

New delimitation of two series within *Alchemilla* subsection *Calycanthum* and new subdivision within *Alchemilla* series *Calycinae* (*Rosaceae*)

Новое разграничение рядов в подсекции *Calycanthum* и новое разделение ряда *Calycinae* рода *Alchemilla* (*Rosaceae*)

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Abstract. The distinctions between *Alchemilla* ser. *Calycinae* and *A.* ser. *Elatae* are emended, treating the latter group as relict, connected to the Tertiary broadleaved forests of the eastern Mediterranean Basin. *Alchemilla* ser. *Calycinae* (in renewed circumscription) is subdivided into seven provisional aggregates according to the specially developed coordinate system (with two axes — a ratio of central zone width to leaf length vs. number of leaf teeth in total). The original key included all the species of the series occurring in the Caucasus and Asia Minor was compiled.

Keywords: aggregates, apomicts, Asia Minor, Caucasus, coordinate system.

Аннотация. Предложено иное разграничение между двумя рядами (*Calycinae* и *Elatae*) рода *Alchemilla*, рассматривающее вторую группу как реликтовую, приуроченную к третичным широколиственным лесам восточной части Средиземно-морского бассейна. Ряд *Calycinae* (в новых границах) подразделен на семь предварительно выделенных агрегатов, руководствуясь оригинальной системой координат (с двумя осями — отношение ширины центральной зоны к длине листа и суммарное количество зубцов листа). Составлен ключ, охватывающий все виды ряда из Кавказа и Малой Азии.

Ключевые слова: агрегаты, апомикты, Кавказ, Малая Азия, система координат.

After morphological bordering of a *Calycinae* group (Buser, 1893, 1896) of the genus *Alchemilla* L., many species were described and different conceptions were presented to organise this diversity into a kind of a system.

Alchemilla subsect. *Calycanthum* (Rothm.) Rothm. ser. *Calycinae* (Buser) Rothm. is a peculiar group within the genus having very distinct geographical, but not morphological, borders. There are different ways to divide the *Calycanthum* group. The first, proposed by Rothmaler (1933, 1938): to *A.* ser. *Calycinae*, to which only small plants with coriaceous leaves, appressed pubescence on petioles and stems, mostly glabrous leaves and ever glabrous flowers would be placed. All other species with another kind of appearance, with petioles and stems pubescent in different types, glabrous flowers or, alternatively, densely hairy ones, were supposed to be arranged in the group *A.* ser. *Elatae* (Rothm.) Rothm. But even with such a narrow concept of *A.* ser. *Calycinae*, some misconceptions appeared (Rothmaler,

1938): *A. venosa* Juz. was placed here, despite the fact that it had hairy hypanthia and leaves beneath; similarly, so was *A. wischniewskii* Rothm., which had densely pubescent leaves beneath and hairy stems throughout, with multilobed leaves (the author noted as the closest to this species *A. subsplendens* Buser, attributed by himself to *A.* ser. *Elatae*).

The second concept was proposed by Juzepczuk (1941). He divided the *Calycanthum* group (using the name “*Calycinae*”) according to an analogy with subdivision of *A.* subsect. *Alchemilla* (also known as “*Vulgares*”): 1) a group with patent indumentum and differently hairy flowers (“*Vulgares: Hirsutae* and *Imberbes*”); 2) a group with dense appressed or sub-appressed indumentum of leaves, petioles, and stems, densely hairy hypanthia (“*Pubescentes*”); 3) a group with appressed sparse indumentum of stems and petioles, mostly glabrous leaves, mostly glabrous flowers (“*Subglabrae Obtusae*”); i. e. it meant that *A.* subsect. *Calycanthum* should be divided into “cycles”

Oxysepalae, *Subsplendentes*, and *Durae*, respectively (all the names invalidly published). The latter group was close in concept to *A. ser. Calycinae* sensu Rothm., therefore the other two were together approximately equal to *A. ser. Elatae*. However, during practical usage there were many exceptions to such strict rules. For example, at the border between “*Oxysepalae*” and “*Durae*” there are *A. tredecimloba* Buser and *A. undecimloba* Juz. (subglabrous, appressed pubescent as “*Durae*”, but large and robust, with multitoothed leaf blade and variably hairy hypanthia as “*Oxysepalae*”). *A. procerrima* S. E. Fröhner, *A. ellenbergiana* Rothm., and *A. wischniewskii* Rothm. have quite dense pubescence on the stem internodes and on the leaves like “*Subsplendentes*”, but glabrous flowers like “*Durae*”. There are many other similar examples.

Very different, non-hierarchical approach was found in the viewpoints of Fröhner (1986, 1990). Here, the most important points about *Calycinae* are as follows:

1. A non-hierarchical system of sections, which reflected a reticulate hybridogenous formation of the genus. It was described as follows: four parental sections (*A. sect. Alpinae* = A, *A. sect. Pentaphylleae* = P, *A. sect. Ultravulgares* = U, *A. sect. Erectae* = E) stated as basal, the other were formed due to hybridization between these four and their progenies, e. g. PA-, UP-, EU-, EUP-hybrids, and so on. Every of 14 “parental” and “hybrid” groups were endowed with a separate position and equal taxonomic rank of a section.

2. Based on morphology, the author narrowed the circumscriptions of two groups, *A. sect. Erectae* (*A. ser. Elatae* Rothm., p. min. p.) and *A. sect. Calycinae* (*A. ser. Calycinae* sensu Rothm., p. p.).

3. *A. sect. Calycinae* was considered EP-hybrid, i. e. a relative of Fröhner’s *A. sect. Coriacea* = EUP (*A. ser. Subglabrae* Pawł., p. p.). Moreover, some species of *A. ser. Calycinae* sensu Rothm. (*A. incisa* Buser, *A. othmari* Buser, *A. firma* Buser) were shifted by the author to *A. sect. Coriacea*.

To discuss this system substantially, I need to elucidate some important traits of *Calycinae* (sensu Rothmaler):

1. Typical morphology is: (a) plants of a small size with coriaceous leaves (up to 10–30 cm); (b) leaf blades mostly glabrous (sometimes sparsely hairy beneath); (c) leaf blade (of medium leaves) dissected to $\frac{2}{5}$ – $\frac{1}{2}$ (central zone 50–60%), with 60–110 teeth in total, 5–6(7) at each side of leaf lobe; (d) indumentum of petioles and stems is poor containing appressed subtle hairs, stems pubescent only on the lower internodes, hairs gradually becoming rare and disappearing in the lower half of stems; (e) flowers with short obconical hypanthia, with almost uniform, approxi-

mately equal (lanceolate, ovate or elongate triangular) sepals and epicalyx segments, longer than hypanthia; glabrous.

2. Ecologically, it is attached to evolutionarily pioneer habitats with low competition: stony substrates, stony slopes usually near a snowline, secondary synanthropic habitats like roadsides; from dry to over-moist, such as those found along springs or riversides, in open or shadowed habitats, and on sour and alkaline soils (Fröhner, 1986, 1990).

