

Notes on the taxonomy of *Spiraea aemiliana* and related species (Rosaceae) in Russia

Vera Kostikova*, Victoria Troshkina

Central Siberian Botanical Garden, SB RAS, Str. Zolotodolinskaya, 101, Novosibirsk, 630090, Russia

Abstract. The diversity of the plants of *Spiraea* genus, *Calospira* section in terms of the morphological characters on the basis of 28 natural populations was studied. Two species of *Calospira* section spirea grow in the Asian part of Russia (*S. betulifolia* Pall. and *S. beauverdiana* C.K. Schneid.). *S. betulifolia* Pall. subsp. *aemiliana* (C.K. Schneid.) H. Hara subspecies grows on the Islands in the Asian part of Russia (Sakhalin and the Kuril Islands). Its distinctive features are small round or spatulate (obovate) lamina and the absence of the inflorescence follicles pubescence, as well as a few metrical characteristics that may be auxiliary in determining the taxon.

Introduction

The research of a polymorphous species complex *S. betulifolia* Pall. – *S. beauverdiana* C.K. Schneid., the plants of *Spiraea* genus, *Calospira* section in Asian part of Russia confirmed the existence of 2 species. *S. beauverdiana* differs from *S. betulifolia* in having dense pubescence of the pedicles and the follicles and the curved position of the follicle rostrum. Two studied species of *Spiraea* genus of *Calospira* section are indistinguishable in terms of quantitative morphological characters. The qualitative composition of the phenolic compounds in aqueous ethanol extractions from spirea leaves is species-specific [1, 2]. Some researchers mark out one more species *S. aemiliana* C.K. Schneid. as a subset of the polymorphous complex *S. betulifolia* – *S. beauverdiana*. This taxon has low height up to 30 cm and round coin-shaped leaves. In terms of the habit it is closest to *S. beauverdiana*. Besides Russia, it also grows in Japan [3]. C.K. Schneider [4] described this species from his research in the high-mountains of Hokkaido, Japan. *S. aemiliana* was described as a separate species by V.N. Voroshilov [5, 6] in the «Flora Sovetskogo Dalnego Vostoka» and the «Opredelitel rasteniy Sovetskogo Dalnego Vostoka». G. Koidzumi [7] ascribed to this species the rank of a variety of *S. betulifolia* Pall. var. *aemiliana* (C.K. Schneid.) Koidz., considering it a synonym of *S. beauverdiana*. The same point of view was expressed by J. Ohwi [8] in the «Flora of Japan» and H. Ikeda [9] in his «Flora of Japan». H. Hara [10] transferred this taxon into the rank of *S. betulifolia* Pall. subsp. *aemiliana* (C.K. Schneid.) H. Hara. V.V. Yakubov [11] noted that on the Southern Kuril Islands one can frequently see a type of *S. betulifolia* with small coin-shaped leaves, which has the appearance similar to the kin species *S. beauverdiana*, differing from it in having completely bare

* Corresponding autor: serebryakova-va@yandex.ru

inflorescence pedicles. In the opinion of N. N. Tsvelev [12], shortgrowing, parvifolious and almost void of pubescence *S. betulifolia* samples from Kunashir Island deserve an independent species' rank which he had denoted as the new *S. vorobjevii* Tzvelev species.

Materials and Methods

In the Asian part of Russia, *S. betulifolia* has been collected from 17 populations and *S. beauverdiana* from 7 populations in 2003–2017 in Amur, Magadan, Sakhalin and Kamchatka regions, the Jewish Autonomous Oblast, Khabarovsk Krai, Primorski Krai and the Republic of Yakutia. The populations of plants with *S. aemiliana* habit has been collected in two locations on Kunashir Island (the «Kislaya» and the «Kipyashchaya» populations). Each of the population includes not less than 30 specimens. All the collecting was done in July and August, during the follicle ripening period. To study the morphological variability, we selected the qualitative and the quantitative characteristics of the most functionally significant organs: the lamina, blossom clusters and the stalks [13]. The shape of the lamina was determined by the criteria which had been developed earlier [14].

