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Contribution to the knowledge of the genus *Alchemilla* L. (*Rosaceae*) in the Italian Alps: Carnic, Julian Alps and Pre-Alps

Abstract

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This paper aims at improving the knowledge of the genus *Alchemilla* in the flora of Friulian Alps (North-Eastern Italy). During 15 years of field observations 33 species were verified, while the sites of *A. coriacea* represent an unconfirmed historical bibliographic data. *Alchemilla carniolica*, *A. filicaulis*, *A. glomerulans*, *A. hirtipes*, *A. propinqua*, *A. venosula* and *A. versipila* occurred in a single population, whereas *A. monticola*, *A. flabellata*, *A. connivens* and *A. xanthochlora* were the most common, having more than 40 records on average. The most frequent geoelements were the orophytes, in particular S-European (12 species), the endemic ones, in particular alpics (8) and finally of the Eurosiberian elements (6). The distribution of the genus in the Friulian Alps, reveals that the maximum presence occurs in the western Main Carnic Chain.

Key words: Vascular flora, distribution, species richness, Carnic, Julian Alps and Pre-Alps, Friuli-Venezia Giulia, Italy.

Introduction

The knowledge about the genus *Alchemilla* in Italy and in particular in the Alpine regions had considerable progress in the last decades, especially due to the activity of floristic cartography, which stimulated the study of some critical genres, including *Alchemilla* (Fröhner & al. 2012; Bovio & Festi 2014; Festi & al. 2015). In this light, the publication of the fundamental monograph of Fröhner (1990), integrated in 2007 by the cartographic work of Kurtto & al., was an important incentive for a modern approach to the study of this genus.

The recognition of the species of *Alchemilla* is always a very difficult task due the complexity of forms and lack of description of the diacritic framework of some species. This makes the majority of literature data unsuitable for phytogeographic purposes, when they are not checked by a taxon specialist. Experience showed that up to 90% of the collections specimens are erroneously determined (Fröhner & al. 2012) and, as consequence, the deriving bibliographic citations are also erroneous. For these reasons, all the records given here, except for explicit warning, are based

on samples reviewed by S. E. Fröhner (Dresden, D), excellent connoisseur of the genus, and deposited at the Friulian Museum of Natural History of Udine (MFU). Recently, Festi (2017 and 2019) published a monography of the genus that, up to date, is the most complete and exhaustive work in Italy.

In the last years, Friuli Venezia Giulia has been subdivided in quadrants following the project for the floristic mapping of Central Europe (Ehrendorfer & Hamann 1965), and aiming at drafting a new chorological atlas. This project aims at updating the floristic knowledge based on the previous atlas carried out at the base area level (Poldini & al. 2002) by adopting the methods applied to the neighbouring regions (northern Italy, Carinthia and Slovenia).

Materials and methods

This study is mainly based on recent herbarium specimens (2001-2018); in addition, few specimens of local historical herbariums were also considered (TSB, MFU, W). Special attention has been paid to the areas of the region where a higher number of species was expected, in particular in the Main Carnic Chain.

The study will present a commented catalogue of the taxa occurring in the area, referring to the treatises of Festi (1998, 2017 and 2019) for the description and examination of the general diacritical characters. The annotations in the text focused on species details concerning mainly ecological and distributive aspects. For species documented by more than one finding, the altitudinal range has been deduced by herbarium specimens. A selection of specimens is reported in the “*Specimina selecta*” with location, altitude, basic area/quadrant, date of collection; where not otherwise indicated, the specimens were collected by F. Martini, reviewed by S. E. Fröhner and deposited in MFU. The findings appear ordered along the arch: Carnic Prealps (PC), Carnic Alps (AC), Julian Alps (AG) and Julian Prealps (PG). Synonymy has been omitted to avoid a burden of dubious utility.

Systematic prospect

The taxonomy followed what proposed by Fröhner (1990), however, it is to be considered provisional due to the occurrence of some *incertae sedis* taxa.

Sect. *Alchemilla*

- A. xanthochlora* Rothm.
- A. micans* Buser
- A. tirolensis* Buser
- A. crinita* Buser
- A. lineata* Buser
- A. venosula* Buser
- A. straminea* Buser
- A. glabra* Neygenf.

- A. obtusa* Buser
A. reniformis Buser
A. impexa Buser
A. effusa Buser

Sect. *Coriaceae* S. E. Fröhner

- [*A. coriacea* Buser]
A. connivens Buser
A. versipila Buser
A. glomerulans Buser
A. undulata Buser

Sect. *Calycinae* Buser em. S. E. Fröhner

- A. fissa* Günth. & Schumm.

Sect. *Decumbentes* S. E. Fröhner

- A. decumbens* Buser
A. hirtipes Buser

Sect. *Ultravulgares* S. E. Fröhner

- A. subcrenata* Buser

Sect. *Plicatae* S. E. Fröhner

- A. strigosula* Buser
A. propinqua H. Lindb. ex Juz.
A. monticola Opiz
A. filicaulis Buser
A. exigua Buser
A. colorata Buser
A. glaucescens Wallr.

Sect. *Flabellatae* S. E. Fröhner

- A. fallax* Buser
A. carniolica (Paulin) Fritsch
A. acutata Buser
A. flabellata Buser

Sect. *Alpinae* Buser ex Camus em. S. E. Fröhner

- Ser. *Hoppeanae* Buser ex Rothmaler
A. leptoclada Buser
A. alpinula S. E. Fröhner

Commented inventory in alphabetical order

A. acutata Buser

Observations. Observed only in the Main Carnic Chain between M. Crostis and Paularo (1500-2050 m) (*Rhododendro-Vaccinion*, *Adenostylion*, *Nardion*).