3. Biogeographically, it is one of the most clearly-bordered *Alchemilla* groups. In comparison to *A. ser. Alchemilla* or *A. ser. Pubescentes*, or *A. ser. Subglabrae*, which are widely distributed in temperate Eurasia, it is connected distinctly with the mountain systems of the Mediterranean basin. The highest species richness (in the circumscription sensu Rothmaler) is observed in the Caucasus (15), while only seven, three, and five species occur in the Alps (Atlas..., 2009), Pyrenees (Fröhner, 1998), and Carpathians (Pawłowski, 1955; Sytschak, 2011) respectively. Thus, the formation center of *Calycinae* group is undoubtedly the Caucasus, as indicated by its high morphological diversity and irradiation there (see also below).

Discussing Fröhner’s system as a whole, I tested Fröhner’s hypothesis that the *Calycinae*-group was an EP-hybrid, i. e. it appeared after hybridization between members of *A. sect. Erectae* (E) and *A. pentaphyllea* L. — the only member of *A. sect. Pentaphylleae* (P).

1. *A. pentaphyllea* has extremely short epicalyx segments (55% of sepal length) and elongate hypanthium. The mean value of those features for *A. sect. Erectae* and *A. sect. Pentaphylleae* would be much higher than those of *A. ser. Calycinae*.

2. None of the parent strains have an appressed indumentum with subtle hairs of petioles and stems (*A. pentaphyllea* is subappressed hairy with bristly hairs), but it is the key peculiarity of *Calycinae* group.

3. “Parental” *A. pentaphyllea* was distributed only in the Alps and there was no obvious reason for its extinction anywhere else. But the diversity centers of *Calycinae* group are located far to the east, in the Caucasus, and, in the sense narrowed by Fröhner, it counts in Europe even less species than mentioned above.

4. Ecologically, *A. pentaphyllea* is a highland species and grows on peaty or sandy overmoist soils often beside a snowline (Fröhner, 1990).

Taking geography into consideration, I conclude that it is a neoendemic species attached to evolutionarily young widespread habitats that did not have enough time to distribute more widely (for more discussion on this topic see Chkalov, Vorotnikov, 2009). Thus, despite its primitive morphological traits, I can

hardly regard *A. pentaphyllea* as an ancient parental line and ancestral group for the *Calycinae*.

The list of weak items of this system may be continued:

1. There are similar circumstances (to above-mentioned *Pentaphylleae*) with *Alpinae*, i. e. at least two of “parental lines”.

2. If they really were ancient and parental to all Eurasian *Alchemilla*, as it was supposed by the author, they or their relatives would be widespread to the Central Asia to establish *Alchemilla* there (to mention, there were no ecological barriers against it). Since they had restricted distribution, Central-Asian *Alchemilla* would be formed independently of those European “parents”.

3. There are two groups of *A. ser. Alchemilla*, *A. aggr. retropilosa* Juz. and *A. aggr. semilunaris* Alechin, which are very numerous in Central Asia and Eastern Europe. In Central Europe, however, the former is presented by only a few species located at the western limits of their distribution areas, and the latter is not yet found. Moreover, a morphometric study showed (Sepp, Paal, 2001) that *A. semilunaris* Alechin fell out of the pool of other European species, which were supposed close relatives to each other, as well as *A. subglobosa* C. G. Westerlund (*A. aggr. retropilosa*).

4. In this isolated system of sections, a place of African *Alchemilla* is not transparent, neither their relations with closely related genera (*Aphanes*, *Lachemilla*). The high rank of the infrageneric taxa (i. e. section) chosen by the author does not correspond to the grade of morphological and biogeographical differences between groups.

Thus, it is highly likely that this system reflects thoroughly circumstances of *Alchemilla* irradiation in the Alps, maybe in the Western Europe concerning the formation of the endemic groups, their hybridization, etc. In such cases, those groups may be considered as parental, and the principles of Fröhner’s system work in the destined way. When the most dominated taxonomic groups of Quaternary endemics are different, as in the Caucasus or Central Asia, one must analyse *Alchemilla* diversity independently in each case.

The aim of this study was to discuss existing systems of the *Calycinae* group to estimate their attribution to Caucasian *Alchemilla* and to modify them, if necessary.

Materials and methods

The material of Caucasian *Alchemilla* in LE and MW was investigated by the author. Many samples were obtained through on-line platforms: B (Herbarium B, 2020); C, M (JSTOR, 2020); E (Herbarium E, 2020); FI (Herbarium FI, 2020); G (Herbarium G, 2020); H

(FinBIF, 2020); K (Herbarium K, 2020); MW (Seregin, 2020); P (Herbarium P, 2020); S (Herbarium S, 2020); W, WU, JE (JACQ, 2020). Calculation of values for two features (i. e. grade of leaf dissection as a ratio of central zone value to leaf length; number of radical leaf teeth in total) of either medium or upper radical leaves, or both (for those that present usually) for species of *A. ser. Calycinae* was fulfilled. The terminology used in the keys and for the calculation was previously described (Chkalov, 2011, 2015). Zoning of the Caucasus and relevant abbreviations were presented in “Caucasian Flora Conspectus” (Caucasian..., 2009).

Results and discussion

The discussion is partly speculative, but still we need to organize this material to a system; thus, even a preliminary and hypothetic trial is welcome. Primary prepositions for the above-mentioned points are such: for the first item, “no morphology without geography” – a geographical morphological approach according to A. De Candolle, R. Wettstein, V. L. Komarov (Kamelin, 1973); therefore, hierarchical division has a sense, when a morphological group is outlined geographically. Following this preposition, I accept that by now it is hardly possible to subdivide those series hierarchically, although they could be bordered more accurately by this approach.

Also, I use some basic prepositions to arrange the group: (1) this group formed in a hybridogenous way and thus represents reticulate system; (2) I expect that hybridogenous progenies must possess some intermediate traits relatively to parental strains (medium for continual features, or those discrete from the only one parent); (3) the same applies to ecological traits; (4) the features to arrange this group must satisfy some requirements, such as: (a) they should have an evolutionary prospect (i. e. they should have clearly changed in comparison with ancient and more recent groups); (b) the features, bordered geographically or ecologically, or both, are favorable; and (c) they must be easy to obtain and study (e. g. checked and used in casual practice, with *in sicco* specimens).

How was it formed?

From the information on *A. ser. Calycinae* outlined above, I conclude that there is no need to look for an ancient parental group, because the progeny is relatively young. It is easy to identify one parent that possesses trait-complex consisting of coriaceous glabrous leaves – poor appressed indumentum – similar long sepals and epicalyx segments: *A. ser. Subglabrae*. The remarkably similar flower structure with *A. ser. Calycinae* suggests the above-mentioned

shifts of the species from one group to another. Fröhner (1986) also mentioned such an affinity between the two groups (see above).