Results and Discussion

We discovered the plants with the typical small and round shape of the lamina only in the «Kislaya» and the «Kipyashchaya» populations from the Kunashir Island (see the Table). We have not discovered such a lamina anywhere else. The round shape of the lamina prevails in these plants. Also, comparatively small spatulate shape of the lamina has been noted in these populations. The plants from the «Kislaya» and the «Kipyashchaya» populations do not differ from *S. betulifolia* by any other qualitative characteristics. No significant differences in quantitative characters have been discovered. The plants from the «Kislaya» and the «Kipyashchaya» populations have smaller mean values of some metrical characteristics, and they do not overlap with the mean values of *S. betulifolia* and *S. beauverdiana*: «The length of the leaf», «The distance from the leaf base to the widest part of the leaf», «The petiole length», while the relative characteristic «The relative length-to-width ration» and «The ratio of the bud length to the petiole length» are noted more in *S. aemiliana*. However, the scope of the abovementioned characteristics in the plants of the «Kislaya» and the «Kipyashchaya» samples fit with the variability amplitude of *S. betulifolia* and *S. beauverdiana*. The putative *S. aemiliana* plants are closer to *S. beauverdiana* in terms of its quantitative characteristics.

Besides, the genome size of the studied spirea and the chemotaxonomy have been researched. The values of the relative DNA content in the spirea are reliably different with high statistical significance ($p < 0,001$). The relative DNA content in *S. betulifolia* ($2C = 0,91$ and $1,01$ pg) is two times higher than the corresponding values for other species. *S. beauverdiana* ($2C = 0,55$ and $0,5$ pg) and the putative *S. aemiliana* ($2C = 0,45$ and $0,48$ pg) are more related taxons in terms of DNA content [15]. The study of the interpopulation variability of the *Calospira* spirea in terms of phenolic compounds demonstrated that *S. betulifolia* is different from *S. beauverdiana* in the rutin and avicularine content in water-ethanol extractions from the leaves. Additional components which are absent in *S. betulifolia* have been discovered in *S. beauverdiana* leaves. The putative *S. aemiliana* samples are not much different from *S. betulifolia* sample in terms of the phenolic compounds content, however, the *S. aemiliana* leaves contain isoquercitrin absent in *S. betulifolia* and *S. beauverdiana* [16].

Thus, we should mark out a separate *S. betulifolia* subsp. *aemiliana*, which is rather

different in having small round lamina shape on the basis of the research conducted in Russia. This taxon does not differ from *S. betulifolia* in terms of other qualitative characters and is close to *S. beauverdiana* in its quantitative characters.

Table. Variability in the shape of lamina of the *Spiraea* genus, section *Calospira*

Taxon	The shape of lamina				
	Ellipsoidal	Ooidal	Diamond	Spatulate	Rounded
					
<i>S. betulifolia</i>	+	+	+	+	-
<i>S. beauverdiana</i>	+	+	-	-	-
«Kislaya»	-	-	-	+	+
«Kipyashchaya»	-	-	-	+	+

We provide the main synonyms for the abovementioned taxons of *Spiraea* genus, *Calospira* section and the key for their determination on the basis of the conducted research.

Spiraea betulifolia Pall. 1784 in Fl. Ross. 1(1): 33; ej 1789 in Fl. Ross. 1(1): 75; Poyark., 1939, in Fl. USSR 9: 288, s. str.; Ohwi, 1965, in Fl. Japan: 521, s. str.; Voroshilov, 1966, in Fl. Sovetsk. Daln. Vost.: 249; Vorobiev, 1968, Dikorastushchiye derev. i kust. Daln. Vost.: 118; Voroshilov, 1982, in Opredel. rast. Sovetsk. Daln. Vost.: 337; Polozhiy, 1988, in Fl. Sib. 8: 14; Yakubov, 1996, Sosud. rast. Sovetsk. Daln. Vost. 8: 134, s. str.; Koropachinsky, Vstovskaya, 2012, Drevesn. rast. Aziatsk. Ros.: 384; Tsvelev, 2008, in Novosti Sist. Vyssh. Rast. 40: 80.

S. betulifolia Pall. subsp. *aemiliana* (C.K. Schneid.) H. Hara, 1951, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. ser. 3, Bot. 6: 77. ≡ *S. aemiliana* C.K. Schneid. 1905, Bull. Herb. Boiss. Ser. 2. T. 5(4): 347; Voroshilov, 1966, in Fl. Sovetsk. Daln. Vost.: 349; he is, 1982, in Opredel. rast. Sovetsk. Daln. Vost.: 336. ≡ *Spiraea betulifolia* Pall. var. *aemiliana* (C.K. Schneid.) Koidz., 1909, Bot. Mag. (Tokyo) 23: 166; Ohwi, 1965, in Fl. Japan: 521.