Specimina selecta. AC: Panoramica delle Vette, fra M. Neval e Cas. Chiadinis, m 2000, 9443/1, 16.7.2008; vers. SE del Cimon di Crasulina, m 2000, 9443/2, 29.8.2008; cresta fra i M. Dimon e Paularo, m 1970 (9444/1), 10.9.2008.

A. alpinula S. E. Fröhner

Observations. According to current knowledge, it has to be considered an endemic species of the mountain-alpine belts of the South-eastern Alps between Garda Lake and Julian Alps. In the Friulian Alps it is currently known only for their eastern part (Julian Alps and one site in the Carnic Alps), where it grows on rocks, scree slopes of small grain size and dry, stony or discontinuous grasslands, preferably on calcareous soils (Fröhner 2012) between (1300) 1400 and 2200 m (*Potentillion caulescentis*, *Thlaspion rotundifolii*, *Seslerion variaie*). The specific epithet intends to emphasize the small size of the plant within the section *Alpinae*.

Specimina selecta. AC: Salita da Sella Poludnig al M. Poludnig, m 1835, 9446/1, 6.8.2014. AG: M. Canin, vers. E di Sella Grubia, m 2050, 9646/2, 17.8.2009; Julische Alpen: Kanaltal: Luschariberg Gipfel, 9547/1, Ronniger, rev. S.E. Fröhner, W; M. Santo di Lussari, vers. NE, lungo la strada, m 1770, 9547/1, 13.7.2010. PG: Salita da P.so di Tanamea a F.lla Kriš, m 1440, 9746/1, 18.8.2012; Bacino superiore del Torr. Bruschie sotto Forca di Campidello, m 1300, 9645/3, 26.6.2015.

A. carniolica (Paulin) Fritsch

Observations. Indicated at Sella Mangart (Fröhner 1990) on the border between Italy and Slovenia (Julian Alps).

A. colorata Buser

Observations. Widespread throughout the Friulian Alps between (770) 1300-1900 m, this South-European orophyte grows on stony, moderately dry to little damp, carbonate or sometimes slightly acid soils of alpine grasslands and dwarf shrub communities (*Seslerion variaie*, *Rhododendro-Vaccinion*).

Specimina selecta. PC: Cansiglio: tra caserma Candaglia e Ciol dei Scios, m1280, 9940/2, 3.7.2020, leg. C. Argenti, det. F. Festi, Hb Argenti; AC: Da Cas. M. dei Buoi a Cima Omblalet (Forni Avoltri), m 1715, 9342/4, 21.7.2015; Forni di Sotto: Punta del Mezzodi presso Cas. Chiampiu, m 1690, 9642/1, 17.7.2015; Sponda sin. del Torr. Fella a SE di Ugovizza, m 770, 9446/4, 1.7.2009, leg. M. Strain, det. S.E.Fröhner; PG: Gran Monte: nei pressi del Rif. Monteperta, m 1500, 9746/1, 18.8.2012.

A. connivens Buser

Observations. It has been observed along the entire alpine region of the study area from the mountain to the alpine belt between (950) 1200-2300 m. It is a species with a wide ecological range, growing in tall forb communities (*Adenostylion*), grasslands (*Polygono-Trisetion*, *Cynosurion*, *Poion alpinae*, *Nardion*, *Seslerion variaie*), wetlands (*Calthion palustris*) and dwarf shrub communities (*Rhododendro-Vaccinion*).

Specimina selecta. PC: Lungo il sentiero da Cas. Pradut (Claut) a M. Resettum, m 1695, 9742/3, 25.7.2015; AC: Alta V. Fleons, passo Sesis, m 2260, 25.7.2013; Vers. SW della Creta d'Aip, sopra la V. d'Aip, 1800, 16.8.2013; AG: Conca di Fusine, poco sopra il bivio fra i sent. per Rif. Zacchi e Biv. Nogara, m 950, 9548/1, 2.6.2011; PG: Vers N del M. Matajur, presso Casere Tu v Dolini, m 1435, 9747/3, 14.8.2008.

[*A. coriacea* Buser]

Observations. AC: there is a historical datum not confirmed by Gortani (1981) for the Mount Varmost.

A. crinita Buser

Observations. It grows in the mountain to alpine belts between (600) 1000-2000 m and prefers fresh to moist or even moderately dry, base-rich soils of calcareous grasslands (*Seslerion variae*) and sometimes in communities of tall forbs (*Adenostylion*, *Rumicion alpini*).

Specimina selecta. AC: M. Tinisa, prati di Cas. Tintina, m 1500, 9542/3, 31.8.2009; Vers. W di Quota Pascoli presso il laghetto Pera (F. Avoltri), m 1950, 9342/4, 8.8.2014; V. Plecia, sella Plecia, m 1616, 9446/2, 16.7.2011. AG: Fusine in V. Romana, piana fra l'Alpe Tamer e l'Alpe del Lago, m 1000, 9547/2, 25.7.2008.

A. decumbens Buser

Observations. Endemic species of the Alps, it is diffused in the high-mountain-alpine belts between 1500 and 2100 m, where it prefers small-grass coenoses on long snow-covered soils, grasslands, meadows, peat bogs, edges of streams, much more rarely megaforb communities. These records confirmed the citation of Gortani (1981) for Paularo and Coglians mounts, excluding this taxon from the group of chorological doubts as noted in Poldini & al. (2001).