The second parent is harder to identify, but the key point may be the geography described above. While the *Subglabrae* group is widely distributed (temperate areas of Eurasia almost throughout), the limited distribution of *A. ser. Calycinae* may be explained due to restricted distribution of its second parent, possibly *A. subsect. Chirophyllum* Rothm. (specifically, two groups within it – *A. ser. Saxatiles* Buser and *A. ser. Sericeae* Buser) or *A. subsect. Alchemilla ser. Pubescentes* Buser (partially – affinity of *A. sericata* Rchb.). *A. subsect. Chirophyllum* could be the second parent because of deeply dissected leaves and appressed indumentum of some species, flowers with quite short hypanthia. However, their epicalyx segments are too short, teeth on the leaves of Caucasian species are too straight, and apical teeth are about the length of neighboring ones; so that hypothesis cannot be adopted. *A. aggr. sericata* Rchb. species are the most suitable for the role of parent for *A. ser. Calycinae* for the following reasons:

1. Morphology: (a) plants mostly of small size; (b) some species have glabrous leaf surfaces (*A. acropsila* Rothm.), which demonstrates an evolutionary opportunity, despite the fact that they are mostly densely pubescent; (c) leaf blade dissected to $\frac{2}{5}$ – $\frac{1}{2}$ (central zone 50–60%), with 50–90 teeth in total, 5–7 at each side of leaf lobe; leaf structure of some species (e. g. *A. bombycina* Rothm.) is similar to that of *A. retinervis* Buser; (d) indumentum of stems and petioles is appressed; (e) epicalyx segments are often as long as sepals or nearly so. With an intermixture of *Subglabrae* traits, the formation of *A. ser. Calycinae* is quite believable.

2. Ecologically, it is similar to the *Calycinae* group, growing in habitats with low competition: on stony substrates, slopes, usually dry, and in secondary synanthropic habitats like roadsides. With the addition of eco-traits of *Subglabrae* group, which is the most vigorous and abundant at high latitudes and in high mountain areas, an ecological specificity of *A. ser. Calycinae* becomes quite reasonable.

3. Geography. The most suitable species of the *A. sericata* aggregate are endemic to the Caucasus; thus, it fits into the geography of the *Calycinae* group mentioned above. Local endemics of this group outside the Caucasus should be discussed thoroughly; it may be the case that they might be a consequence of polytopous speciation (i. e. repeated hybridogenous formation of the similar *Calycinae* species) or might be a subsequent progeny of some widely distributed *Calycinae* species.

How to arrange this group?

I have accepted quite limited applying of the hierarchical system within *A. subsect. Calycanthum*, and still believe that it is possible to arrange these species into a better system.

Some ideas on opportunity of taxonomic groups arrangement through a construction of periodical (coordinate) system were developed by Lyubischev (1982). The most promising way to achieve this is to use a coordinate system applying the features fit to the above-mentioned requirements. The first feature is grade of leaf dissection as a ratio of central zone value to leaf length because it has clear evolutionary prospects, from wholly dissected (compound) leaves (e. g. *Potentilla palustris* (L.) Scop., some species of the genus *Lachemilla* (Focke) Rydb. and *Alchemilla* subsect. *Chirophyllum*, *A. pentaphyllea*), to the almost lobeless leaves of *A. ser. Elatae* s. str. and *A. ser. Alchemilla*. The second feature is total number of leaf teeth, as its evolutionary prospect is similarly wide: fewer than 10 teeth in *Aphanes* L. and some *Lachemilla*, the 20–30 teeth of some *A. subsect. Chirophyllum* and *A. pentaphyllea* to the 220 teeth of some *A. ser. Elatae* s. str. and *A. ser. Alchemilla*.

I conclude that this approach permits the combination of species into groups with similar appearance and, thus, provide a more holistic analysis of the species similarity. I have achieved such a coordinate system (Fig.), by which several more or less clearly outlined groups have been qualified as preliminary aggregates.

Alchemilla aggr. *retinervis* Buser (Re).

A. adelodictya Juz., *A. ancerensis* Kalheber, *A. deylii* Plocek ex Soják, *A. fissa* Günther et Schummel, *A. hayirliogluorum* Kalheber, *A. microdictya* Juz., *A. retinervis* Buser, *A. retinervisiformis* Juz., *A. rivularis* Ponert, *A. tiryalensis* Pawl.

Geography: Asia Minor and Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: Malk., U. Ter.; EC: Ass.-Arg., U. Sulak., Man.-Samur., Kubin.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Adzh.; CTC: Kart.-S. Oss.; ETC: Alaz.-Agrich., Murg.-Murovd.; SWTC: Meskh., Dzhav.-U. Akh., Arag.; STC: Sevan, Nakh., Zang., S. Karab.) (8), Balkans (1), Carpathians (2), Alps (1), Pyrenees (1).

Here is the most typical group, with the morphological features described above. However, there is an exception: four species (*A. ancerensis*, *A. hayirliogluorum*, *A. retinervisiformis*, *A. tiryalensis*) are strongly pubescent (in most parts, including stems and flowers, but not on the upper surface of leaves), while still having the typical flower structure and the appearance. Logically, it is likely that the latter are also a

