Alchemilla cadinensis (Rosaceae), a new species from the Pyrenees (SW Europe)

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Source: Willdenowia, 45(3) : 435-442

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.45.45310
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Abstract


DOI: http://dx.doi.org/10.3372/wi.45.45310

Alchemilla cadinensis Aymerich & L. Sáez, sp. nov. (Rosaceae) is described, illustrated and compared to morphologically close species. The new species morphologically resembles A. demissa Buser, but it is easily distinguished by several qualitative and quantitative characters in leaf shape, indumentum and fruit. The conservation status of A. cadinensis is assessed as Endangered (EN) according to IUCN Red List categories and criteria.

Additional key words: taxonomy, Alchemilla, alpine flora, conservation, endemism

Introduction

Alchemilla L. is one of the most diverse genera in the Rosaceae, being highly diverse in W Eurasia (Fröhner 1990). The taxonomy of Alchemilla is complex and poorly understood, most likely due to confusion resulting from apomixis, polyploidization and hybridization (Gehrke & al. 2008). Alchemilla is currently accepted to be represented by 541 species in Europe and the Mediterranean region (Kurtto 2009). Among them, only few species grow in areas with late-lying snow (snowbeds) in high mountain areas (Bolòs & Vigo 1984; Fröhner 1998; Festi 2000). Some of these species that grow in areas with late-lying snow in the Pyrenees are a conservation priority (Sáez & al. 2010). They are specialized to the kind of conditions found in these mountain areas and, in some cases, are found at the edge of their natural area of occurrence.

In the course of botanical inventory work conducted on the Cadí range and neighbouring mountains (E Pyrenees, Catalonia, Spain), three populations of an unknown species of Alchemilla were found in snowbed habitats and rocky places on the N side of this mountain. The plants drew our attention because they do not match any other species described in recent floras and revisions (Bolòs & Vigo 1984; Fröhner 1998; Festi 2000; Ferrez & Tison 2010; Tison & al. 2014). However, the samples from the Cadí range seemed to be related to the A. demissa Buser aggregate. A detailed comparison of the Cadí populations with European taxa of Alchemilla revealed constant and conspicuous morphological differences in floral and vegetative features. The combination of ecological data of the population and morphological characters that have diagnostic value suggests that the plants belong to an undescribed species. They are described here as A. cadinensis, and the supporting reasons are given.

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Material and methods

Detailed observations and morphological measurements of vegetative and reproductive parameters were undertaken on herbarium materials from BC, BCN, G, W and ZT (acronyms according to Thiers 2015+), as provided in the Appendix. Morphological observations of materials were carried out under a Zeiss Stemi DV4 stereomicroscope. For taxonomic identification, revisionary work on scientific papers and floras of European territories (Bolòs & Vigo 1984; Fröhner 1998; Festi 2000; Ferrez & Tison 2010; Tison & al. 2014) was made. A detailed comparison between the new species and other morphologically related species is shown in Table 1. The descriptive terminology follows Fröhner (1998). The extent of occurrence and area of occupancy were calculated using the GeoCAT tool (Bachman & al. 2011).

Results and Discussion

Alchemilla cadinensis Aymerich & L. Sáez, sp. nov. – Fig. 1, 2 & 3.

Holotype: Spain, Catalonia, S Pre-Pyrenees, Serra de Cadi, Cava, between Canal Baridana and la Roca de la Balma, 42°17'19"N, 01°37'48"E, 2250 m, calcareous rock crevices and snowbeds, 9 Aug 2013, P. Aymerich s.n. (BCN 122700; isotype: BC).

