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Taxonomy of *Symphytum asperum* Lepechin and *S. sylvaticum* Boiss. (Boraginaceae) based on Macro- and Micro-morphology

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Abstract

Symphytum asperum Lepechin and *S. sylvaticum* Boiss. species are taxonomically very difficult to solve. Many taxonomical arrangements were done by different researchers before with observing herbarium sheets. In our research 25 populations were observed in field and we reached the decision that both of these species' infraspecific taxa should be synonymized because of the continuation of the characters used to distinguish taxa before. *S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto proposed by Kurtto was synonymed and included in *S. asperum* Lepechin. *S. sylvaticum* Boiss subsp. *sepulcrale* var. *sepulcrale* and *S. sylvaticum* Boiss subsp. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet var. *hordokopii* (Kurtto) R.Mill. were synonymed and included to *S. sylvaticum*. The reasons of these taxonomical rearrangements were gathered from field observations, morphological measurements and scanning electron microscope images.

INTRODUCTION

The genus *Symphytum* L. (Boraginaceae) is a mesophytic genus of approximately 40 species, mostly distributed in the Euro-Siberian phytogeographical region. The monophyletic genus *Symphytum*, belongs to tribe Boragineae, is related to west mediterranean genus *Borago* [1], With 18 species, Turkey holds the largest number of *Symphytum* species. North-east Anatolian *Symphytum* species are *S. asperum* Lepechin, *S. sylvaticum* Boiss. and *S. ibericum* Steven. The interspecific hybridization appears to be one of the main speciation processes in the evolution of Symphytum [2]. Therefore especially in North-east Anatolia *S. asperum and S. sylvaticum* group has many taxonomical difficulties to solve. Since the lack of taxonomic confusion about *S. ibericum*, its taxonomy is not discussed here.

S. asperum Lepechin was first described from specimen(s) cultivated in the Botanical Garden of the Academy of Sciences in St. Petersburg. The seeds originated from Caucasus. A closely allied taxon was later described by Boissier [3] from the collections of Balansa from north-east Turkey under the name of *S. sepulcrale* Boiss.& Bal. [4], which is represented in our research as *S. sylvaticum*. Bucknall described *S. armeniacum* Buckn. (Figure 1) in 1913 which related to *S. asperum* and *S.*

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sepulcrale [5]. This taxon was regarded as a variety of *S. asperum* by Kurtto [4]. *S. sepulcrale* Boiss. & Bal. subsp. *sepulcrale* var. *hordokopii* Kurtto was defined as a new variety by Kurtto [4]. However in Flora of Turkey vol. 10 [6] it was changed as *S. sylvaticum* Boiss subsp. *sepulcrale* (Boiss. & Bal.) Greuter & Burdet var. *hordokopii* (Kurtto) R.Mill., according to nomenclatural priority rule. Also *S. sepulcrale* Boiss. & Bal. subsp. *sepulcrale* var. *sepulcrale* was defined by Kurtto [4] is rearranged in Flora of Turkey vol. 10 [6] as *S. sylvaticum* Boiss subsp. *sepulcrale* var. *sepulcrale* (Boiss. & Bal.) Greuter & Burdet for the same reason (Figure 2-4).

Taxonomic rank of these two taxa was rearranged in our research with more sampling and the help of field observations in the area. Morphological measurements, pollen and nutlet information were also given.

MATERIAL AND METHOD

Herbarium of Hacettepe University Biology Department (HUB), Ankara University Faculty of Science (ANK), Gazi University (GAZI), Istanbul University Faculty of Forestry (ISTO), Istanbul University Faculty of Pharmacy (ISTE), Geneva (G) and Berlin (B) were visited to observe specimens and to record localities. Type specimens of *S. armeniacum* Bucknall is housed at CGE and E. Type specimen of *S. armeniacum* was loaned from Edinburgh herbarium (E) and digital image was gathered from Cambridge Herbarium (CGE), measurements were done with both. *S. sylvaticum* Boiss subsp. *sepulcrale* (Boiss. & Bal.) Greuter & Burdet var. *hordokopii* (Kurtto) R.Mill type was loaned from E. *S. sylvaticum* Boiss and *S. sylvaticum* Boiss. subsp. *sepulcrale* (Boiss. & Bal.) Greuter & Burdet var. *sepulcrale* types belong to Boissier Collection (G-Boiss.).

Between 2006 and 2008 a sum of 25 populations were observed in field, in means of morphology, habitats, population and at least 5 specimens with nutlets collected from each population, and prepared as herbarium material then measured. Specimens were deposited in HUB.

For scanning electron microscopy (SEM), pollen grains and nutlets were directly mounted on double-sided adhesive tape and sputter coated with gold and photographed with Philips XL 20 Scanning Electron Microscope. Hairs were observed and photographed with a Tronic stereomicroscope. The list of examined populations was given in Table 1.

RESULTS AND DISCUSSION

Morphology

Kurtto treated *S. armeniacum* Bucknall (Figure 6-lectotype) as a variety of *S. asperum* instead of a separate species (*S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto [4], claiming that indumentum, leaf shape and floral properties show a minor difference. In Flora of Turkey vol. 6 [7], these taxa are distinguished by having or lacking asperous hairs and upper leaves sessile or with petiole. We have found out that these plants have soft hairs at the early stage of flowering time and then hairs become asperous at a later stage of flowering. Also all petioles of lower cauline leaves' are longer than upper ones and the ones at the top are sessile. According to Kurtto [4], calyx of *S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto is slightly longer than *S. asperum* Lepechin var. *asperum*. However as it can be seen from Table 2, the calyx length of var. *armeniacum* is 4-6 mm and this value is not different from other populations of *S. asperum.* Also in Flora of Turkey [7], these two taxa are differentiated from each other with corolla length: var. *asperum* 10.5-13 mm, var. *armeniacum* 13-16 mm. However corolla lengths of all

Table 1. List of examined populations (Type specimens are signed with "*").