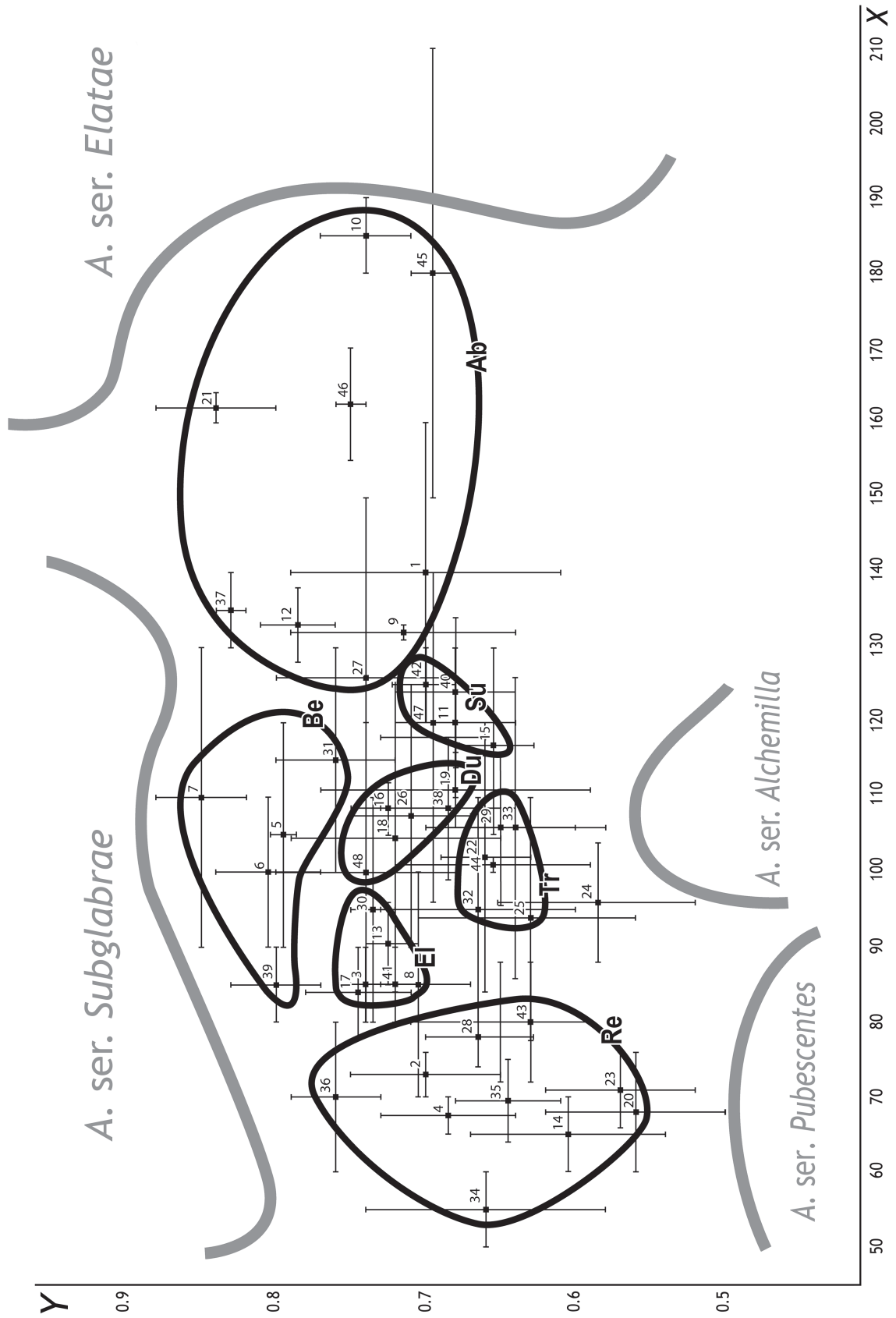


Fig. Coordinate system of *Alchemilla* series *Calycinae* diversity.

X-axis – total number of teeth on leaf blade; Y-axis – degree of leaf dissection (central zone width / leaf length ratio).
 1 – *A. abchasica*, 2 – *A. adelodictya*, 3 – *A. akdoganica*, 4 – *A. ancerensis*, 5 – *A. barbatiflora*, 6 – *A. betuletorum*, 7 – *A. beyazoglui*, 8 – *A. bezenziensis*, 9 – *A. busseriana*, 10 – *A. camptopoda*, 11 – *A. cartilaginea*, 12 – *A. ciminensis*, 13 – *A. debilis*, 14 – *A. deylii*, 15 – *A. divaricans*, 16 – *A. dura*, 17 – *A. ellenbergiana*, 18 – *A. fallax*, 19 – *A. firma*, 20 – *A. fissa*, 21 – *A. gorcensis*, 22 – *A. grandidens*, 23 – *A. hayirliogluorum*, 24 – *A. incisa*, 25 – *A. indurata*, 26 – *A. kazbekensis*, 27 – *A. longipedicellata*, 28 – *A. microdictya*, 29 – *A. muldaschevii*, 30 – *A. oriturcica*, 31 – *A. procerima*, 32 – *A. pseudotranscaucasica*, 33 – *A. ptysschensis*, 34 – *A. retineriviformis*, 35 – *A. retinerivus*, 36 – *A. rivularis*, 37 – *A. sctadiophylla*, 38 – *A. sericoneura*, 39 – *A. sevangensis*, 40 – *A. speciosa*, 41 – *A. stricta*, 42 – *A. subsplendens*, 43 – *A. turyalensis*, 44 – *A. transcaucasica*, 45 – *A. tredcimloba*, 46 – *A. undecimloba*, 47 – *A. venosa*, 48 – *A. venosula*.
 Brackets – minimal and maximal values. For abbreviations, see the text. Grey – contingent positions of provisional parental groups (with no link to coordinate values).

consequence of hybridization between *Subglabrae* and *Sericatae* groups, but have predominantly *Sericatae* traits. There are many mesoxerophilic and xerophilic *Alchemilla* species in the Caucasus that can compete with this Re-species; thus, such progenies cannot be especially numerous and abundant. Once, other Re-species possessed mostly *Subglabrae*-trait-complex, and were more successful due to their ecological peculiarity and as a consequence of low competition in the absence of ecologically similar species. That is why I did not separate the four species mentioned above, considering all the species of *A. aggr. retinerivis* are a consequence of the same process. I conclude with confidence that Asia Minor and the Caucasus were a formation center for this most typical *Calycinae*-group. Only one of widespread European species (*A. fissa*) belongs here. Likely, it migrated from the primary speciation center and became an ancestor of the European *Calycinae*-representatives.

Moreover, the inconsistency of the indumentum character of flowers and pedicels is typical in *A. subsect. Calycanthum* and all its groups (similar variation has also been identified for *A. ser. Elatae* s. str.), and is observed in most aggregates listed below (see Table).

All following groups differ from Re by more numerous teeth of leaf blades. Their hairiness can vary widely, as it does so in the Re-group, but special attention should be paid to an inconsistency between glabrous flowers and densely hairy leaves and stems, or *vice versa*.

Alchemilla aggr. *betuletorum* Rothm. (Be).

A. barbatiflora Juz., *A. betuletorum* Rothm., *A. beyazoglui* Kalheber, *A. eugenii* Pawł., *A. procerrima* S. E. Fröhner, *A. sevangensis* Juz. (*A. ikizdereensis* Kalheber).

Geography: Asia Minor and Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: U. Kum., Malk., U. Ter.; EC: U. Sulak.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Rion.-Kvir., Adzh.; CTC: Kart.-S. Oss.; ETC: Alaz.-Agrich., Murg.-Murovd.; SWTC: Meskh., Arag.; STC: Sevan.) (4), Iran (1), Carpathians (1).

Here, I focus on the traits most divergent from typical Re-group. These include wide central zone, short lobes (mostly arcuate), stems more densely and higher pubescent, and leaves ± pubescent beneath, hypanthia sometimes hairy (*A. barbatiflora*, *A. sevangensis*). As a second parental group, based on these features, I assume members of *A. ser. Subglabrae* subser. *Appressipilae* Juz. ex V. N. Tikhom., the affinity of *A. obtegens* Juz. in particular.

Alchemilla aggr. *ellenbergiana* Rothm. (El).

A. akdoganica Kalheber, *A. bezenziensis* Czkalov ined., *A. debilis* Juz., *A. ellenbergiana* Rothm., *A. oriturcica* Pawł., *A. stricta* Rothm.

Geography: Asia Minor and Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: Malk., U. Ter.; EC: U. Sulak., Man.-Samur., Kubin.; WTC: Tuap.-Adl., Abkh.; CTC: Kart.-S. Oss., Trial.-L. Kart.; ETC: Alaz.-Agrich., Murg.-Murovd.; SWTC: Meskh., Dzhav.-U. Akh.; STC: Erev., Sevan, Nakh., S. Karab.) (6).