Description — Herbs with woody rhizome; stems 1–5, procumbent, slender, 7–25 cm × 0.7–1.2 mm, with adpressed (0–15°) hairs (0.5–1.7 mm long), usually confined to 1 or 2 lowest internodes. Basal leaves: stipules yellowish becoming cream, brown when dry, 9–17.5 mm long, membranous, abaxially glabrous to sparsely hairy; auricles 2–4 mm wide (length/width ratio = 1.4–2), both with 1–3 teeth 0.1–0.3 mm long; ocrea incision 3–6.5 mm long; petiole 3–10.5 × 0.5–0.8 cm, covered by adpressed (0–15°) hairs 0.5–1.5 mm long; leaf blade adaxially dark green, abaxially paler, suborbicular, divided to 32–61% of nerve length, flat or slightly undulate, 1.5–3.1 × 2.5–5.5 cm, adaxially glabrous, with adpressed (0–20°) hairs (0.5–1.5 mm long) on margin and main nerves abaxially (main nerves densely covered by hairs throughout their length); leaf lobes 7–9, ± cuneiform to hyperbolic, with straight sides and rounded apex, 1.5–2 × longer than wide; teeth subequal, obliquely triangular, acute, 0.7–1.7 × 0.5–1 mm (3–4.5% of nerve length, length/width ratio = 1.4–2.5), ± connivent, apical tooth narrower and shorter than adjacent laterals. Cauline leaves 1 or 2(3), shortly petiolate (petiole to 1 cm long), sometimes subsessile; stipules 4.5–7 × 5–8.3 mm, usually wider than long, margin serrate; leaf blade usually 5-lobed, to 11 × 17 mm, gradually smaller higher up stem. Bracts divided in 20–65% of their length, 5–12 × 7–12.5 mm. Inflorescences 2–7.5 cm long, with 25–87 flowers. Flowers yellow-green, 3–4 mm in diam.; pedicels 1.5–3.5 mm long, glabrous (sometimes slightly hairy at proximal part). Receptacle oblong-cylindric, 1–1.6 × 0.8–1.5 mm, glabrous, base slightly decurrent. Sepals triangular-ovate, 1–1.5 × 0.7–1.2 mm (length/receptacle length ratio = 65–100(–120)), glabrous; epicalyx segments ovate-lanceolate, 0.7–1.3 × 0.4–0.7 mm, nearly ¾ as long as sepals, glabrous. Staminodes 0.4–0.6 mm long. Style filiform, 1–1.5 mm long, exceeding receptacle by 15–30% of its length.

Phenology — Flowering from June to August; fruiting from August to September.

Distribution and ecology — Alchemilla cadinensis is currently known only from three populations in the Cadi range and Tosa d’Alp massif, E Pyrenees (Catalonia, Spain) (Fig. 4). The new species grows in rocky calcareous places on N-facing slopes, where snowbeds persist until June and exceptionally until midsummer. Its populations are placed in a narrow altitudinal zone between 2200 and 2250 m. Alchemilla fissa Günther & Schummel, a species morphologically close to A. cadinensis, was reported from the nearby Pedraforca massif (Fig. 4) by Vigo & al. (2003). This record is not supported by herbarium specimens and it is probably referable to A. cadinensis, but the presence of this species in the Pedraforca massif requires verification.

Conservation status — Among alpine plant communities, snowbeds are regarded as particularly sensitive indicators of climate change (Björk & Molau 2007). Therefore, changes in species composition in snowbeds can be expected. In this context, it is likely that Alchemilla cadinensis may suffer a loss of its habitat and increased plant competition. Our data so far indicate that A. cadinensis should be listed as Endangered EN D, following the categories and criteria of IUCN (2012), in view of its low population size (c. 150 individuals). In addition, this species has an extent of occurrence of 3.15 km² and the area of occupancy calculated on a 0.5 × 0.5 km grid is 0.75 km². The subpopulations from the E Cadi range (Tosa d’Alp) are found close to a ski resort, so it is likely that disturbances caused by heavy machinery and new ski pistes can cause impact on the natural populations of A. cadinensis.

Etymology — The specific epithet cadinensis is derived from “Cadino”, the ancient form of the name for the type locality, the Cadi range, E Pyrenees, Catalonia, Spain.

Remarks — On morphological grounds, the new species is related to Alchemilla demissa (endemic to mountains of C and W Europe), with which it shares most of the vegetative characters and some flower features (sepals longer than or exceptionally subequalling epicalyx segments, receptacle glabrous, or sometimes slightly hairy in proximal part). However, a careful comparison of their
morphological features (Table 1) shows relevant differences: *A. cadinensis* is easily distinguished from *A. demissa* by its hairy petioles, shorter teeth of distal lobes and smaller achenes exceeding receptacle in 15–30% of their length.

*Alchemilla borderei* S. E. Fröhner, a species endemic to the C Pyrenees and Cantabrian Mountains (Fröhner, 1998), is somewhat similar to *A. cadinensis*, but can be easily separated by several characters (Table 1): erect to ascending stems, wider petioles (which are sometimes glabrous), basal leaves abaxially hairy only on distal part of nerves, larger distal teeth, larger flowers, achenes exceeding receptacle in 33–40% of their length and especially by almost always having sepals shorter than epicalyx segments (Fröhner, 1998). We have never observed epicalyx segments longer than sepals in *A. cadinensis*.