No	City	District-village	Altitude (m)	Recognized taxa with our research	Previously recognized taxa by Kurtto (Kurtto, 1982)
1	Artvin	Ardanuç-Kutul platform	2145	*S. asperum*	*S. asperum*
2	Artvin	Şavşat-Veliköy	1965	*S. asperum*	*S. asperum*
3	Ardahan	Yavuzköy-Çamlıbel pass	2005	*S. asperum*	*S. asperum* var. *armeniacum*
4	Ardahan	Posof	1440	*S. asperum*	undefined
5	Ardahan	Damal-Otağlı	2086	*S. asperum*	undefined
6	Ardahan	Göle	1835	*S. asperum*	*S. asperum*
7	Kars	Doğruyol-Çıldır lake	1994	*S. asperum*	*S. asperum*
8	Kars	Sarıkamış-Handere	2115	*S. asperum*	undefined
9	Erzurum-Trabzon*			*S. asperum*	*S. asperum* var. *armeniacum*
10	Trabzon*	Maçka-Hordokop	670	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *hordokopii*
11	Trabzon	Maçka-Hordokop	670	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *hordokopii*
12	Trabzon	Maçka-Dikkaya	1050	*S. sylvaticum*	undefined
13	Trabzon	Maçka-Hamsiköy	1200	*S. sylvaticum*	*S. sylvaticum* subsp. *sylvaticum*
14	Trabzon	Maçka-Hamsiköy	1562	*S. sylvaticum*	*S. sylvaticum* subsp. *sylvaticum*
15	Trabzon	Maçka-Düzköy	1242	*S. sylvaticum*	undefined
16	Trabzon	Maçka-Düzköy	1762	*S. sylvaticum*	undefined
17	Trabzon	Maçka-Altındere	963	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
18	Rize*	İkizdere	1000	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
19	Rize*	İkizdere-Tiron	1365	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
20	Rize	İkizdere-Tiron	1060	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
21	Rize	İkizdere-Çamlıkköy	1523	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
22	Rize	İkizdere-Dereköy	898	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
23	Rize	Çamlıhemşin-Ayder	1550	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
24	Giresun	Tamdere	1690	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*
25	Giresun	Kümbet	1340	*S. sylvaticum*	*S. sylvaticum* subsp. *sepulcrale* var. *sepulcrale*

populations are between 14-20 mm including var. *armeniacum* (Table 2). Greuter et. al [8] synonymed *S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto before the 10th vol. of Flora of Turkey [6]. In Flora of Turkey [6], this taxonomic treatment was not recorded and this taxon was regarded as subspecies. The difference of our research from former is: the researches performed before ours were done by using herbarium sheets, therefore the variations between populations were discarded and small variations in a species are considered as different taxa. Kurtto considered some of the populations in Kars and Artvin as *S. asperum* var. *armeniacum* and some as *S. asperum* var. *asperum.* However from Artvin to Kars *S. asperum* has continous dispersal with big variations in and between populations. With our research, the continuous state of the characters that are used to discriminate taxa was shown. As a result, *S. armeniacum* Bucknall, and *S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto proposed by Kurtto is synonymed and included in *S. asperum* Lepechin.

S. sepulcrale Boiss. & Bal. subsp. *sepulcrale* var. *hordokopii* Kurtto is defined as a new variety by Kurtto [4]. However in Flora of Turkey vol. 10 [6] it was changed as *S. sylvaticum* Boiss subsp.

Table 2. Floral properties of *S. asperum* and *S. sylvaticum* populations (Type specimens are signed with "*").

City	District-village	Altitude (m)	Calyx length (mm)	Corolla length (mm)	Corolla scale length (mm)	Anther length (mm)	Scales exceeding stamens by (mm)	Nutlet length (mm)	Nutlet width (mm)
Artvin	Ardanuç-Kutul platform	2145	5-7	16-17	5-6	2.5-3.5	1	-	-
Artvin	Şavşat-Veliköy	1965	4-5	14-15	5.5-6	4	0	3-3.5	2.5-3
Ardahan	Yavuzköy-Çamlıbel pass	2005	6	15-16	5-5.5	3.5	0	-	-
Ardahan	Posof	1440	3-6	14.5-15,5	5-6	3	1	-	-
Ardahan	Damal-Otağlı	2086	4-5	15-16,5	6.5-7	3	1.5-2	-	-
Ardahan	Göle	1835	5	15-16	5.5-6	3-3.5	0.5	3.5	2.5
Kars	Doğruyol-Çıldır lake	1994	6-6.5	19-20	7-8	3.5	0.5-1	2.5	3
Kars	Sarıkamış-Handere	2115	6	15-16	5.5	3-3.5	0.5-1	-	-
Erzurum-Trabzon*	Maçka-Hordokop	670	4-6	14-15	4.5	2.5	1.5	-	-
Trabzon	Maçka-Dikkaya	1050	6	14	4.5	2.5	1-1.5	4	2.5
Trabzon	Maçka-Hamsiköy	1200	6.5-7.5	13-15	5-5.5	3	1-1.5	3	3
Trabzon	Maçka-Hamsiköy	1562	7-8	16-17	5-5.5	3	1	-	-
Trabzon	Maçka-Düzköy	1242	5,5	13	4	2.5	1	3	2.5-3
Trabzon	Maçka-Düzköy	1762	6	16	6	2.5	2	-	-
Trabzon	Maçka-Altındere	963	4-5	12	5	2-2.5	1	2.5	2.5
Rize*	İkizdere	1000	4.5	11-12	4	2.25	1	3	3
Rize*	İkizdere-Tiron	1365	3-5	10-11	3.5	1.5-2	1	3	2.5
Rize	İkizdere-Tiron	1060	4-5	10-13	5	2-2.5	0.5-1	-	-
Rize	İkizdere-Çamlıkköy	1523	4.5-5	14.5-15	5	3	0.5	-	-
Rize	İkizdere-Dereköy	898	6	15-15.5	5	2.5	1	4	2.5
Rize	Çamlıhemşin-Ayder	1550	5-6	14-15	5-6	2.5	2	-	-
Giresun	Tamdere	1690	4-6	14	5	2-2.5	1-1.5	3.5-3	3
Giresun	Kümbet	1340	6-9	13-15	5	2-3	0.5-1	3.5	3

sepulcrale (Boiss.&Bal.) Greuter&Burdet var. *hordokopii* (Kurtto) R.Mill., according to nomenclatural priority rule, because the "sylvaticum" epithet was published 8 months before "sepulcrale". This taxon was described as a new taxon because of having characters like; having longer softer and more spreading indumentum on the stem and some cauline leaves having long petioles. Also *S. sepulcrale* Boiss. & Bal. subsp. *sepulcrale* var. *sepulcrale* was defined by Kurtto [4] is rearranged in Flora of Turkey vol. 10 [6] as *S. sylvaticum* Boiss subsp. *sepulcrale* var. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet for the same reason. This taxon was considered as a subspecies of *S. sylvaticum* with the reasons that *S. sylvaticum* has more slender and more branched habit, also has shortly attenuate stem leaves with more clearly repand even serrate margin and with smaller floral parts. Specimens collected from field excursions at type localities and surrounding areas showed that the