The traits most divergent from those of Re-group are short wide teeth, 6–8 at each side of leaf lobe, lobes rounded at the top, usually semicircular or nearly so, stems more densely and upper pubescent, and leaves ± pubescent beneath (except for *A. debilis*), hypanthia variously pubescent. Such features – the grade of leaf dissection, larger apical teeth, and the appearance of leaves – point to *A. ser. Alchemilla*, *A. aggr. retropilosa* Juz. (for example, *A. compactilis* Juz. and *A. dzhavakhetica* Juz.) as a probable second parental group.

Alchemilla aggr. *dura* Buser (Du).

A. dura Buser, *A. fallax* Buser, *A. firma* Buser, *A. kazbekensis* Czkalov ined., *A. sericoneura* Buser, *A. venosula* Buser.

Geography: Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: Malk., U. Ter.; EC: U. Sulak., Man.-Samur., Kubin.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Rion.-Kvir., Adzh.; CTC: Kart.-S. Oss.; ETC: Alaz.-Agrich., Murg.-Murovd.; SWTC: Dzhav.-U. Akh., Arag.; STC: Sevan, Nakh., Megr.-Zan., S. Karab.) (2), Balkans (2), Alps (4), Pyrenees (1).

This is a very interesting group, and mostly European. Likely, there was a parental species of *A. ser.*

Table. Traits of the *Alchemilla* series *Calyciniae* aggregates

Traits	Aggregates							
	Re	Be	El	Du	Tr	Su	Ab	
Total teeth number in radical leaves	60–82 50–80(90)* [25%]	(80)90–130 [27%]	(70)80–110 [30%]	(80)90–125 [33%]	(80)100–130 [30%]	(95)105–135 [19%]	(100)125–210 [33%]	
Central zone to leaf length ratio, %	50–75(79) 52–74* [19%]	(72)77–86 [10%]	(67)70–78 [10%]	59–75 [18%]	56–73 [20%]	(60)64–73 [15%]	(61)64–88 [25%]	
Angle of leaf sector, grades	42–51(60) 52–74*	33–46	32–47(55)	35–47(55)	40–54(60)	36–48(60)	20–39(43)	
Leaf lobe length to leaf length ratio, %	19–34 16–34(42)*	11–25(27)	17–25(30)	(10)16–34	22–39	20–36	12–31	
Incision depth to standard tooth length ratio	1–3(4) 1–3*	0.5–3	0.5–1.5	1.5–2(3)	0.5–1.5	1.5–3	0.5–4	
Standard tooth length to leaf length ratio, %	(6)9–16 9–20*	4.5–9	3–10	3–9(13)	5.5–13	3–10.5	1.5–5(7.5)	
Apical tooth length to neighboring teeth length ratio	(0.2)0.4–1.1 0.2–0.7*	0.2–0.7(0.9)	0.5–0.8	(0.2)0.4–0.8(1.2)	0.2–0.5(0.7)	0.5–1	0.3–1	
Indumentum density	Leaves beneath	G Ge Ge* S*	S D Ge(r)	D Ge	Ge D(r)	Ge D(r)	D Ge(r)	Ge D S
	Hypanthia	G D* GS*	G GS	D GS G	G	G GS D(r)	D GS	D GS G
	Pedicels	G G* GS*	G D(r)	G	G	G D(r)	D GS G(r)	G GS(r)
	Stem	G S D*	D S	D S(r) G(r)	S D	D S	D S	S D(r) G(r)
Stem indumentum height	0– $\frac{1}{3}$ – $\frac{1}{2}$ $\frac{1}{2}$ *– $\frac{2}{3}$ *–1*	$\frac{1}{2}$ – $\frac{2}{3}$ – $\frac{3}{4}$ –1	$\frac{1}{3}$ – $\frac{1}{2}$ – $\frac{2}{3}$ – $\frac{3}{4}$ –1	$\frac{1}{3}$ – $\frac{1}{2}$ – $\frac{2}{3}$ – $\frac{3}{4}$ –1	0(r)– $\frac{1}{4}$ – $\frac{1}{2}$ –1	$\frac{1}{2}$ –1	$\frac{1}{4}$ – $\frac{1}{3}$ – $\frac{1}{2}$ – $\frac{2}{3}$ – $\frac{3}{4}$ –1	

Note. Bold borders – the most differentiative traits; * – trait values for the pubescent species of the Re-aggregate; in square brackets – the largest of (max–min)×100/max value of a trait. Indumentum density: G – glabrous; Ge – glabrous leaves with hairy main veins and basal lobes beneath; S – sparsely hairy; D – densely hairy; GS – glabrous and sparsely hairy hypanthia/pedicels in the same plant. Stem indumentum height: 0 – stem glabrous; $\frac{1}{4}$... $\frac{3}{4}$ – stem hairy to the $\frac{1}{4}$... $\frac{3}{4}$ of its length; 1 – stem hairy throughout. (r) – rarely detected value. See the text for the aggregate abbreviations.

Calycinae (e. g. *A. fissa*), and (an)other parent(s) from a group that should be identified. Here, there are orbicular, more rarely orbicular reniform, leaves (angle of sector mostly 40–55°) with a central zone of medium width (near the mean value of Re-group), lobes with large acute teeth. Most of these species look like a representative of the Re-group that acquired more teeth. Moreover, they are similar in appearance to some representatives of *A. ser. Subglabrae* subser. *Denudatae* V. N. Tikhom. (e. g., Caucasian *A. pseudocartalinica* Juz., *A. pilicineta* Buser (= *A. cartalinica* Juz.), *A. erectilis* Juz.; European *A. reniformis* Buser, *A. effusa* Buser, *A. impexa* Buser etc.). I consider this to be a second parental group.

***Alchemilla* aggr. *transcaucasica* Rothm. (Tr).**

A. grandidens Juz., *A. indurata* Juz., *A. muldashevii* Czekalov ined., *A. pseudotranscaucasica* Czekalov ined., *A. ptyschensis* Czekalov ined., *A. transcaucasica* Rothm.

Geography: Asia Minor and Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: U. Kum., Malk., U. Ter.; EC: Ass.-Arg., U. Sulak., Man.-Samur.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Rion.-Kvir., Adzh.; CTC: Kart.-S. Oss., Trial.-L. Kart.; ETC: Alaz.-Agrich.; SWTC: Meskh., Dzhav.-U. Akh.; STC: Sevan, Nakh., S. Karab.) (6).

These are very similar in appearance to the Re-group, but differ in having longer lobes with short incisions between, and more numerous, but similarly large curved wide teeth. It likely formed through admixture of some traits of *A. ser. Alchemilla* subser. *Pastorales* V. N. Tikhom. or *A. ser. Alchemilla* subser. *Alchemilla* (when the species is poorly pubescent in some parts). The more pubescent species (e. g. *A. grandidens*, *A. pseudotranscaucasica*) may be progenies of *Pastorales* group, the others would be closer to *A. subser. Alchemilla*, the affinity of *A. subcrenatisformis* Juz. (because of the teeth and leaf form). These are second parental groups.