Specimina selecta. PC: Claut, sentiero da Cas. Pradut a M. Resettum, m 1595, 9741/1, 25.7.2015. AC: M. Arvenis, m 1860, 9543/2, 27.6.2002. AG: M. Canin, vers. E di Sella Grubia, m 2050, 9646/2, 17.8.2009.

A. effusa Buser

Observations. S-European orophyte, so far observed only in the western Carnic Alps between 1500 and 2200 m on fresh and wet soils by surface trapelation, from ± basic to weakly acid soils. It frequents vegetation of springs, banks of streams, shrubs and communities of tall forbs.

Specimina selecta. AC: M. Tinisa, fra Le Forcelle e il M. Brutttopasso, m 1840, 9542/3, 31.8.2009; Vers. N M. della Piana (Sappada), m 1970, 9442/1, 12.7.2028, C. e S. Argenti, rev. F.Festi, Hb Argenti; Pramollo, verso Cas. Auernig e For, m 1550, 9445/2, 14.8.2008, M. Crasnich, rev. S.E. Fröhner; Fra i monti Zoncolan e Tamai, m 1740, 1.8.2009, 9543/2.

A. exigua Buser

Observations. It is an endemic species of the Alps, growing from the (lower) mountain to the alpine belt, from (650) 950 to 2000 m. It prefers moderately dry to fresh, humic, often eutrophic, base-rich soils in meadows (*Poion alpinae*, *Nardion*, *Polygono-Trisetion*), grasslands (*Mesobromion*, *Seslerion variae*), clearings and megaphorb communities (*Adenostylion*).

Small specimens of other species have been often erroneously attributed to *A. exigua*, although this taxon, in spite of the specific epithet, may reach the size of related species. The main discriminating characters of *A. exigua* are the presence of thin flower pedicels and stems, the leaves teeth mostly finely pectinate and the small flowers, usually carried in pseudoumbels, briefly pedicellated, with a very slender hypanthium. (Fröhner & al. 2012).

Specimina selecta. PC: V. Zemola (Erto), salita da Stalle Mola a Cas. Bedin di Sopra, m 1520, 9640/3, 17.7.2013; M. Lovinzola, presso la cava, m 1635, 9643/2, 22.8.2008. AC: Vers. W di Quota Pascoli presso il laghetto Pera (F. Avoltri), m 1950, 9342/4, 8.8.2014; Salita da Sella Poludnig al M. Poludnig, m 1445, 9446/1, 6.8.2014. AG: Fusine in V. Romana, piana fra l'Alpe Tamer e l'Alpe del Lago, m 1000, 9547/2, 25.7.2008. PG: M. Glava (Matajur), vers. SW, sent. 736, m 1390, 9743/3, 23.6.2012.

A. fallax Buser

Observations. It grows from the (lower) mountain to the alpine belt between (600) 1000–2000 m on wet and humid soils by surface trapelation, eutrophic, base-rich soils in coenoses of *Adenostylion*, *Piceion excelsae*, *Erico-Pinion*, *Rhododendro-Vaccinion* and *Seslerion variae*.

Specimina selecta. PC: M. Costa Paladin, vers. N a SW di Cas. Fors, m 1540, 9642/4, 31.8.2013. AC: Fra Cas. Fleons Bassa e Cas. Creta Verde (F. Avoltri), m 1924, 9342/4, 8.8.2014; Salita da loc. Cristo di Forca (Amaro) al M. Amariana, m 1500, 9644/1, 24.6.2015. PG: M. Plauris, fra M.ga Confin e Jof di Ungarina, m 1530, 9645/3, 7.7.2011; Colovrat, presso Biv. Zanuso, m 600, 9847/2, 25.6.2011.

A. filicaulis Buser

Observations. For this Eurosibirian-North American species, only one site on the North-western border of the region is known so far. The most important characters useful to distinguish *A. filicaulis* are represented by the red colouration of the basal stipules (shared with *A. tenuis* Buser and *A. rubristipula* Buser, both absent in Friuli) and by the flowers mostly in pseudoumbels, with elongated pedicels and slender hypanthium.

Specimina selecta. AC: Lasen in Martini (2019) per l'alta V. di Sesis nelle vicinanze del Rif. Calvi, m 2160, 9342/3, 11.7.2015, leg. Lasen, rev. S.E. Fröhner, Hb Lasen).

A. fissa Günther & Schummel

Observations. It can be observed mainly on acid substrates between 1300 and 2300 m, usually in grasslands with long snow cover persistence, scree slopes of fine grain, meadows and grasslands (*Nardion*, *Poion alpinae*) and tall forb communities (*Adenostylion*). For distinctive characters with respect to *A. fallax* and *A. venosula*, see Fröhner & al. (2012).

Specimina selecta. PC: M. Lovinzola, nei pressi della cava di marmo, m 1625, 9643/2, 22.8.2008. AC: M. Zoncolan, nei dintorni di M.ga Pozof, m 1600, 9443/4, 31.7.2008. AG: Conca di Fusine, loc. Alpe Vecchia, m 1300, 25.7.2008; Sotto F.la Infrababa Grande, m 2000, 10.8.2001.

A. flabellata Buser

Observations. From the mountain to the alpine belt, between (750) 1000–2300 m, on moderately dry to moderately moist soils, rocky or superficial, rich to poor in bases and at times weakly acid, in lean grasslands, *Elyna* communities, dwarf shrubs and pine forests (*Seslerion variae*, *Oxytropido-Elynion*, *Rhododendro-Vaccinion*, *Erico-Pinion*). For the distinctive characters with respect to *A. glaucescens* see the notes to the latter.