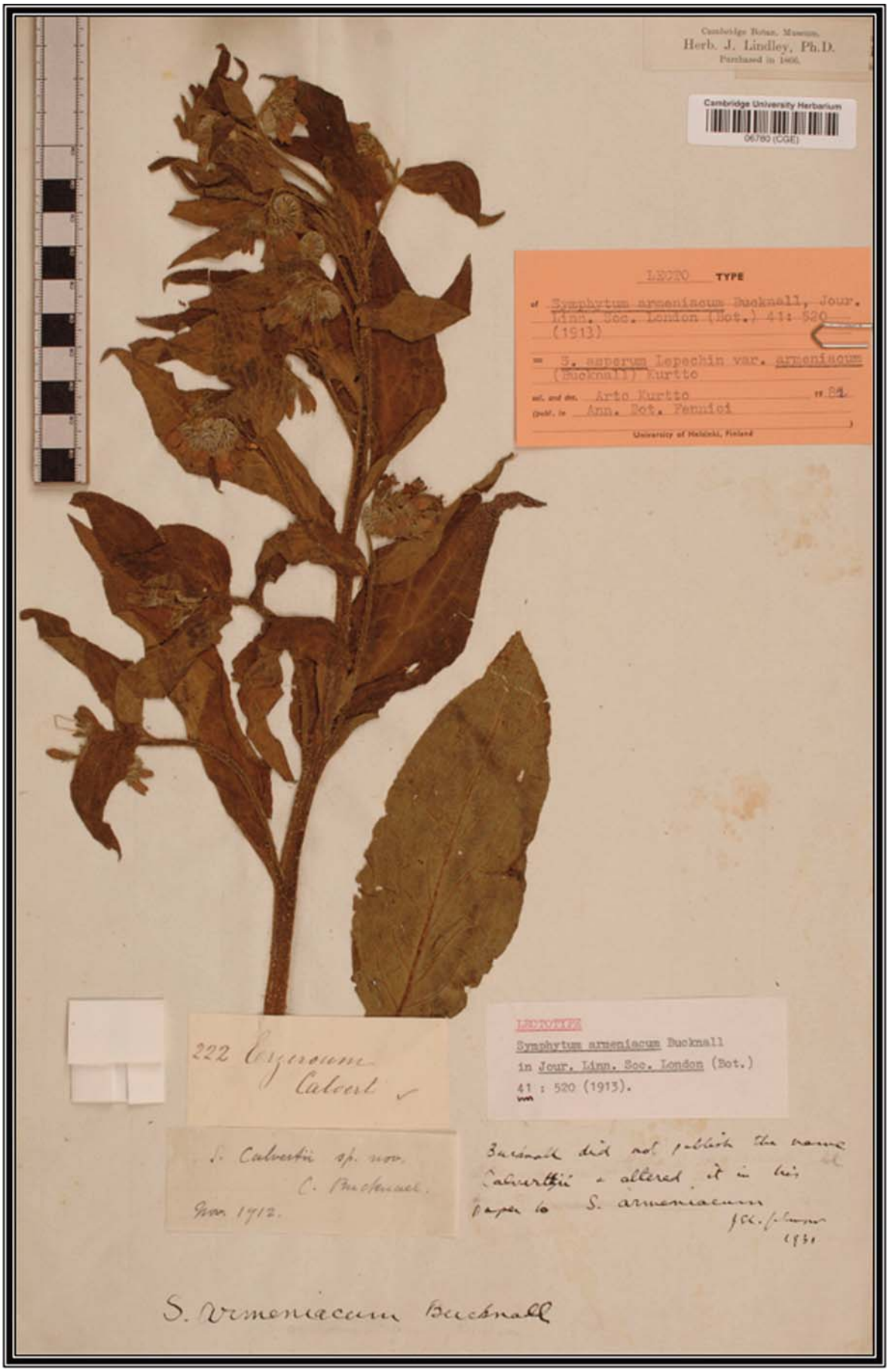

Figure 1. Type specimen of *S. asperum armeniacum* Bucknall (CGE!).

