in the Kazakh uplands [16].

Mesoxerophyte. Calcephilus. Petrophyt. It grows in stony steppes, usually with sparse herbage. It often grows on limestone outcrops.

It occurs in fescue-forb and feather-grass-forb communities [16].

The species has been studied in introduction since 2014. The plants height are 12-27 cm (Figure 3). Plants pass through the whole shoots growth cycle every year. Plants in culture do not reach natural size. The survival rate of young plants reached 16.7%. The species reproduces by seeds. A significant part of the plants die off in winter. Their seasonal rhythmotype is spring-summer-autumn-green. Plants begin to bloom from the second year of development.



Fig. 3. *Potentilla eversmanniana* and *P. kuznetzowii* in the introduction nursery (fruiting, June).

The flowering period encompasses May. According to the flowering time (flowering period), this is a late spring plant, according to the duration of flowering – medium-long-flowering (up to 20 days). Seeds ripen in June. Seeds are full-fledged. Self-seeding is not

observed. In culture, the species is short-lived. It remains in culture for two years. The species is weakly resistant.

3.4 *Potentilla kuznetzowii* in introduction experiment

P. kuznetzowii is a tap root herbaceous perennial plant. The plant height is 10-25 cm. Hemicryptophyte.

The species is distributed in the Urals (from the Polar to the South) and the Timan Ridge. Mesophyte. Calcephilus. Petrophyt. The species grows on riverside limestone rocks and talus. The species is discovered in the republic in 1996 (in the Kugarchinsky district).



Fig. 4. *Potentilla kuznetzowii* in the introduction nursery (flowering, May).

The species has been studied in introduction since 2002 [26, 27]. The plant height varies from 22.7 to 35.7 cm depending on cultivation conditions (Figure 3, 4, 5). Plants have 2-20 generative shoots. The habitus of plants in culture is preserved. Plants pass through the whole shoot growth cycle every year. The species reproduces by seeds. Their seasonal rhythmotype is spring-summer-autumn-green plant. Plants begin to bloom from the second – third year of development. The flowering period encompasses May. According to the flowering time (flowering period), this is a late spring plant, according to the duration of flowering – medium-long-flowering. Seeds ripen in June (III decade) – July (I decade). Seeds are full-fledged. Laboratory seed germination is 40-90%. There is a single self-seeding, non-annual. Self-seeding is observed. Self-seeding is viable. In some years, the leaves are damaged by rust. It remains in culture for three or more years. The lifespan of plants depends on growing conditions. The species is resistant.

The biological features and methods of reproduction of *P. kuznetzowii* are studied in the Botanical Garden of the Institute of Biology, Komi Science Center, Ural Branch, Russian Academy of Sciences [12]. The Botanical Garden is located in the conditions of the middle subzone of the taiga of the Komi Republic. The species is included in the Red Data Book of the Republic of Komi (2019) [28] with status 3 – a rare species. *P. kuznetzowii* plants flower and bear fruit. There is a single self-seeding in some years.



Fig. 5. *Potentilla kuznetzowii* in the introduction nursery (vegetation, September).

3.5 *Potentilla nivea* in introduction experiment

P. nivea is a tap root herbaceous perennial plant. The plant height is 20-30 cm.

It is the Holarctic species, common in Central and Eastern Europe, the Caucasus, Siberia, Central Asia, Mongolia, China and North America. In the Urals, it occurs from the Polar to the South. It was discovered relatively recently in RB in 2 localities [16].

It grows in mountain and plain tundras, on loaches, in thickets of bushes. In the Republic of Bashkortostan, it was found on basalt rocks and mossy scree below them at an altitude of about 1300 m a.s.l. m. in community with *Cerastium jenisejense*, *Dianthus acicularis*, *Oxytropis sordida*, *Rhodiola iremelica*, *Saxifraga spinulosa*, *Schivereckia hyperborea*, *Poa korshinskyi*, *Thymus paucifolius*, etc. [16].



Fig. 6. *Potentilla nivea* in the introduction nursery (vegetation, September).

The species has been studied in introduction since 2010. The plants height is 7.0-7.5 cm (Figure 6). Plants pass through the whole shoot growth cycle every year. Plants have 1-4 reproductive shoots. The species reproduces by seeds. Their seasonal rhythmotype is spring-summer-autumn-winter-green. Plants begin to bloom at 3-4 years of age. Plants bloom and bear fruit non-annually. The flowering period encompasses May. According to the flowering time (flowering period), this is a late spring plant, according to the duration of flowering – medium-long-flowering. Seeds ripen in May and June. Seeds are full-fledged. In some years, up to 100% of the flowers form fruits, and the proportion of completed seeds per fruit is 45.5%. Self-seeding is not observed. In some years, the leaves are damaged by rust. The species is weakly resistant [17, 29].

4 Conclusions

Primary introduction studies have shown the possibility of conservation and reproduction rare species of the genus *Potentilla* of the flora of the Republic of Bashkortostan under cultivation conditions. According to the scale of introduction resistance proposed by N.V. Trulevich (1991) [7], under cultivation in the forest-steppe zone of the republic, *P. agrimonioides* and *P. kuznetzowii* are resistant species, *P. eversmanniana* and *P. nivea* are weakly resistant, *P. arenosa* is unstable species. It is necessary to continue studying the ecological and biological characteristics of rare species of the genus *Potentilla* under cultivation conditions. For the successful development of plants, conditions are necessary that are as close as possible to their "native" natural habitats.

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