Specimina selecta. PC: M. Lovinzola, nei pressi della cava, m 1625, 9643/2, 22.8.2008. AC: Vers. S. M. Chiadenis, verso Passo dei Cacciatori, m 2200, 9342/3, 25.7.2013; Lunze, a N di Illegio, m 900, 9544/4, 2.6.2013. AG: M. Mangart, Forc. Mangart, m 2263, 9547/4. PG: M. Plauris, fra M.ga Confin e Jof di Ungarina, m 1450, 9645/3, 7.7.2011; Vetta del M. Matajur, m 1640, 9747/3, 14.8.2008.

A. glabra Neygenf.

Observations. This eurosiberian species grows in the mountain-alpine belts between (950) 1300-2000 m, on humid to wet areas by surface trapelation, silty, eutrophic, base-rich soils in a different type of coenoses: grasslands (*Seslerion variae*, *Nardion*, *Polygono-Trisetion*, *Poion alpinae*), wet meadows (*Cynosurion*), peat bogs, banks of brooks (*Caricion davallianae*, *Calthion palustris*), tall forbs communities (*Adenostylin*) and dwarf shrubs (*Rhododendro-Vaccinion*). Indicated by Poldini & al. (2001) as a chorological doubt, it was later confirmed. The finding on the Cimon di Crasulina also gives credit to the record of Zirnich in Mezzena (1986) for some neighbouring groups of the Carnic Alps (Pal Piccolo, M. Coglians), while the collection on M. Lussari by the same author makes plausible those of Mainardis & Simonetti (1991) from the Julian Pre-Alps (M. Cuarnan, M. Chiampon). Nonetheless, it should be pointed out that the difficult distinction with respect to *A. versipila* makes uncertain the bibliographical records not supported by revised samples.

Specimina selecta. PC: Forni di Sotto: Punta del Mezzodi presso Cas. Chiampiu, m 1690, 9642/1, 17.7.2015. AC: M. Tinisa, prati di Cas. Tintina, m 1500, 9542/3, 31.8.2009; Sappada: Col di Caneva, m 1890, 25.7.2000, leg. C. Lasen, rev. S.E. Fröhner, Hb Lasen; Vers. SE del Cimon di Crasulina, m 2000 9443/2, 29.8.2008; M. Osternig, sotto Sella Bistrizza, m 1650, 9446/2, 16.7.2011. AG: Conca di Fusine, poco sopra il bivio fra i sent. per Rif. Zacchi e Biv. Nogara, m 950, 9548/1, 25.7.2008; M. Santo di Lussari, lungo la strada che porta verso Cima del Cacciatore, poco fuori l'abitato, m 1750, 9547/1, 13.8.2010. PG: M. Glava (Matajur), vers. SW, sent. 736, m 1405, 9747/3, 23.6.2012.

A. glaucescens Wallr.

Observations. *A. glaucescens*, like *A. glabra*, is also an Eurosiberian species; it prefers moderately humid, mesotrophic, base-rich soils in lean grasslands on carbonate or silicate substrate between (600) 1000-2300 m in lean grasslands (*Mesobromion*, *Seslerion variae*, *Nardion*, *Polygono-Trisetion*). Its presence in Friuli was commented by Feoli Chiapella & Poldini (1986) for some specimens reviewed by F. Lippert (München).

Specimina selecta. PC: Vers. S del Col Chiavrais, loc. Fienili Chiavrais (Forni di Sotto), m 600, 9642/1, 1.8.2014. AC: Sent. n. 140 da M.te Piana a Casera Olbe (Sappada), m 2025, 9442/1, leg. C. & S. Argenti, rev. S.E. Fröhner, Hb Argenti; M. Coglians, Forca Monumenz, m 2290, 21.8.2010; Sponda sin.del Torr. Fella a SE di Ugovizza, m 770, 9446/4, 1.7.2009, leg. M. Strain. AG: Altopiano del Montasio, m 1550, 9546/4, 5.8.2009, leg. A. Danelutto.

A. glomerulans Buser

Observations. *A. glomerulans* populates the subalpine-alpine belts with a preference for eutrophic to mesotrophic soils in snowbeds, peat bogs, vegetation of springs, banks of streams and brooks, alpine shrubs, forest fringes. So far the only finding is in the Carnic Alps and thus extends the eastern limit of the species, previously fixed on the Venetian Alps (Festi 2017; Argenti & al. 2019).

Specimina selecta. AC: Pic Chiadin, vers. S (Forni Avoltri), m 2290, 9443/1, 21.8.2010.

A. hirtipes Buser

Observations. It is an alpic endemic species, whose closest sites in the Italian Alps are located in Alto Adige / Südtirol (Festi 2017). It is present from the mountain to subalpine belt in coenoses referable to *Polygono-Trisetion* and *Nardion, Molinion, Filipendulo-Petasition*. According to Fröhner (1990), the fairly falcate profile of the lamina teeth represents a more important distinctive character than the abrupt interruption of the hairiness usually towards the half of the stem (from which the specific epithet). Locally it is known only for the following site.

Specimina selecta. AC: M. Zoncolan, dintorni di M.ga Pozof, m 1580, 9443/4, 31.7.2008.

A. impexa Buser

Observations. According to Fröhner & al. (2012), it is an element of the mountain-subalpine belts, widespread throughout the Alps, which grows on humid areas by surface trapelation, silty, base-rich, humic and eutrophicized soils in peat bogs, grasslands, tall forb communities and fine-grained screes, whose broad phytocoenotic spectrum may include *Caricion davallianae*, *Calthion palustris Polygono-Trisetion*, *Poion alpinae*, *Adenostyilion* and *Thlaspion rotundifolii*. The absence of previous records from our region is likely due to both the knowledge still insufficient, and perhaps the possible confusion with *A. effusa* (see Fröhner 1990), since *A. impexa* is reported in the Carinthian Alps (Hartl & al. 1992).