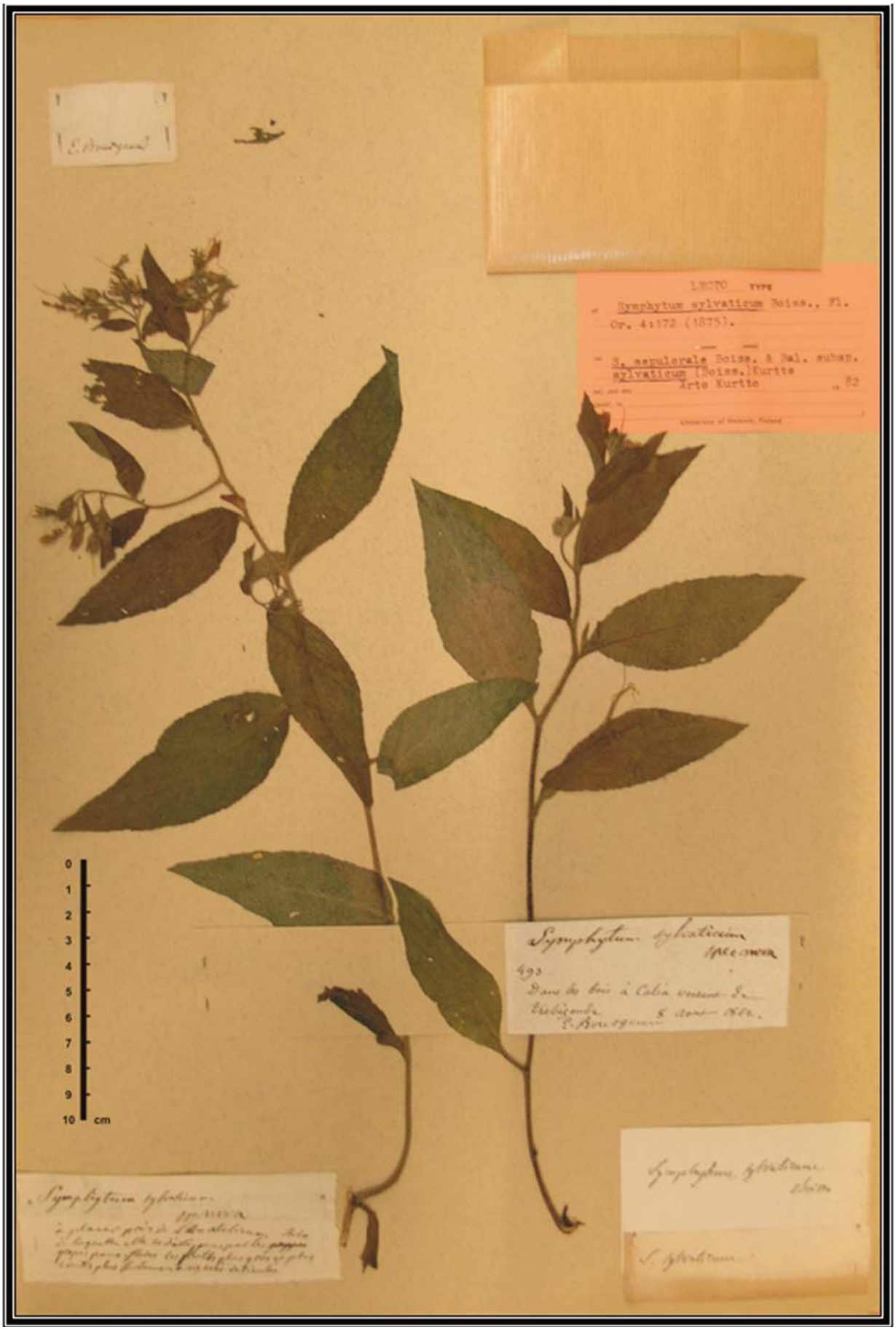

Figure 2. Type specimen of *S. sylvaticum* Boiss (G-Boiss!).

Figure 3. Type specimen of *S. sylvaticum* Boiss. subsp. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet var. *sepulcrale* (G-Boiss!).

Figure 4. Type specimen of *S. sylvaticum* Boiss. ssp. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet var. *hordokopii* (Kurtto) R.Mill. (E!)

characters mentioned to distinguish infraspecific taxa are not constant (Table 2). The discriminating character of subsp. *sylvaticum* from other taxa in Flora of Turkey is: Corolla scale 0.5 mm longer than stamens; measured by us from the population at type locality was ca. 1 mm, also this length was measured 0.5 mm at type locality population of subsp. *sepulcrale* var. *hordokopii* that was given 1-1.5 mm in the diagnostic key of Flora of Turkey. All populations have pleiocormus and branching stems -most probably Kurtto couldn't recognize because he performed his research with herbarium material [4] -therefore this is not a distinguishing character. Another character used was subsp. *sylvaticum* has shorter corolla scale length (3.3-3.7 mm), which other taxa have longer, (4-) 4.2-4.8 mm, in Flora of Turkey [6]. However 4 mm, which was given in parenthesis, is not an extreme value, on the contrary it was measured from many plants at the type locality population of subsp. *sepulcrale* var. *hordokopii* and also other populations in Trabzon and Rize (Table 2). For this reason, 0.3 mm length of difference should be regarded as a variation and discarded. As a result, this group sharing the same distribution area have variations in and between populations so there is no need to name them as different taxa, better to consider *S. sylvaticum* Boiss subsp. *sepulcrale* var. *sepulcrale* and *S. sylvaticum* Boiss subsp. *sepulcrale* (Boiss.&Bal.) Greuter& Burdet var. *hordokopii* (Kurtto) R.Mill. as *S. sylvaticum*.

Indumentum

Symphytum species are hispid herbs. Hairs are mostly strigose, rarely pubescent. Main types of hairs are given in Figure 5. These main types form 17 variants on different organs and/or species (long, short, medium sized, hooked and simple forms).

There are eleven different types of hairs in *S. asperum* Lepechin. The distribution of hair types to organs are given in Table 3. Long simple strigose hairs (l) are present on all organs of plants. Long simple hairs (a) are present on all organs except upper surface of cauline leaves. Medium-sized simple hairs (b) are present on branches of inflorescences in Erzurum-Trabzon population and long hooked strigose hairs (o) are present on branches of inflorescences in Ardahan: Yavuzköy-Çamlıbel pass population. Middle-sized hooked strigose hairs (p) and short hooked strigose hairs (q) are only present on petiole of cauline leaves in Erzurum-Trabzon population.

Table 3. The distribution of hair types to organs in *S. asperum.*

Organs	Hair Types																
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q
Lower cauline	x		x			x						x					
Upper cauline	x		x			x						x	x	x			
Branch of inflorescences	x	x				x	x					x			x		
Petiole of basal leaves	x					x	x					x					
Lower surface of basal leaves	x		x			x	x					x					
Upper surface of basal leaves	x											x	x	x			
Petiole of cauline leaves	x		x			x						x				x	x
Lower surface of cauline leaves	x					x	x					x					
Upper surface of cauline leaves												x	x	x			

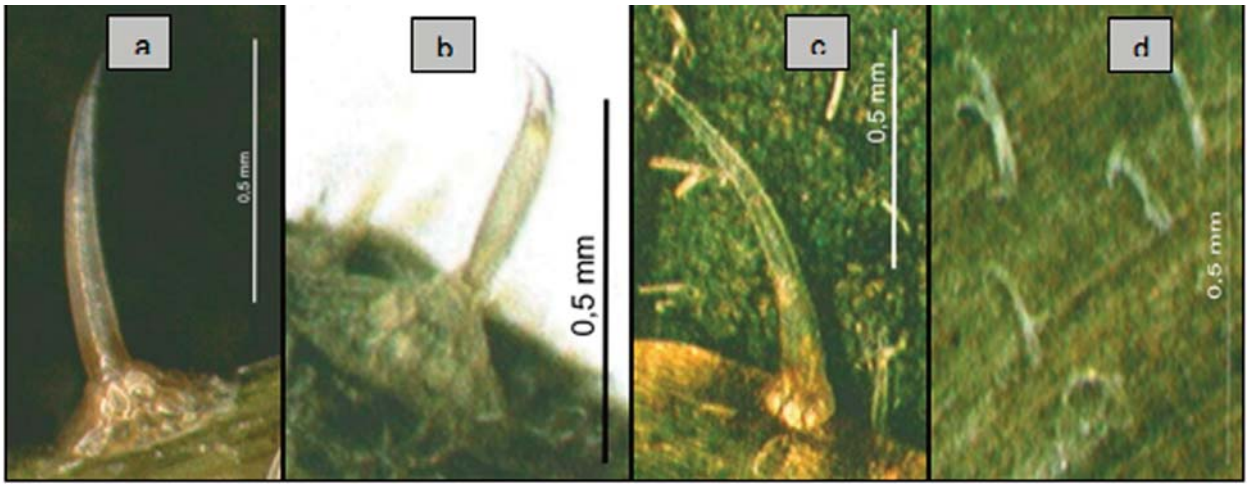

Figure 5. Main hair types of *Symphytum*: a. Long simple hairs arising from tubercles with multi row of cells (strigose) b. Long hooked strigose hairs c. Long simple hairs arising from tubercles with one row of cells d. Short hooked hairs (*S. sylvaticum* - B.Tarıkahya 2608).