*Alchemilla cadinensis* also resembles *A. frigens* Buser, a species included within the *A. demissa* aggregate (Fröhner 2004) endemic to the Alps and Jura. *Alchemilla*
frigens differs from A. cadinensis in shorter pedicels, usually 0.4–1 mm long, longer achenes and less deeply lobed leaves (Table 1). In addition, the stems of A. frigens are usually glabrous.

The new species is somewhat close to Alchemilla fal lax Buser (endemic to mountains of S Europe), but differs in the following features: epicalyx segments shorter than or exceptionally subequaling sepals (vs longer than sepals) and length/width ratio 1.6–2.2 (vs 2.5–4), leaves more deeply lobed, 32–61 % of nerve length (vs 8–30(–40) % of nerve length), stems distinctly narrower, 0.7–1.2 mm wide (vs 7–30 mm wide), hairy in 15–25 % of their length (vs 30–80 % of their length), and achenes smaller, 1.2–1.45 mm long (vs 1.5–1.8 mm long).
Fig. 3. A–E: *Alchemilla cadinensis* – A: apical portion of basal leaf, abaxial surface; B: portion of upper stem; C: portion of basal stem; D: fruits; E: portion of a flower. – All from the holotype.

Fig. 4. Distribution of *Alchemilla cadinensis*. The red spots show the known populations. The question mark represents the unconfirmed record of *A. fissa* from the Pedraforca massif.
Table 1. Comparative table with discriminant characters between *Alchemilla cadinensis* and the most similar species. All measurements are in mm.