Specimina selecta. PC: Punta del Mezzodì (Forni di Sotto) presso Cas. Chiampiuz, m 1690, 9642/1, 17.7.2015. AC: M. Zoncolan, nei dintorni di M.ga Pozof, m 1580, 9443/4, 31.7.2008; M. Tamai, vers W, m 1930, 9543/2, 1.8.2009.

A. leptoclada Buser

Observations. The species has a range extending from the Jura Massif (France) to the western Alps. The site of M. Matajur is the only one so far established in Friuli. It would be therefore the most eastern site for the species (see Kurtto & al. 2007), since the nearest known localities are those of the Bergamo Alps reported in Fröhner & al. (2012) and in Martini & al. (2012). Moreover, some indications of *A. alpina* s.latiss., such as those of Minio and Crichiutti in Gortani & Gortani (1905-06) by Matajur himself should perhaps be ascribed to this species. In addition, the close affinity with *A. conjuncta*, suggests that historical records of the latter may be referred to *A. leptoclada* (Fröhner 1990). *A. leptoclada* prefers cracks in cliffs, scree slopes with small size grains, nutrient poor grasslands on rocky or shallow soils, mainly on carbonate substrates (*Potentillion caulescentis*, *Seslerion variae*). *A. alpinula* and *A. leptoclada* are currently the only representatives of the sect. *Alpinae* in the Friulian Alps.

Specimina selecta. PG: M. Matajur, fra Rif. Pelizzo e loc. Dolina, m 1345, 9747/3, 14.8.2008.

A. lineata Buser

Observations. This species were also recorded by Poldini & al. (2001), included as chorological doubt. It is a south European orophyte, present in the mountain-subalpine belts (1200-1800 m), preferably on mesotrophic, base-rich soils in wet meadows (*Cynosurion*), water-flowing habitats (*Caricion ferrugineae*), coenoses of tall grasses and forest fringes (*Adenostylin*).

Specimina selecta. PC: Vers. N del M. Costa Paladin, a E di Forca del Mugnol, m 1480, 9642/3, 31.8.2013. AC: M. Pieltnis, vallecchia sotto M.ga Pieltnis, m 1700, 9542/1, 31.7.2013; Timau, dintorni di Cas. Pramasio, m 1520, 9444/1, 1.7.2008; Alta V. Bartolo, pendici a W del valico con l'Austria a sin. di Sella del Bartolo (Ugovizza), m 1200, 9447/1, 28.7.2012. PG: Vers SW del M. Matajur, m 1355, 9747/3, 14.8.2008.

A. micans Buser

Observations. Eurosiberian species that can be observed from the mountain to the alpine belt at an altitude that ranges between (950) 1300 and 2000 m, on wet areas by surface trapelation, silty, eutrophic, base-rich soils in plant communities such as *Calthion palustris*, *Polygono-Trisetion*, *Cynosurion* and *Adenostylin*.

Specimina selecta. AC: V. Pesarina: Pradibosco, m 1200, 9442/3, 18.7.1972, leg. F. Barbieri, TSB; V. Plecia (Ugovizza), m 1310, 94462, 16.7.2011. AG: Fusine in V. Romana, piana fra l'Alpe Tamer e l'Alpe del Lago, m 1000, 9547/2, 25.7.2008. PG: Salita da P.so di Tanamea a F.lla Kriš (Gran Monte), m 1200, 9746/1, 18.8.2012.

A. monticola Opiz

Observations. This eurosiberian *Alchemilla* is one of the most frequent species in the Friulian Alps. It shows a high variability in the hair-covering, with individuals from totally hairless (often confused with *A. subcrenata*) to densely hairy (confused with *A. glaucescens*) (Fröhner & al. 2012). In the region, it is found from the (low) mountain to the alpine belt between 800 and 2100 m, generally on moderately dry to humid, eutrophic, base-rich soils. It grows in dry grasslands of *Mesobromion* and *Seslerion variaae*, relatively wet meadows (*Poion alpinae*, *Polygono-Trisetion*, *Cynosurion*), banks of brooks (*Calthion palustris*) and forest fringes (*Adenostylin*).

Specimina selecta. PC: Punta del Mezzodi (Forni di Sotto) presso Cas. Chiampiu, m 1690, 9642/1, 17.5.2015. AC: A SE di Cima Sappada, m 1300, 9442/1, leg. S. & C. Argenti, 16.6.2017, Hb Argenti; M. Dimon, m 1690, 9444/1, 10.9.2008; Nei pressi di Cas. Winkel (Pontebba), m 1480, 9445/2, 25.8.2014; Vers. S M. Capin di Ponente, Sella Cantore, m 1413, 9447/3, 24.8.2011. AG: Alta V. Romana fra la Portella e Sella Ursic lungo il sent. 511, m 1740, 9547/4, 13.8.2015; Sella Somdogna, m 1400, 9546/2, 1.9.2010. PG: V. Ucea, S. Anna di Carnizza, m 1110, 9646/3, 8.7.2011; Vers N del M. Matajur, presso Casere Tu v Dolin, m 1435, 9747/3, 14.8.2008.