***Alchemilla* aggr. *subsplendens* Buser (Su).**

A. cartilaginea Rothm., *A. divaricans* Buser, *A. speciosa* Buser, *A. subsplendens* Buser, *A. venosa* Juz.

Geography: Asia Minor and Caucasus (WC: Bel.-Lab.; CC: U. Kum., Malk., U. Ter.; EC: Ass.-Arg.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Rion.-Kvir.; CTC: Kart.-S. Oss.; ETC: Alaz.-Agrich., Murg.-Murovd.; STC: Sevan, Nakh., S. Karab.) (5).

Very pubescent with appressed silky hairs in most parts including pedicels and hypanthia plants, with deep leaf dissection. I suspected its parent was the *Sericatae* group, but the many teeth of the leaf blade forced me to look it in the opposite direction. The high teeth number and abundant indumentum are only found from among *A. ser. Elatae* (a second parental group), such as

A. hirtipedicellata Juz., *A. orthotricha* Rothm., *A. holotricha* Juz., *A. ziganadagensis* Pawł. etc. This group is very close to Juzepczuk's "cycle" *Subsplendentes*, and might be a separate subseries.

***Alchemilla* aggr. *abchasica* Buser (Ab).**

A. abchasica Buser (*A. ayderensis* Kalheber), *A. buseriana* Rothm., *A. camptopoda* Juz., *A. ciminensis* Pawł., *A. gorcensis* Pawł., *A. longipedicellata* Czekalov ined., *A. sciadiophylla* Rothm., *A. sericoneuroides* Pawł., *A. tredecimloba* Buser, *A. undecimloba* Juz.

Geography: Asia Minor and Caucasus (WC: Bel.-Lab., Urup-Teb.; CC: U. Kum., Malk., U. Ter.; WTC: Tuap.-Adl., Abkh., Ing.-Rion., Adzh.; CTC: Kart.-S. Oss.; ETC: Alaz.-Agrich., Murg.-Murovd.; SWTC: Arag.; STC: Sevan, S. Karab.) (8), Crimea (1), Carpathians (2), Balkans (1).

As the previous one, the latter group is a progeny of the *Elatae* group, but the teeth number is dramatically large. That is obviously heterogeneous, because (a) *A. ser. Elatae* s. str. is variable itself. Here, among the progenies, there are mostly glabrous plants (*A. buseriana*, *A. gorcensis*, *A. tredecimloba*, *A. undecimloba*), some with ± hairy hypanthia; other species (*A. longipedicellata*, *A. sciadiophylla*, *A. ciminensis*) have hairy leaves beneath, pubescent stems and hypanthia; some are strongly pubescent, sometimes with almost erectopate hairs (*A. abchasica*, *A. camptopoda*); (b) there is a geographical heterogeneity as consequence of secondary irradiation in other speciation centers (some local *Calycinae* endemics might have formed by a widespread ancestor of Caucasian origin or by their aboriginal relatives), or this indicates polytopous speciation (i. e. analogous hybridization between some species of *Sericatae* and *Subglabrae* groups might have taken place). Thus, revision of the latter group as a whole is still needed. As well, if further geographical and morphological specificity is revealed, further hierarchical subdivision will be possible.

The last two aggregates are at the border between series, because of a natural hybridization process, and produce most difficulties in their delimitation. Their geographical and ecological features forced me to shift representatives of these aggregates to *A. ser. Calycinae*.

Also, there is *A. incisa*, with a position isolated from all other species. Treating this species as a part of the *Calycinae* group, I believe its position points to a separate paraphyletic formation, which includes the rest of the species of the probable corresponding aggregate.

Therefore, the system of *A. ser. Calycinae*, including all of its European representatives, is necessary, but careful attention must be paid to all its representatives. Geography of the aggregates listed above was outlined rather superficially in the case of the European represen-

tatives (e. g. there are about 20–30 species (Pawłowski, 1954, 1957; Plocek, 1983, 1990) of this subsection from Southern and Eastern Europe, which are hard to arrange with any aggregate, as I cannot assess their features) and must be further explored. From my primary observation in the relatives of *Calycinae* group, a key for the aggregates described above is proposed.

Identification key for aggregates of *Alchemilla* ser. *Calycinae*

1. Teeth of leaf blades of medium and upper leaves in total 50–80 (maximum 90) *A. aggr. retinervis*.
- + Teeth of leaf blades of medium and upper leaves in total 80–120 (maximum 135) 2.
- ++ Teeth of leaf blades of medium and upper leaves in total 125–210 *A. aggr. abchasica*.
2. Central zone of the most medium and upper leaves more than 76% of leaf length (total range 72–86%)
..... *A. aggr. betuletorum*.
- + Central zone of the most medium and upper leaves less than 74% of leaf length (total range 52–78%), 6–8 teeth at each side of the leaf lobes 3.
3. Incisions between lobes short, less than 1.5 of the standard tooth length 4.
- + Incisions between lobes profound, more than 1.5 of the standard tooth length 5.
4. Leaf lobes less than 25% of leaf length, apical tooth more than 0.5 of the standard tooth length
..... *A. aggr. ellenbergiana*.
- + Leaf lobes more than 25% of leaf length, apical tooth less than 0.5 of the standard tooth length
..... *A. aggr. transcaucasica*.
5. Hypanthia and pedicels ± hairy, often quite densely, stems pubescent up to the top *A. aggr. subsplendens*.
- + Hypanthia and pedicels glabrous, stems hairy only in the lower half *A. aggr. dura*.

Applying this scheme (Fig.) and reasoning presented above, the change of the borders between two series of *A. subsect. Calycanthum* is presented as follows:

Alchemilla* ser. *Elatae (Rothm.) Rothm., emended here. ≡ *A. subsect. Elatae* Rothm. 1933, Feddes Repert. 33: 854, p. p. ≡ *A. ser. Elatae* (Rothm.) Rothm. 1938, Feddes Repert. Beih. 100: 59, p. p.; Plocek, 1982, Preslia, 53: 50, p. max. p.

= *A. sect. Calycinae* Buser, 1893, in Magnier, Scr. Fl. Sel. 12: 278, p. p., excl. typo; id. 1896, Bull. Herb. Boiss. 4: 758, p. p., excl. typo.

= *A. sect. Erectae* S. E. Fröhner, 1986, Gleditschia, 14: 30, p. max. p.

= *A. sect. Alchemilla*: S. E. Fröhner, 1986, Gleditschia, 14: 34, p. p., non auct. mult.

Found in mesophilic conditions, large plants (up to 70 cm), with a patent, long, sometimes rather bristly indumentum of petioles and stems, radical leaves

with 120–250 teeth in total (from 90 teeth of small specimens from dry habitats, but with non-coriaceous leaves), spreading pubescent beneath (sometimes woolly); with (30)60–140 teeth of cauline leaves, differently pubescent on leaves (above), stems, flowers, and pedicels. Mesophilic plants tied to margins of relict Tertiary broadleaved forests, or derivative meadows. Distributed in the Caucasus, Asia Minor, Balkans, Carpathians (1 species), and Iran (6).