Hair types**:** a. Long simple. b. Medium-sized simple. c. Short simple. d. Long hooked. e. Middle-sized hooked. f. Short hooked. g. Long simple hairs arising from tubercles with one row of cells. h. Middle-sized simple hairs arising from tubercles with one row of cells. i. Short simple hairs arising from tubercles with one row of cells. j. Long hooked hairs arising from tubercles with one row of cells. k. Middle-sized hooked hairs arising from tubercles with one row of cells. l. Long simple strigose hairs. m. Middle-sized simple strigose hairs. n. Short simple strigose hairs. o. Long hooked strigose hairs. p. Middle-sized hooked strigose hairs. q. Short hooked strigose hairs.

There are sixteen different types of hairs in *S. sylvaticum* Boiss. The distribution of hair types to organs are given in Table 4. Short hooked hairs (f); long simple hairs arising from tubercles with one row of cells (g) and long simple strigose hairs (l) are present on all organs. Long hooked hairs arising from tubercles with one row of cells (j) are only present on branch of inflorescences in 4 populations in Trabzon and Giresun; middle-sized hooked strigose hairs (p) are only present on lower surface of basal leaves in 7 populations at Trabzon, Rize and Giresun.

Table 4. The distribution of hair types to organs in *S. sylvaticum.*

Organs	Hair Types																
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q
Lower cauline	x		x			x	x	x	x			x	x	x			
Upper cauline	x	x	x			x	x					x	x	x	x		x
Branch of inflorescences	x			x	x	x	x			x		x			x		x
Petiole of basal leaves	x	x	x			x	x	x	x			x	x	x			
Lower surface of basal leaves	x	x	x	x	x	x	x					x	x			x	
Upper surface of basal leaves			x			x	x	x	x			x	x	x			
Petiole of cauline leaves	x	x	x	x	x	x	x	x	x			x	x	x			
Lower surface of cauline leaves	x	x	x	x	x	x	x					x			x		
Upper surface of cauline leaves	x		x			x	x	x	x			x	x	x			

Hair types**:** a. Long simple. b. Medium-sized simple. c. Short simple. d. Long hooked. e. Middle-sized hooked. f. Short hooked. g. Long simple hairs arising from tubercles with one row of cells. h. Middle-sized simple hairs arising from tubercles with one row of cells. i. Short simple hairs arising from tubercles with one row of cells. j. Long hooked hairs arising from tubercles with one row of cells. k. Middle-sized hooked hairs arising from tubercles with one row of cells. l. Long simple strigose hairs. m. Middle-sized simple strigose hairs. n. Short simple strigose hairs. o. Long hooked strigose hairs. p. Middle-sized hooked strigose hairs. q. Short hooked strigose hairs.

Pollen

Outline of pollen grains of *S. asperum* and *S. sylvaticum* is elliptic in equatorial view and circular in polar view (Figure 6-10).

Pollen properties of var. *armeniacum* is similar in shape and texture to *Symphytum asperum* (Figure 6,7). 8-10(-11) colporate, prolate, P/E=1.50. Polar axis 25.5-30.5 µm, equator axis 16.5-24.5 µm. Apertures lalongate, 3.3-4.6 µm long. Colpi 10-14 µm long. Mesocolpium 4.5-6.5 µm wide; exine 1.4-2.0 µm thick in the equator, 0.7-1 µm at the pole [9]. Tectum punctate, covered by spheroidal gemmae [10].

S. sylvaticum pollens (Sin*. S. sylvaticum* subsp. *sepulcrale*, *S. sylvaticum* subsp. *sepulcrale* var. *hordokopii*) (Figure 8-10) are 8-10 colporate, prolate, P/E=1.40. Polar axis 26-31.5 µm, equator axis 17-21.5 µm. Apertures lalongate, 3.3-4.4 µm long. Colpi 8-10 µm long. Mesocolpium 4.5-6 µm wide; exine 1.4-1.9 µm thick in the equator, 0.9-1.3 µm at the pole [9]. Tectum punctate, covered by spheroidal gemmae [10].

Nutlets

Nutlets of *S. asperum* Lepechin (Sin*. S. asperum*

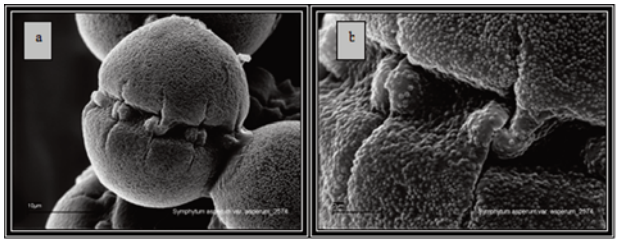

Figure 6. Pollen grain of *Symphytum asperum* a. General view b. Closer view (B.Tarıkahya 2574- A9 Artvin: Ardanuç-Kutul platform).

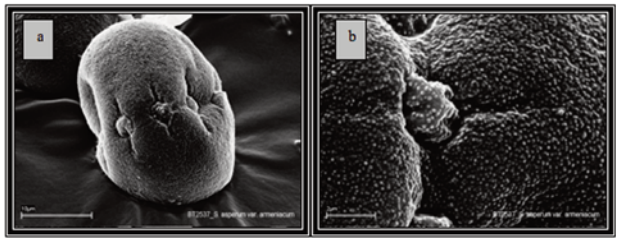

Figure 7. Pollen grain of *Symphytum asperum* var. *armeniacum* a. General view b. Closer view (B.Tarıkahya 2537- A9 Kars: Sarıkamış-Handere).

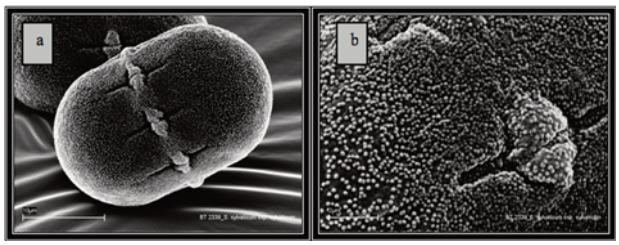

Figure 8. Pollen grain of *Symphytum sylvaticum* subsp. *sylvaticum* a. General view b. Closer view (B.Tarıkahya 2339- A7 Trabzon: Maçka-Dikkaya).