A. obtusa Buser

Observations. It is an endemic species of the Alps, with only few known sites. In the western Carnic Alps it occurs in the mountain-alpine belts between 1300 and 2000 m. The species prefers wet to humid, loamy, eutrophic, base-rich soils of springs, rivulets (*Calthion palustris*, *Montio-Cardaminetalia*), bushes and forest fringes (*Adenostylion*). It can be confused with specimens of *A. glabra* with developed hair-covering, but *A. obtusa* is a more slender plant, with light blue-green leaves on the upper surface and mostly rounded teeth and not infrequently in some basal leaves the stipules are fused for 0.5-2 mm at the base (free in *A. glabra*).

Specimina selecta. AC: Cima Avroni (Forni di Sotto), m 1620, 9542/3, 24.8.1974, leg. L. Poldini, TSB.

A. propinqua H. Lindb. ex Juz.

Observations. Species of North-eastern Europe, whose Italian sites, disjointed from the main range, were hitherto known only for Trentino (Festi 2017). That of the Val Rauna (near Tarvisio) would constitute to date the eastern limit of the species on the Italian Alps.

Specimina selecta. AC: V. Rauna (Malborghetto), m 1090, 9446/4, 11.6.2013.

A. reniformis Buser

Observations. South European orophyte, is present in the Alps from the Maritime to Styria, as well as on Jura, Fichtelgebirge, Erzgebirge, Sudetes, Carpathians, North-western Balkan Peninsula, Bulgaria and Northern Apennines (Fröhner 1990, Kurtto & al. 2007). It grows in the mountain and subalpine belts between 1450 and 1900 m, on soils with variable contents in bases, also subacid, from moist to wet, mesotrophic, in grasslands, meadows and communities of tall herbs (*Nardion*, *Polygono-Trisetion*, *Adenostylion*).

Specimina selecta. AC: M. Tinisa, vers. N delle Forcelle, m 1670, 9542/3, 31.8.2009; Col Gentile, presso il laghetto di Cas. Forchia, m 1719, 9542/2, 19.8.2011.

A. straminea Buser

Observations. This south European orophyte can be observed throughout the Friulian Alps on moist to wet, base-rich soils, loamy, from eutrophic to mesotrophic. It prefers the mountain-alpine belts (but locally it can also be observed in the lower mountain belt) between (950) 1300 and 2300 m where it populates bogs and banks of streams (*Caricion ferrugineae*), meadows and grasslands (*Polygono-Trisetion*, *Poion alpinae*, *Nardion*, *Seslerion variaae*), forest fringes (*Adenostylion*), dwarf shrubs communities (*Rhododendro-Vaccinion*).

Specimina selecta. PC: M. Borgà, vers. E, m 1800, 9740/1, 9.7.2008; M. Lovinzola, lungo la strada fra Sella Chianzutan e M. Verzegnis, m 1470, 9643/2, 22.8.2008. AC: Panoramica delle vette, sotto M. Neval, m 1950, 9443/1, 16.7.2008; Lanza [Pontebba], m 1870, 9445/1, 21.7.2009, leg. C. Genzo. AG: Greto del Rio del Lago a S di Cave, m 980, 9547/3, 5.8.2015; V. Resia, verso M. Guarda, m 1650, 9646/4, 6.7.2011. PG: Vers. N del M. Matajur, presso Casere Tu v Dolini, m 1435, 9747/3, 14.8.2008.

A. strigosula Buser

Observations. It is a South-West European orophyte that in our region is currently known for the western part of the Friulian Alps. The findings corroborate the historical citations of Gortani & Gortani (1905-06, 1981) from Casadorno (Rigolato) and Casera Talm (M. Talm), located a few kilometres SE of M. Neval (see *Specimina selecta*). It has been observed between 1400 and 2000 m on moderately dry to moist soils, silty, rich in limestone and eutrophic, in grasslands and meadows (*Seslerion variaie*, *Polygono-Trisetion*).

This species could be easily confused with the closely related *A. subglobosa*, which has not yet been found in Friuli and which has a dark green colouration, at times suffused with violet, infundibuliform-plicated leaves, strongly wavy at the margin, with deep incisions (25-60%) and globose hypantium, largely rounded at the base, glabrous. *A. subglobosa* is known for Alto Adige / Südtirol (Wilhelm & al. 2006).

Specimina selecta. PC: M. Buscada, sopra la cava di marmo, m 1700, 9640/3, 9.7.2008; M. Lovinzola, lungo la strada fra Sella Chianzutan e M. Verzegnis, m 1470, 9643/2, 22.8.2008. AC: Vers. S del M. Pieltinis, m 1920, 9542/1, 31.7.2013; Strada panoramica delle vette, sotto M. Neval, m 1950, 9443/1, 16.7.2008; M. Dimon, m 1775, 9444/1, 10.9.2008.

A. subcrenata Buser

Observations. Species with eurosiberian distribution, of the mountain-alpine belts, locally observed between 1100 and 2000 m, it grows in wet to humid soils, silty, rich in limestone or in bases, eutrophic. It is found in grasslands and meadows (*Poion alpinae*, *Polygono-Trisetion*), vegetation of springs and in the banks of streams (*Calthion palustris*), shrubs and forest fringes (*Adenostylien*).

Specimina selecta. PC: M. Borgà, vers. E, m 1800, 9.7.2008. AC: M. Tinisa, prati di Cas. Tintina, m 1500, 9542/3, 31.8.2009; Vers. W di Quota Pascoli presso il laghetto Pera (F. Avoltri), m 1950, 9342/4, 8.8.2014; Costa Robbia (Ligosullo), m 1410, 9444/2, 8.8.2008, leg. V. Casolo.

A. tirolensis Buser ex Dalla Torre & Sarnth.

Observations. Orophyte of the Eastern Alps with disjunction on the Swiss Jura (Hügin & al. 2009), has recently been removed from the category of species indicated by Poldini & al. (2001) as chorological doubts.