Alchemilla* ser. *Calycinae (Buser) Rothm., emended here. ≡ *A. ser. Calycinae* (Buser) Rothm. 1938, Feddes Repert. Beih. 100: 59; Plocek, 1982, Preslia, 53: 50. ≡ *A. sect. Calycinae* Buser, 1893, in Magnier, Scr. Fl. Sel. 12: 278, p. p., incl. typo; id. 1896, Bull. Herb. Boiss. 4: 758, p. p., incl. typo; S. E. Fröhner, 1986, Gleditschia, 14: 35.

= *A. subsect. Elatae* Rothm. 1933, Feddes Repert. 33: 854, p. p., excl. typo. ≡ *A. ser. Elatae* (Rothm.) Rothm. 1938, Feddes Repert. Beih. 100: 59, p. p., excl. typo.

= *A. ser. Retinerves* Plocek, 1982, Preslia, 53: 50.

= *A. ser. Venosae* Plocek, 1982, Preslia, 53: 50.

= *A. sect. Coriacea* S. E. Fröhner, 1986, Gleditschia, 14: 41, p. min. p.

= *A. sect. Erectae* S. E. Fröhner, 1986, Gleditschia, 14: 30, p. min. p.

= *A. sect. Alchemilla*: S. E. Fröhner, 1986, Gleditschia, 14: 34, p. min. p., non auct. mult.

Usually small plants, or medium (up to 40 cm), found in mesophilic conditions, generally glabrous or with appressed slender indumentum of petioles and stems; if subappressed, then with appressed hairs on the leaves beneath; radical leaves with 50–120 teeth in total (to 220 teeth for *A. aggr. abchasica*, but still mostly glabrous or with appressed hairs on the leaves beneath), with ever glabrous leaves from above; with 15–40 (to 70–100 for *A. aggr. abchasica*) teeth of cauline leaves; usually with a coriaceous appearance. Plants of rocky slopes, dry or moist, often near the snowline, banks of watercourses, or of secondary disturbed habitats such as roadsides. Distributed in the Caucasus, Asia Minor, Iran (2), as well as the Balkans, Carpathians, Alps, Pyrenees, and ?Urals.

In the light of suggestions outlined above, several additions to the Rothmaler's concept made by Pawłowski (1954) and Plocek (1982, 1990) need to be discussed.

The *Calycinae* as proposed above is approximately equal as a whole to the three series presented by Plocek (1982): *A. ser. Calycinae*, *A. ser. Retinerves* Plocek, *A. ser. Venosae* Plocek. As it came from Plocek's comparison of *A. ser. Retinerves* with *A. ser. Calycinae*, the

latter was supposed to comprise European representatives. Therefore, it should include most of my *A. dura* aggregate. In that concept, the *Retinerves*, being supposed as a Caucasian group, united arbitrarily *A. dura* and *A. retinervis*, which were in fact rather remote from each other. At the same time, the types of both groups (*A. retinervis* Buser and *A. fissa* Günther et Schummel (*A. glabra* Poiret, non Neygenf.), respectively) belong, in my opinion, to the same aggregate. Thus, I shall consider *A. ser. Retinerves* synonymic to *A. ser. Calycinae*. The last *A. ser. Venosae* Plocek (1982) being barely described, probably, was supposed to embody the rest of our aggregates. However, the only I can say with confidence is that the valid name *A. subser. Venosae* Plocek (from *A. ser. Venosae*), which was typified by *A. venosa* and noted with a reference to Juzepczuk's "cikl" (circle) *Subsplendentes*, may be applied to my *A. aggr. subsplendens*, but in restricted sense. Shifted by Plocek (1982) *A. subser. Semielatae* Pawł. (with the type *A. gorcensis*) from *A. ser. Elatae* to *A. ser. Venosae* may be relevant for that part of *A. aggr. abchasica*, which includes species with no or poor hairiness. Later, endemic of the Carpathians *A. ser. Calycinae* subser. *Serratae* Plocek (1990) was also described, which I can hardly discuss having almost no material available — only illustration of *A. hyperptycha* Plocek (1990: Fig. 16). It might be quite close to *A. subser. Semielatae* mentioned above and a part of *A. aggr. abchasica* as well as another group, *A. ser. Venosae* subser. *Pterophyllum* Plocek. I can conclude that Re-, Su-, and Ab-aggregates were covered by previous studies with some taxonomic outcomes, which can be employed in the future, especially, for the latter group. The presence of Be-, El-, Du-, and Tr-aggregates have been previously overlooked, and their specificity has not been outlined.

Key for the *Alchemilla ser. Calycinae* species of the Caucasus and Asia Minor

1. Central zone of most of the leaves 50–70% of leaf length, and stems glabrous at least in the upper 1–2 internodes to glabrous throughout 2.
- + Central zone of most of the leaves more than 70% of leaf length, or, when less than 70%, stems hairy throughout 11.
2. Teeth 9–12 at each side of the leaf lobes, lobes triangular at the top, stems hairy almost up to the top with appressed or patent hairs *A. tredecimloba*.
- + Teeth fewer than 9 at each side of the leaf lobes, lobes different 3.
3. Stems hairy only in the 1–2 lower internodes (in two, when the first one shortened), or totally glabrous 4.
- + Stems hairy above the first lower elongate internode 6.
4. Leaf lobes more than $\frac{1}{4}$ of leaf length, teeth to 8 at each side of the leaf lobes, stems hairy at the lowermost internode or glabrous throughout 5.
- + Leaf lobes less than $\frac{1}{4}$ of leaf length, teeth to 5 at each side of the leaf lobes, stems glabrous throughout *A. adelodictya*.
5. Stems hairy at the lowermost internode, incisions between lobes less than standard tooth length, teeth to 8 at each side of the leaf lobes *A. ptyschensis*.
- + Stems glabrous throughout, incisions between lobes 1–2 of standard tooth length, teeth to 6 at each side of the leaf lobes *A. microdictya*.
6. Teeth 4–6 at each side of the leaf lobes 7.
- + Teeth 6 and more at each side of the leaf lobes 9.
7. Hypanthia glabrous, stems hairy very sparsely in the lower half only *A. retinervis*.
- + Hypanthia \pm hairy, stems densely hairy 8.
8. Indumentum patent, stems hairy only in the lower half *A. hayirliogluorum*.
- + Indumentum appressed or subappressed, stems hairy also in the upper half *A. ancerensis*.
9. Angle of leaf sector 45–60° *A. transcaucasica*.
- + Angle of leaf sector 25–40° 10.
10. Indumentum erectopatent, leaves densely hairy beneath, leaf lobes rounded at the top *A. kazbekensis*.
- + Indumentum appressed, leaves glabrous on the surfaces beneath, leaf lobes obtuse at the top *A. buseriana*.
11. Teeth 9 or more at each side of the leaf lobes 12.
- + Teeth usually fewer than 9 at each side of the leaf lobes 16.
12. Angle of leaf sector 25–35° 13.
- + Angle of leaf sector 35–45° 15.
13. Incisions between lobes 1–3 of standard tooth length 14.
- + Incisions between lobes less than standard tooth length, leaf lobes obtuse or triangular at the top, leaves mostly plain or nearly so *A. undecimloba*.
14. Leaf lobes obtuse or triangular at the top, leaves mostly plain, indumentum of stems and petioles very sparse *A. buseriana*.
- + Leaf lobes mostly rounded at the top, leaves undulate, indumentum of stems and petioles dense .. *A. camptopoda*.
15. Leaf lobes semiovate, parabolic or elongate triangular, leaves mostly reniform *A. abchasica*.
- + Leaf lobes arcuate or shortly trapezoid to widely parabolic, leaves mostly orbicular or orbicular reniform *A. ciminensis*.
16. Stems hairy only in the lower internode or totally glabrous 17.
- + Stems hairy above the lower internode 21.
17. Angle of leaf sector 30–45° 18.
- + Angle of leaf sector 45–60° 19.
18. Some hypanthia sparsely hairy at the base, pedicels to 2(3) of the hypanthia length, upper leaves glabrous beneath (except for basal lobes and main veins) *A. cartilaginea*.
- + All hypanthia glabrous, pedicels to 6(8) of the hypanthia length, upper leaves evenly hairy beneath *A. longipedicellata*.
19. All the petioles hairy (with sub-appressed and erectopatent hairs), leaf lobes shorter than $\frac{1}{4}$ of leaf length *A. debilis*.