<table>
<thead>
<tr>
<th></th>
<th>A. borderei</th>
<th>A. cadinensis</th>
<th>A. demissa</th>
<th>A. fallax</th>
<th>A. fissa</th>
<th>A. frigens</th>
<th>A. incisa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stem</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>size</td>
<td>100–400 × 1–2</td>
<td>70–250 × 0.7–1.2</td>
<td>50–200 × 1–4</td>
<td>150–700 × 7–30</td>
<td>70–350 × 0.7–2</td>
<td>50–300 × 1–2</td>
<td></td>
</tr>
<tr>
<td>hairiness</td>
<td>glabrous or hairy in 10–40% of its length</td>
<td>hairy in 15–25% of its length</td>
<td>glabrous or hairy in 40% of its length</td>
<td>hairy in 30–80% of its length</td>
<td>glabrous (rarely hairy in 10–30% of its length)</td>
<td>glabrous or hairy in 10–40% of its length</td>
<td></td>
</tr>
<tr>
<td><strong>Petiole of basal leaves</strong></td>
<td></td>
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<td></td>
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<tr>
<td>width</td>
<td>1–1.5</td>
<td>0.5–0.8</td>
<td>1–2.5</td>
<td>0.5–2</td>
<td>0.6–1</td>
<td>0.5–1.5</td>
<td>1–1.5</td>
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<tr>
<td>hairiness</td>
<td>glabrous to sparsely hairy</td>
<td>densely hairy</td>
<td>glabrous (rarely hairy)</td>
<td>glabrous to sparsely hairy</td>
<td>glabrous to sparsely hairy</td>
<td>glabrous to sparsely hairy</td>
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<tr>
<td><strong>Blade of basal leaves</strong></td>
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<tr>
<td>width</td>
<td>20–100</td>
<td>20–55</td>
<td>20–70</td>
<td>30–120</td>
<td>10–100</td>
<td>25–75</td>
<td>20–100</td>
</tr>
<tr>
<td>translucence</td>
<td>not translucent</td>
<td>not translucent</td>
<td>not translucent</td>
<td>not translucent</td>
<td>translucent</td>
<td>not translucent</td>
<td></td>
</tr>
<tr>
<td>hairiness</td>
<td>adaxially glabrous, abaxially hairy on distal part of nerves and teeth</td>
<td>not divergent</td>
<td>not divergent</td>
<td>not divergent</td>
<td>adaxially glabrous, abaxially hairy on nerves and teeth</td>
<td>not divergent</td>
<td></td>
</tr>
<tr>
<td>teeth of distal lobe divergence</td>
<td>1–3.5 × 1–3</td>
<td>0.7–1.7 × 0.5–1</td>
<td>1.5–5 × 1–3.5</td>
<td>1.3–5 × 1–3</td>
<td>1.5–5 × 0.5–4.5</td>
<td>1.2–5 × 0.7–2</td>
<td>1.2–5 × 1–2.2</td>
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<tr>
<td><strong>Pedicel</strong></td>
<td></td>
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<tr>
<td>length</td>
<td>2–5</td>
<td>1–3.5</td>
<td>0.5–3(–5)</td>
<td>1–3(–7)</td>
<td>1–4(–7)</td>
<td>0.4–1(–2)</td>
<td>2–5(–7)</td>
</tr>
<tr>
<td><strong>Flower</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>size</td>
<td>2–4 × 2–5–5</td>
<td>2–3 × 3–4</td>
<td>2.5–5 × 3–5</td>
<td>2.5–3.5 × 3–5</td>
<td>2.4–5 × 2–6.5</td>
<td>1.7–3.5 × 2.5–4.5</td>
<td>2.5–4 × 2.8–5</td>
</tr>
<tr>
<td>length/width ratio</td>
<td>1–2</td>
<td>1.2–1.5</td>
<td>0.9–2</td>
<td>1.3–2</td>
<td>1.2–2</td>
<td>1.1–1.3</td>
<td>1.2–2</td>
</tr>
<tr>
<td>% of receptacle length</td>
<td>80–120</td>
<td>65–100(–120)</td>
<td>67–100</td>
<td>(70–)100(–130)</td>
<td>90–140</td>
<td>60–75</td>
<td>75–115</td>
</tr>
<tr>
<td><strong>Epicalyx segments</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>length/width ratio</td>
<td>1–2</td>
<td>1.6–2.2</td>
<td>1.2–2</td>
<td>2.5–4</td>
<td>1.5–4</td>
<td>1.7–3.2</td>
<td>1.5–3</td>
</tr>
<tr>
<td>% of receptacle length</td>
<td>67–100</td>
<td>57–80</td>
<td>50–90</td>
<td>40–100</td>
<td>30–120</td>
<td>50–67</td>
<td>62–95</td>
</tr>
<tr>
<td>% of sepal length</td>
<td>75–120</td>
<td>65–80</td>
<td>60–90</td>
<td>(50–)90(–110)</td>
<td>50–120</td>
<td>60–80</td>
<td>85–100</td>
</tr>
<tr>
<td>nervature</td>
<td>1–3-nerved</td>
<td>1-nerved</td>
<td>1–3-nerved</td>
<td>1–3-nerved</td>
<td>(1–)3-nerved</td>
<td>1–3-nerved</td>
<td>(1–)3-nerved</td>
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<tr>
<td><strong>Stamen filament</strong></td>
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<tr>
<td>length</td>
<td>0.4–0.7</td>
<td>0.35–0.5</td>
<td>0.5–0.7</td>
<td>0.5–0.8</td>
<td>0.4–0.7</td>
<td>0.4–0.7</td>
<td>0.4–0.7</td>
</tr>
<tr>
<td>length/width ratio</td>
<td>1.2–1.7</td>
<td>1.2–1.45</td>
<td>1.5–1.7</td>
<td>1.5–1.8</td>
<td>1.2–1.5</td>
<td>1.5–1.8</td>
<td>1.3–1.5</td>
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<tr>
<td><strong>Achene</strong></td>
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<tr>
<td>length</td>
<td>1.3–1.5</td>
<td>1.3–1.5</td>
<td>1.3–1.5</td>
<td>1.5–2</td>
<td>1.3–1.5</td>
<td>1.3–1.45</td>
<td>1.2–1.5</td>
</tr>
</tbody>
</table>
Morphological relationships with *Alchemilla fissa* (endemic to mountains of C and S Europe) appear to be more remote. This species can be easily separated by several characters: glabrous (rarely hairy) stems and leaves, translucent and deeply divided basal leaves with strongly divergent teeth, and longer epicalyx segments (Table 1).

Moreover, there are significant morphological differences between *Alchemilla cadinensis* and other species that are not strictly associated with alpine snowbeds, such as *A. incisa* Buser, endemic to the Alps, Jura, N Apennines and Tatra. *Alchemilla incisa* differs distinctively from *A. cadinensis* in its deeply divided basal leaves (40–67 % of nerve length) with well-separated lobes (with almost U-shaped incisions) and longer teeth (up to 4 mm long), and by its epicalyx segments being usually as long as the sepals.