It frequents the mountain-alpine belts (1100-2000 m) on eutrophic, humid, loamy, bases-rich soils in grasslands and meadows referable to *Poion alpinae*, *Nardion* and *Polygono-Trisetion*.

Specimina selecta. PC: V. Zemola (Erto), salita da Stalle Mola a Cas. Bedin di Sopra, m 1520, 9640/3, 17.7.2013; M. Costa Paladin, vers. N a SW di Cas. Fors, m 1530, 9642/4, 31.8.2013. AC: M. Tamai, vers. W, m 1930, 9543/2, 1.8.2009. AG: Piani del Montasio sotto Cima Gambon, m 1580, 9546/4, 5.7.2011; V. Resia sotto M.ga Coot, m 1100, 9646/4, 6.7.2011.

A. undulata Buser

Observations. Endemic to the Alps and the northern and central Apennines, the species appears on the mountain-alpine belts between (1300) 1600 and 2300 m. It is found on humid to wet, humic and base-rich soils, eutrophic, in different habitats: grasslands and meadows (*Poion alpinae* and *Polygono-Trisetion*, for instance), humid environments (*Calthion palustris*, *Caricion ferrugineae*), forest fringes (*Adenostylion*), communities of tall herbs of alpine huts (*Rumicion alpini*).

Small specimens may be confused with *A. decumbens*, but the latter is recognizable because usually has less developed hair-covering particularly on the leaf page and the basal leaves have fewer teeth and are never stellate.

Specimina selecta. PC: M. Borgà, vers. E, m 1800, 9740/1, 9.7.2008. AC: Alta V. Fleons, passo Sesis, m 2260, 9342/3; Vers. S di Cima Madrizze sopra Cas. Winkel (Pontebba), m 1800, 9445/2, 25.8.2014. AG: M. Canin, vers. E di Sella Grubia, m 2050, 9646/2, 17.8.2009. PG: Bacino superiore del Torr. Bruschie, sotto Forca di Campidello, m 1300, 9645/3, 26.5.2015.

A. venosula Buser

Observations. It is a widespread species in the Alps, from the Bergamasque Alps to the Karavanks, it populates the mountain-alpine belts in wet to humid, silty, seldom weakly acid, mesotrophic, base-rich soils. Currently in the Friulian Alps is known only for the site indicated below. For a comparison of characters among other morphologically related species (*A. connivens*, *A. fallax*, *A. fissa*) see the tables in Fröhner & al. (2012).

Specimina selecta. AC: Sopra il Rif. Chiampizzulon (Rigolato), m 1750, 9442/2, 3.8.2013, leg. C. Lasen, Hb Lasen.

A. versipila Buser

Observations. It is a species diffuse especially on the northern slope of the Alps and on the southern Jura (Fröhner & al. 2012). It grows particularly on calcareous soils in grasslands, scree slopes of small grain size, forest fringes. The collection site lies at a short distance from the border with Carinthia, making it plausible that even the sample of uncertain attribution collected at Mauthner-Alm (Fröhner 1990) may be referred here.

The difficult distinction from *A. glabra* makes the collection and careful review of samples essential (Festi 2017).

Specimina selecta. AC: Timau, dintorni di Cas. Pramosio, m 1520, 9444/1, 1.7.2008.

A. xanthochlora Rothm.

Observations. It is a Central European element, widespread in the Friulian Alps, it is found within the (low) mountain-alpine belts between (900) 1300 and 2300 m of altitude in wet to humid, silty, rich in limestone or in bases eutrophic soils. It is a species that populates meadows and pastures (*Poion alpinae*, *Polygono-Trisetion*, *Cynosurion*, for instance), humid environments (*Calthion palustris*, *Filipendulo-Petasition*) and forest fringes (*Adenostylion*).

Specimina selecta. PC: V. Zemola (Erto), salita da Stalle Mola a Cas. Bedin di Sopra, m 1550, 9640/3, 17.7.2013; Vers. N del M. Costa Paladin, a E di Forca del Mugnol, m 1480, 9642/3, 31.8.2013. AC: Alta V. Fleons, passo Sesis, m 2260, 9342/3, 25.7.2013;

Sopra sella Tamai, m 1850, 9543/2, 1.8.2009; Salita da Sella Poludnig al M. Poludnig, m 1545, 9446/1, 6.8.2014. **AG**: Conca di Fusine, vers. W della Ponza Grande, m 1280, 9548/1, 25.7.2008; Salita a Sella Mogenza dal Rio del Lago, m 1520, 9647/1, 5.8.2015. **PG**: M. Glava (Matajur), vers. SW, sent. 736, m 1360, 9747/3, 23.6.2012; Colovrat, sotto M. Nagnoj, lungo la strada, m 1190, 9847/2, 4.10.2014.

Discussion and conclusion

The genus *Alchemilla* in the Friulian Alps is currently encompassing by 33 species, to which is added *A. coriacea* of which exists an unconfirmed historical bibliographic data of Gortani (1981) for M. Varmost (Carnic Alps).

The most represented sections are sect. *Alchemilla* with 12 species and sect. *Plicatae* with 7 species. *Alchemilla carniolica*, *A. filicaulis*, *A. glomerulans*, *A. hirtipes*, *A. propinqua*, *A. venosula* and *A. versipila* occurred in a single population, while *A. monticola*, *A. flabellata*, *A. connivens* and *A. xanthochlora* were the most common species, having more than 40 records on average.

From the chorological point of view, we observe the predominance of the orophytes, in particular South-European (12 species), of the endemic, in particular alpic (8), and finally of the Eurosiberian elements (6).