S. beauverdiana C.K. Schneid. 1905, in Bull. Herb. Boiss., 2 ser. 5: 348, incl. var.; Poyark., 1939, in Fl. USSR 9: 289; Voroshilov, 1966, in Fl. Sovetsk. Daln. Vost.: 249; Vorobiev, 1968, Dikorastushchiye derev. i kust. Daln. Vost.: 120; Polozhiy, 1988, in Fl. Sib. 8: 12; Yakubov, 1996, Sosud. rast. Sovetsk. Daln. Vost. 8: 134; Tsvelev, 2008, in Novosti Sist. Vyssh. Rast. 40: 81, hybr.; Koropachinsky, Vstovskaya, 2012, Drevesn. rast. Aziatsk. Ros.: 383. ≡ *S. stevenii* (C.K. Schneid.) Rydb. 1908, in N. Amer. Fl. 22(3): 247; Voroshilov, 1966, in Fl. Sovetsk. Daln. Vost.: 250; Vorobiev, 1968, Dikorastushchiye derev. i kust. Daln. Vost.: 120; Tsvelev, 2008, in Novosti Sist. Vyssh. Rast. 40: 80.

The key to the taxons of *Calospira* section in Russia

1. Pedicels and follicles are bare, or with scarce or single pubescence, the rostrum of follicle is straight.....3
2. Pedicels and follicles have dense and wooly pubescence, the rostrum of follicle is curved.....5
3. The stem length is bigger than the bud length, the leaves have ooidal, ellipsoidal,

- spatulate or diamond shapes.....*S. betulifolia*
 4. The stem length is equal to the bud length, the leaves are small and of round or spatulate shape*S. betulifolia* subsp. *aemiliana*
 5. The stem equals the bud in length, the leaves are of ellipsoidal or ooidal shape.....*S. beauverdiana*

Conclusion

The authors have studied the diversity of the *Calospira* section *spirea* in terms of the quantitative morphological characters on the basis of 28 natural samples. The key has been made for the identification of species. Two species of *Calospira* section *spirea* grow in the Asian part of Russia (*S. betulifolia* and *S. beauverdiana*), which most probably used to be 2 ecotypes of the same species some time ago. *S. betulifolia* subsp. *aemiliana* subspecies grows on the Islands in the Asian part of Russia (Sakhalin and the Kuril Islands). Its distinctive features are small round or spatulate (obovate) lamina and the absence of the inflorescence follicles pubescence, as well as a few metrical characteristics, the average values of which do not overlap with *S. betulifolia* and *S. beauverdiana* average values. This taxon has a trend towards stabilization of morphological characteristics, but has not yet sufficiently separated from *S. betulifolia*.

The reported study was funded by RFBR according to the research (project No. 16-34-00106 мол_a to Kostikova)

References

1. V.A. Kostikova, T.A. Polyakova, *Contemp. Probl. of Ecol.*, **7**, 3 (2014)
2. V.A. Kostikova, T.A. Polyakova, *Bull. of Mosc. Soc. of Natur.*, 4 (2018)
3. D.P. Vorobiev, *Wild trees and shrubs of the Far East. Determ.* (Nauka, L. 1968)
4. C.K. Schneider, *Bull. Herb. Boiss.*, **5**, 4 (1905)
5. V.N. Voroshilov, *Flora of the Soviet Far East* (Nauka, M., 1966)
6. V.N. Voroshilov, *Determ. of plants of the Soviet Far East* (Nauka, M., 1982)
7. G. Koidzumi, *Bot. Mag. Tokio*, 23 (1909)
8. J. Ohwi, *Flora of Japan* (DC: Smithsonian Institution, Washington, 1965)
9. H. Ikeda, *Flora of Japan*, **2b** (Tokyo, 1995)
10. H. Hara, *J. Fac. Sci. Univ. Tokyo*, 3, **6** (1952)
11. V.V. Yakubov, *Vascular plants of the Soviet Far East*, **8** (Nauka, St. Petersburg, 1996)
12. N.N. Tsvelev, *Systematics news of higher plants*, **40** (2008)
13. T.A. Polyakova *Intraspecific variability of the Far Eastern and Siberian species of the genus Spiraea L. : PhD thesis* (SB RAS, Novosibirsk, 2004)
14. A.A. Fedorov et al. *Atlas on descriptive morphology of higher plants. Sheet* (Edition of the USSR AS, M. – L., 1956).
15. V.A. Kostikova, M.S. Voronkova, E.V. Banaev, T.A. Polyakova, *Botan. Pacif.*, 7(1) (2018)
16. V.A. Kostikova, *Mat. of the VI Internat. Scient. Conf. dedicated to the 100th anniversary of Prof. A.V. Polozhiy* (State University Publishing House Tomsk, Tomsk, 2017)