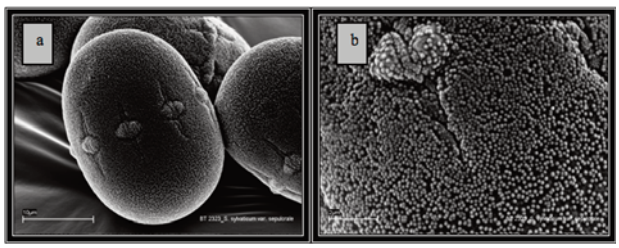

Figure 9. Pollen grain of *Symphytum sylvaticum* subsp. *sepulcrale* a. General view b. Closer view (B.Tarıkahya 2323- A7 Giresun: Tamdere).

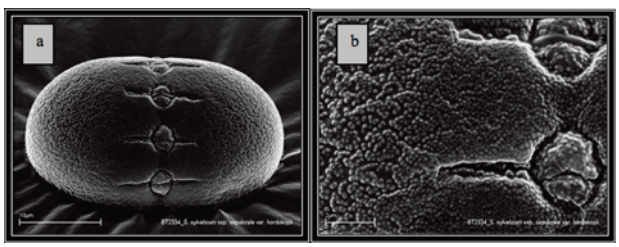

Figure 10. Pollen grain of *Symphytum sylvaticum* subsp. sepulcrale var. *hordokopii* a. General view b. Closer view (B.Tarıkahya 2334-A7 Trabzon: Maçka-Hordokop).

Figure 11. Nutlet of *Symphytum asperum* a. General view b. Closer view (B.Tarıkahya 2565-A9 Artvin: Şavşat-Veliköy).

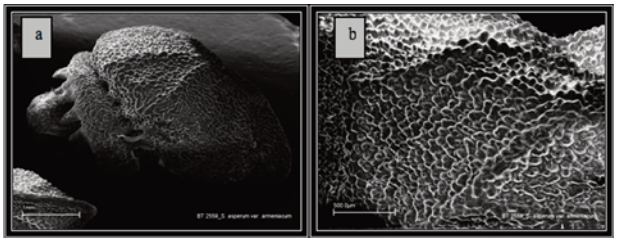

Figure 12. Nutlet of *Symphytum asperum* var. *armeniacum* a. General view b. Closer view (B.Tarıkahya 2559- A9 Ardahan: Göle).

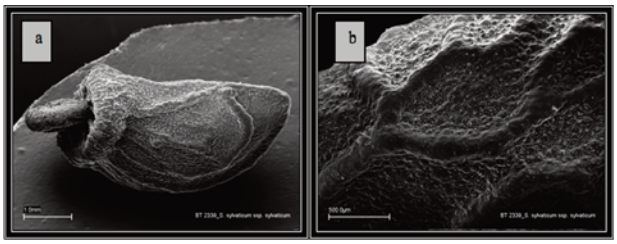

Figure 13. Nutlet of *Symphytum sylvaticum* subsp. *sylvaticum* a. General view b. Closer view (B.Tarıkahya 2339- A7 Trabzon: Maçka-Dikkaya).

Figure 14. Nutlet of *Symphytum sylvaticum* subsp. *sepulcrale* a. General view b. Closer view (B.Tarıkahya 2581-A8 Rize: İkizdere-Tiron).

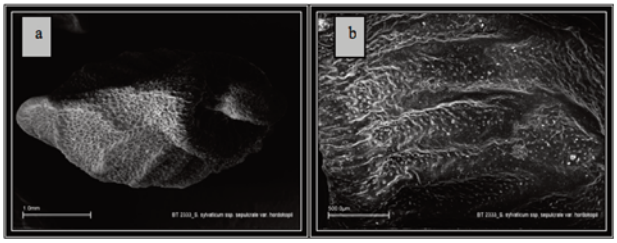

Figure 15. Nutlet of *Symphytum sylvaticum* subsp. sepulcrale var. *hordokopii* a. General view b. Closer view (B.Tarıkahya 2333-A7 Trabzon: Maçka-Hordokop).

var. *armeniacum*) 2.5-3.5 x 2.5-3 mm in size, ovoid, oblique, constricted at base, surface with indistinct ridges, tuberculate and small granulate (Figure 11, 12). Nutlets of *S. sylvaticum* (Sin. *S. sylvaticum* subsp. *sepulcrale*, *S. sylvaticum* subsp. *sepulcrale* var. *hordokopii*) 2.5-4 x 2.5-3 mm in size, ovoid, oblique, constricted at base, surface with indistinct ridges, tuberculate and small granulate (Figure 13-15).

Taxonomy

S. ASPERUM Lepechin in Nova Acta Acad. Sci. Petrop. 14:442 (1805).(6:380) (Revised account).

= *S. asperrimum* Donn ex Sims in Bot. Mag. 24:t.929 (1806).

= *S. armeniacum* Bucknall in J. Linn. Soc. (Bot.) 41:520, f. 1. (1913)

=*S. asperum* Lepechin var. *armeniacum* (Bucknall) Kurtto in Ann. Bot. Fennici 19:186 (1982).

Perennial herbs. Root fusiform, branched, woody. Vegetative reproduction is with pleiocormus. Stem robust, erect, 30-150 cm; hairs long strigose, short hooked and simple. Lower cauline leaves semiamplexicaul, petiole winged, 5-15 cm; lamina base subcordate, attenuate; lamina ovate-elliptic, ovate-lanceolate, elliptic; 10-20 x 5.5-8 cm, semicraspedodrom. Upper cauline leaves decurrent, petiole winged, lowest petiole 14 cm, upper becomes sessile; base attenuate, cuneate, asymmetric, lamina ovate-elliptic, ovate-lanceolate, elliptic, 3-20 x 0.5-9.5 cm, acute. Flowers nodding, born on well developed cymes, 5-21 on a branch; pedicel 3-5(-9) mm. Calyx (3-)4–6(-7) mm, divided to 1/2-3/5, lobes narrowly triangular-lanceolate, subacute-obtuse. Corolla blue, 14-16(-20) mm, limbus 8-11 mm, shortly lobed, slightly enlarged on apex, tube shorter than limbus, tube 6-9 mm; scale triangular-lanceolate, 5-6(-8) mm, ±longer than stamens. Anther 2,5-4 mm, filament 2,5-4 mm. Nutlet dull brown, 2.5–3.5x2.5–3 mm, constricted at