The distribution of *Alchemilla* species richness in the Friulian Alps (Fig. 1), even if still lacking in some zones, reveals that the maximum number of taxa occurs in the western Main Carnic Chain, where a maximum of 13 species is reached in the quadrants 9444/1 (M. Paularo) and 94443/1 (M. Crostis). Southernmost, similar values are found in the quadrants 9443/4 (M. Zoncolan), 9543/2 (Group M. Arvenis-Tamai) and 9542/3 (M. Tinisa). In the Julian Alps the highest values are found in the quadrants 9546/4 (Jof di Montasio-Jof Fuart groups), 9646/2 and 9646/3 (Group of M. Canin). In the Julian Pre-Alps the maximum value is reached on M. Matajur (9747/3), while on the Carnic Pre-Alps the peak can be observed on the chain M. Duranno-M. Borgà (9640/3, 9740/2). This distribution pattern indicates some gaps to fill, the most meaningful of which concerns the group of the M. Cavallo of Pordenone, that it still appears insufficiently investigated.

However, as Fröhner & al. (2012) pointed out, while along the northern foot of the Alps many species penetrate deeply into the Alpine foreland, descending at very low altitudes, on the southern Alps, in particular in the pre-alpine sectors, this occurs with low frequency. As well as in the mountains of the Lombard Pre-Alps, also in Friuli the limit of southern diffusion of the genus seems to stop in the mountain belt around the 900-1000 m, with descents at lower altitudes in the northern slopes. A further limit to the diffusion of *Alchemilla* in Friuli is linked to the scarce diffusion of siliceous substrata, which favour the formation of humid environments (springs, banks of brooks, marshy areas, humid meadows, alder and willow shrubs, etc.). In fact, humid habitat represent the ecological optimum for many species (e.g. *A. acutata*, *A. effusa*, *A. glabra*, *A. micans*, *A. subcrenata*, *A. xanthochlora*, etc.). On the other hand, the large diffusion of carbonate substrates in the pre-alpine area, with their high permeability, represent a limiting factor together with the lowering of the less average altitudes. Species linked to carbonate substrates are considered for example *A. alpinula*, *A. colorata*, *A. crinita*, *A. flabellata* and *A. leptoclada*.

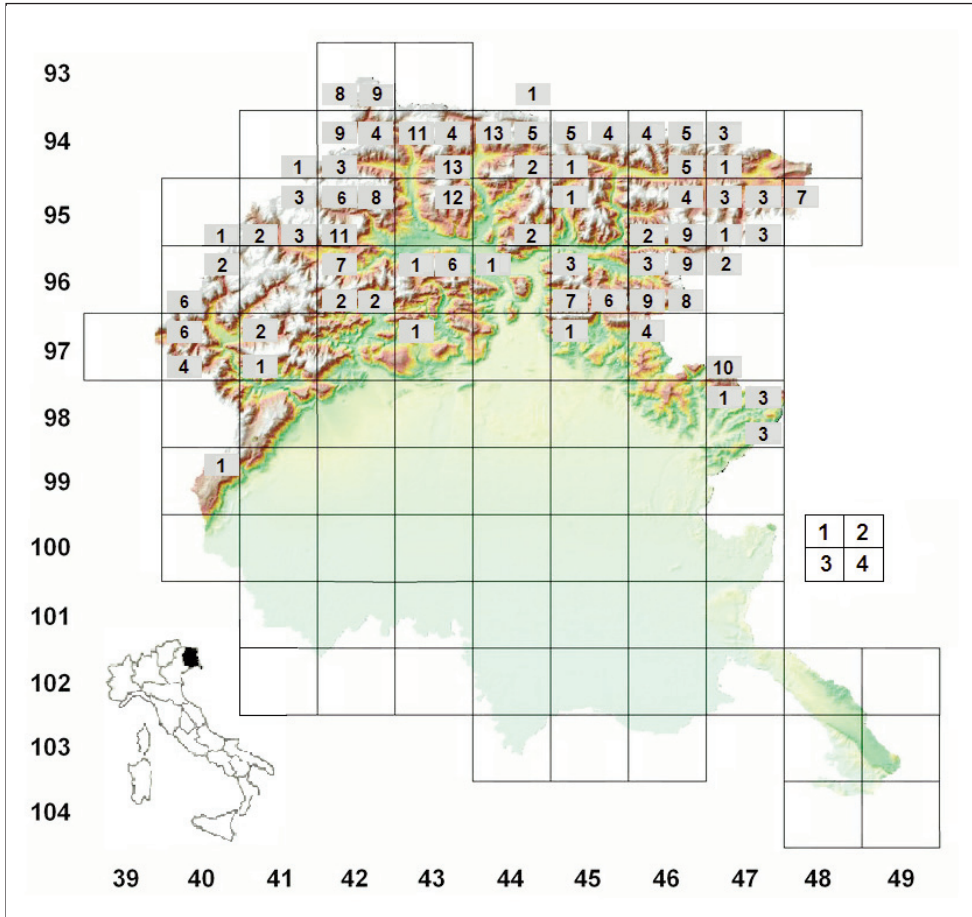


Fig. 1. Distribution of species richness of the genus *Alchemilla* in the Friulian Alps according to the adopted grid.

On the eastern side of the Region (Natisone Valleys) the wide diffusion of the sandstone substrata and the presence of wet ravines, itself favourable to the presence of *Alchemillae*, is contrasted by the relatively modest altitude and the diffusion of woods, whose expansion in recent decades has been greatly facilitated by the abandonment of the management of meadows and pastures.

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