**Acknowledgements**

The authors express their appreciation to S. E. Fröhner and an anonymous reviewer for valuable comments on an earlier version of this paper. The staff and curators of the herbaria cited in the text are kindly acknowledged for the loan of plant material. We are also grateful to P. Carnicer, C. Roquet and S. Santamaria for their technical support.

**References**


**Appendix**

**Representative specimens included in the morphological study**

*Alchemilla borderei* S. E. Fröhner

**SPAIN**: Catalonia, Lleida province, Portarró d’Espot, 2400 m, 20 Jul 1944, *P. Font Quer* s.n. (BC 95632, det. S. Fröhner); sobre Estany d’Amítges, 2430 m, 9 Aug 1981, *A. Carrillo* & *J. M. Nitot* s.n. (BC 93512, det. S. Fröhner); Estany de Besiberri (Vall de Barravés), 1980 m, 14 Jul 1985, *R. Massalles* & *J. M. Nitot* s.n. (BC 93513, det. S. Fröhner); Pirineus, s.d., *P. Aymerich* s.n. (*Alchemilla cadinensis* and isotype (see above)).

*Alchemilla cadinensis* Aymerich & L. Sáez

**SPAIN**: Catalonia, Girona Province, Alp-Uràs, La Masella, Coma Oriola, 31TDG084870, 2237 m, rock crevices, 29 Jun 2006, *A. Romo, N. Nualart* & *I. Soriano* s.n. (BC 864184, sub *A. fissa*); Catalonia, Barcelona Province: E Pyrenees, Tosa d’Alp, Bagà, Comabella, 42°18’58”N, 01°54’33”E, 2200–2210 m, snowbeds and rock-crevices, 20 Aug 2014, *P. Aymerich* s.n. (BCB); also the holotype and isotype (see above).

*Alchemilla demissa* Buser

**ANDORRA**: Canillo, sota la Portella de Joan Antoni, 2550 m, snowbed, 14 Aug 1986, *J. Nuet* s.n. (BC 672893).
Alchemilla fallax Buser


Alchemilla fissa Günther & Schummel

Spain: Catalonia, Girona Province Núria, 5 Jul 1919, M. Garriga de Gallardo s.n. (BC 877325); Catalonia, Lleida Province, C Pyrenees, Coll Alford, 7 Aug 1924, J. Cuatreellas s.n. (BC 79389); Catalonia, Espot, La Mosquer, 2000 m, wet places, 14 Jul 1934, P. Font Quer s.n. (BC 79334); Catalonia, Montis de Llacs, 2100 m, alpine meadows, 26 Jul 1944, P. Font Quer & O. Bolós s.n. (BC 95443); Catalonia, Aigües Torotes, 2200 m, meadows, 25 Jul 1979, P. Litzler 79477 (BC 802216); Vall d’Aneu, 2350 m, 26 Jul 1985, A. Carrillo & R. M. Masalles s.n. (BC 60376).

Alchemilla frigens Buser

France: Jura, Crêt de la Neige, Jura Français, 1700 m, 9 Aug 1891, A. Schmidely s.n. (ZT 88830, ZT 88832); Haute Savoie, Mont Méry, 24 Jul 1893, R. Buser s.n. (ZT 88817). — Switzerland: Alpes Valaisannes, plateau de la gemmi, près du Daubuensee, 2050–2400 m, 12 Aug 1891, O. Buser 3772 (G 408045); Alpes Valaisannes, massif du Grand Saint-Bernard, 2100–2500 m, 23–29 Aug 1893, W. Barbey s.n. (W); Wallis, Berner Alpen, Leukerbad, zwischen Rinderhütte (Bergstation) und Wolfstritt, 1900–2300 m, 17–25 Jul 1982, A. Polatschek s.n. (W).

Alchemilla incisa Buser

France: Jura, chemin de la Feucille, au mont Colombier, en travers les bois dans de petites éclaircies, 1500 m, 30 Jul 1899, R. Buser & A. Schmidely 2730 (G 386946, 386947, 386948, 386949-holotype). — Italy: Vallombrosa, Toscana, Jul 1855, E. Caroli s.n. (G 408056). — Poland: Tatry Wysokie, m. Zoltsa Turnia, 2000 m, 4 Aug 1929, B. Pawlowski & K. Wallisch 35 (G 408054). — Switzerland: Alpes Lemanennes (Valais), versant N Pas de la Boste, 4 Aug 1899, J. Briquet s.n. (G 408063).