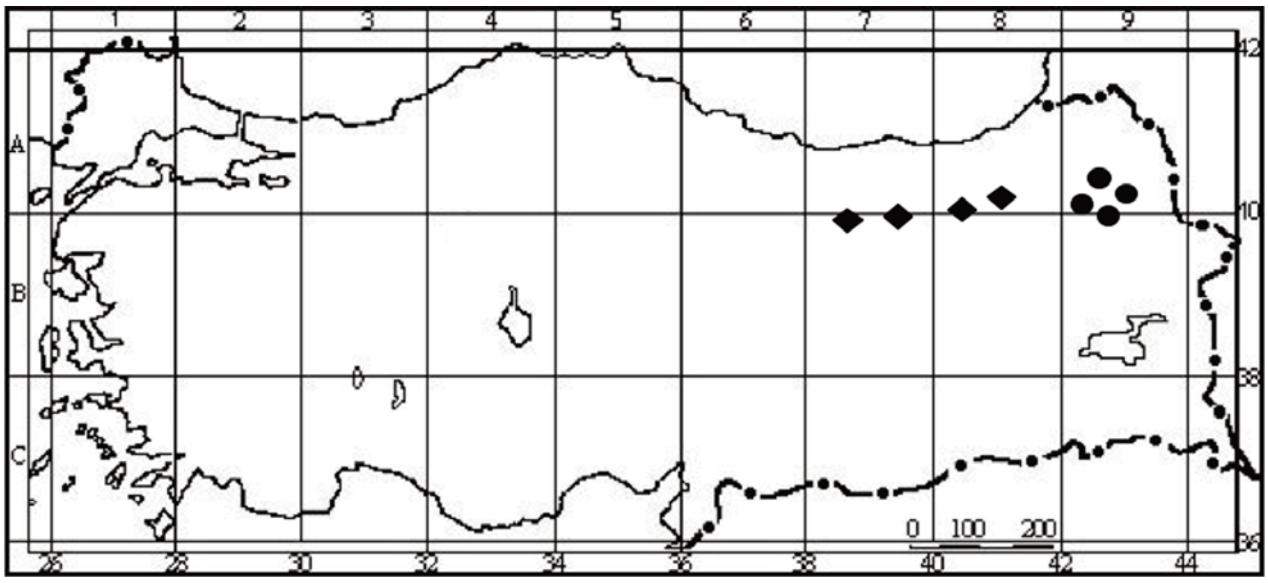

Figure 16. Distribution of *S. sylvaticum* (♦) and *S. asperum* (●) in Turkey.

base, surface tuberculate, small granulate. Fl. 5-8. Meadow, high land meadow, rocky, 1400-2400 m.

Type: Described from specimens(s) cultivated in the Botanical Garden of the Academy of Sciences in St. Petersburg in 1805. The seeds belong to collection of Bieberstein and originated from Caucasus "Hab. In jugo montium Caucasi Rossici" [4,11].

Distribution in Turkey: North-east Anatolia (Artvin, Ardahan, Kars)

General distribution: Caucasus, N.&NW Iran, Georgia.

Hyrcano-Euxine element.

S. SYLVATICUM Boiss., Fl. Or. Nov. Dec. 2:4 (20 Feb. 1875). (6:381).
= Sin: *S. sepulcrale* Boiss.&Bal. in Boiss., Fl. Or. 4:174 (Sept-Oct. 1875);
=*S. longipetiolatum* Wickens in Notes R.B.G. Edinb. 29:179 (1969);
= *S. sepulcrale* Boiss.&Bal. subsp. *sylvaticum* (Boiss.) Kurtto in Ann. Bot. Fennici 19:1982;
= *S. sepulcrale* Boiss. & Bal. subsp. *sepulcrale* var. *sepulcrale* Kurtto in Ann. Bot. Fennici 19:188 (1982);
= *S. sepulcrale* Boiss. & Bal. var. *hordokopii* Kurtto in Ann. Bot. Fennici 19:188 (1982);
=*S. sylvaticum* Boiss subsp. *sepulcrale* var. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet in Willdenowia 14:40 (1984). **syn. nov.**
= *S. sylvaticum* Boiss subsp. *sepulcrale* (Boiss.&Bal.) Greuter&Burdet var. *hordokopii* (Kurtto) R.Mill. in Flora of Turkey 10:188 (1988) **syn. nov.**

Perennial herbs. Root fusiform, branched, woody. Vegetative reproduction is with pleiocormus. Stem robust erect, 35-160 cm; hairs long, tuberculate, simple and short simple. Lower cauline leaves amplexicaul, petiole winged, 2-20 cm, lamina ovate, cordate, elliptic, 2.5-20x2-13 cm, semicras-pedodrom. Upper cauline leaves decurrent, petiole winged, lowest petiole 18 cm upper becomes sessile; base truncate, cuneate or cordate, asymmetric, lamina ovate, ovate-lanceolate, elliptic, 3-17 x 1-9 cm, acute. Flowers nodding, born on well developed cymes, 8–20 on a branch; pedicel 3-5(-7) mm. Calyx 3-6(-9) mm, divided 1/2 to 3/5, lobes triangular-lanceolate, subacute to acute. Corolla blue, rarely pink or white, (10-) 13-15(-17) mm, limbus 5-10 mm, shortly lobed, slightly enlarged on

apex, tube shorter than limbus, tube 5-7 mm; scale triangular-lanceolate, 4-6 mm, acute, longer than stamens. Anther 2-3 mm, filament 2-3 mm. Nutlet brown, 2.5-4 x 2.5-3 mm, constricted at base, surface tuberculate, small granulate. Fl. 5-10. Shady, humid areas, 750-2350 m.

Lectotype: (Kurtto in Ann. Bot. Fennici 19:1982): (Turkey A7 Trabzon) in Sylvis Ponti ad Calia supra Trapezuntem, (8 viii 1862), E. Bourgeau (G - Boiss.!; isolecto P).

Distribution in Turkey: North-east Anatolia (Giresun, Trabzon, Rize, Artvin)

General distribution: Turkey.

Endemic. Euxine element.