- + Most of petioles glabrous (if hairy, with appressed hairs), leaf lobes longer than $\frac{1}{4}$ of leaf length 20.
20. Stems glabrous throughout, leaf teeth of ordinary width (length to width ratio 1–2) *A. muldaschevii*.
- + Stems hairy at the lowest internode, leaf teeth wide (length to width ratio less than 1) *A. rivularis*.
21. Stems hairy throughout 22.
- + Stems glabrous at least in the upper 1–2 internodes to glabrous throughout 33.
22. Teeth 3–5(6) at each side of the lobes 23.
- + Teeth 6–8 at each side of the lobes 27.
23. Lobes longer than $\frac{1}{4}$ of leaf length 24.
- + Lobes shorter than $\frac{1}{4}$ of leaf length 25.
24. Apical teeth less than $\frac{1}{2}$ of standard ones, pedicels hairy ...
..... *A. grandidens*.
- + Apical teeth more than $\frac{1}{2}$ of standard ones, pedicels glabrous *A. tiryalensis*.
25. Incisions between lobes short, around 1 standard tooth length, indumentum appressed 26.
- + Incisions between lobes long, more than 2 standard tooth lengths, indumentum patent *A. akdoganica*.
26. Leaves reniform, evenly hairy beneath *A. bezengiensis*.
- + Leaves orbicular or orbicular reniform with glabrous surfaces beneath *A. retinerviiformis*.
27. Lobes longer than $\frac{1}{4}$ of leaf length 28.
- + Lobes shorter than $\frac{1}{4}$ of leaf length 30.
28. Hypanthia and pedicels glabrous or nearly so
..... *A. pseudotranscaucasica*.
- + Hypanthia and pedicels hairy 29.
29. Incisions short (about 1 standard tooth length), teeth nearly obtuse, and almost equally-sized (standard tooth 1–2 times longer than the lowermost tooth) ... *A. subsplendens*.
- + Incisions long (more than 2 standard tooth length), teeth acute, strongly unequally-sized (standard tooth to 4–5 times longer than the lowermost tooth) *A. speciosa*.
30. Angle of leaf sector 40–50° 31.
- + Angle of leaf sector 35–45°, apical teeth more than $\frac{2}{3}$ of standard ones, hypanthia and pedicels hairy
..... *A. sevangensis*.
31. Petioles and stems patent hairy, hypanthia glabrous
..... *A. beyazoghui*.
- + Petioles and stems pubescent with appressed hairs 32.
32. Apical teeth less than $\frac{1}{2}$ of standard ones, pedicels hairy, hypanthia hairy, incisions long (more than 1.5 standard tooth length) *A. divaricans*.
- + Apical teeth more than $\frac{1}{2}$ of standard ones, pedicels almost glabrous, hypanthia sparsely pubescent or glabrous, incisions short (less than 1 standard tooth length)
..... *A. venosa*.
33. Lobes longer than $\frac{1}{4}$ of leaf length 34.
- + Lobes shorter than $\frac{1}{4}$ of leaf length 37.
34. Hypanthia \pm hairy *A. oriturcica*.
- + Hypanthia glabrous 35.
35. Angle of leaf sector 45° and more *A. indurata*.
- + Angle of leaf sector 40° and less 36.
36. Indumentum erectopatent, lobes to semicircular
..... *A. kazbekensis*.
- + Indumentum appressed, lobes to parabolic
..... *A. wischniewskii*.
37. Hypanthia \pm hairy 38.
- + Hypanthia glabrous 40.
38. Angle of leaf sector 35–45(50)°, leaves dissected to $\frac{1}{4}$ and more, 7–9-lobed 39.
- + Angle of leaf sector 25–30°, leaves dissected to $\frac{1}{3}$ and less, 11–13-lobed *A. sciadiophylla*.
39. Lobes semicircular, rounded at the top, medium and upper leaves glabrous on both surfaces *A. stricta*.
- + Lobes \pm triangular at the top, medium and upper leaves evenly sparsely hairy on both surfaces *A. barbatiflora*.
40. Leaf lobes plane, shortly trapezoid to arcuate 41.
- + Leaf lobes semicircular to semiovate 42.
41. Stems to $\frac{2}{3}$ hairy, leaves sometimes sparsely hairy beneath, with hairy main veins throughout *A. betuletorum*.
- + Stems to $\frac{1}{3}$ – $\frac{1}{2}$ sparsely hairy, leaves glabrous on the lower surface, with glabrous main veins at the base *A. dura*.
42. Teeth 6–8 at each side of the lobes, leaves glabrous or sometimes sparsely hairy on the lower surface
..... *A. procerrima*.
- + Teeth 4–6 at each side of the lobes, leaves densely hairy on the lower surface *A. ellenbergiana*.

Conclusion

I have emended the borders between *A. ser. Calycinae* and *A. ser. Elatae*, treating the latter group as relict, attached to the Tertiary broadleaved forests of the Eastern Mediterranean basin. In these renewed circumscription, *A. ser. Calycinae* is subdivided into seven provisional aggregates according to the specially developed coordinate system (with two axes — a ratio of central zone value to leaf length vs. number of leaf teeth in total). The subdivision of the series in a hierarchical way is expected after a proper revision of European representatives and revealing of these aggregates geography in full.

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