SPECIMENS EXAMINED

S. asperum:

A9 ARTVİN: Şavşat, Between Veliköy-Karagöl, road side, exp.W, 1967 m, N 41° 17' 49'' E 42° 28' 33''. 09.vii.2007, B.Tarıkahya 2565. Ardanuç, Kutul plateau, near brook, meadow, exp. N, 2143 m, N 41° 04' 24'' E 42° 12' 50''. 09.vii.2007, B.Tarıkahya 2571. Çoruh, Kordevan Dağ (Yalnızçam Dağları), Kütül plateau, ca. 2100 m, 28.6.1957, Davis et Hedge 30192! Yalnızçam, Nazarbezer 1900 m. 11.8.1976 V.Yüksel No:35720! **ARDAHAN**: Ardahan-Şavşat road, 15 km to Şavşat, after Çamlıbel pass, Yavuzköy road, road side, rocky w. slope, *Picea orientalis* zone, 2005 m, N 41° 13' 23'' E 42° 27' 43''. 10.vii.2007, B.Tarıkahya 2562. Ardahan-Göle road, road side, meadow, 1835 m, N 41° 04' 51'' E 42° 39' 15'', 09.vii.2007, B.Tarıkahya 2557. Between Ardahan Göle, 6 km from Ardahan, meadows. 1800 m. 17.7.1979. A.Baytop, B.Çubukçu, E.Tuzlacı&M.Saraçoğlu No:43069! Damal, Otağlı, meadow, 2086 m, N 41° 20' 24'' E 42° 51' 02''. 09.vii.2007, B.Tarıkahya 2548. Hanak-Posof road, close to Posof, road side, 1441 m, N 41° 29' 36'' E 42° 44' 04''. 09.vii.2007, B.Tarıkahya 2553. Posof, Ulgar (Çiçek dağı) Çamyazı, Hırammevkii-Al village, fields 1580-2730 m, 16-20.6.1986, N.Demirkuş 3567! Ardahan, Sulakyurt plateau, 2100-2350 m, Ovit meadow, 10.8.1983, A.Güner 5289! **KARS**: Between Arpaçay-Doğruyol, around Çıldır lake, Çanaksu, road side, meadow, 1994 m, N 41° 01' 21'' E 43° 18' 29''. 8.vii.2007, B.Tarıkahya 2542. Between Arpaçay Doğruyol, 1960 m. 16.7.1979. A.Baytop, B.Çubukçu, E.Tuzlacı&M.Saraçoğlu no:43040! Sarıkamış-Handere, road side, meadow, 2113 m, N 40° 18' 59'' E 42° 32' 54'', 8.vii.2007, B.Tarıkahya 2536. Posof, from Al village fields to Osof stream, 1500–1700 m, 27.7.1985, N.Demirkuş 2991! Hanak, Çat village, Kımılık brook valley, 2050–2100 m, meadows, 11.8.1983, A.Güner 5307! Kağızman, between Paslı-Çilehane villages, 1500–1650 m, 15.6.1980, O.Güneş 1612! Between Taşlıağıl-Malikköy, rocky brook, ca. 2200 m, 12.8.1986. H.Ocakverdi 2590! Sarıkamış, Soğuksu, *Pinus sylvestris* forest, 2000–2400 m, 9.7.1981. O.Güneş 1926!

S. sylvaticum:

A7 GİRESUN: Tamdere, Around mill, shady, 1690 m. 20.vi.2006, B.Tarıkahya 2321. Betwwen Giresun-Tamdere, Kümbet road 2. km, stream side, rocky, shady, 1340 m. 20.vi.2006, B.Tarıkahya 2328. **A7 TRABZON**: Maçka, Between Dikkaya-Anayurt villages, road side, shady, 1050 m. 21.vi.2006, B.Tarıkahya 2338. Maçka, Yukarı village (Hordokop), road side, exp. N-W, 760 m. 21.vi.2006, B.Tarıkahya 2333. To Sümela, path. 29.5.1992 M.Kartal AEF 16683! Hamsiköy, 1400 m. Tobey (T.2170), 21.6.1967! Maçka, Meryemana d. Medoş, 800 m. R.Anşin (KATO 397). 20.6.1973. **A8 RİZE**: İkizdere-Tiron road, road side, *Picea orientalis* forest, 1060 m, 22.vi.2006, B.Tarıkahya 2355. İkizdere, Cimil plateau, Tiron, exp. W, 1328 m, N 40°46'05'' E 40°40'50''. 22.vi.2006, B.Tarıkahya 2349. Çamlıhemşin, Ayder plateau, road side, 1550 m. 23.vi.2006, B.Tarıkahya 2360. Çamlıhemşin, Elevit,

Cevizlidere, rocky brooks, 2100 m. 15.7.1985 M.Vural 3516! İkizdere, form Sivrikaya village 2 km to İspir, *Rhododendron luteum*, rocky, 2000 m, 8.7.1979, A.Güner 2036! Çamlıhemşin, Amlakıt plateau, Çayırlığınırmak (Makensuz), *Rhododendron-Picea-Fagus* mixed forest, 1900–2000 m, 21.7.1974, A.Güner 1172! İkizdere, Cimil stream, around Tiron, 1200 m, wet meadows, 26.6.1984, A.Güner 5684! Çamlıhemşin, Çat plateau, Elevit brook, Lakabar, 1500 m, *Picea* forest, 15.7.1984, M. Vural 3064! İkizdere, Ovit pass, above Sivrikaya Yayla N40° 39' 17,7" E 40° 437'32,7" 2150 m. 10/2004 No: 9773 G. Parolly! Çamlıhemşin, Ayder, between Kaler-Kavrun, *Picea orientalis* forest and wet meadows, 1600–1750 m, 25.6.1980, A. Güner 2555! Çamlıhemşin, Yukarı Amlakıt plateau, *Rhododendron caucasicum*, 2100–2350 m, 25.6.1981, A.Güner 3843! Çamlıhemşin, between Çat-Elevit, *Picea orientalis* forest and wet meadows, 1200–1500 m, 24.6.1980, A.Güner 2483! Çamlıhemşin, Yukarı Kavrun-Pornag-Arçavit, alpine steppe, 2200–3000 m, 10.8.1980, A.Güner 3008! İkizdere, Yerlama village, ca. 1200 m. 9.7.1993 M.Kartal & İ.Ertürk AEF 17909! After İkizdere ca. 1200–1400 m. 9.7.1993 M.Kartal&İ.Ertürk AEF 17908! **ARTVİN**: Borçka, Karadağ, *Fagus orientalis* forest, ca 1350 m, 15.7.1978, A. Düzenli s.n.!

ACKNOWLEDGEMENTS

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