

LEAF INDUMENTUM TYPES IN *POTENTILLA* (ROSACEAE) AND RELATED GENERA IN IRAN

MARZIEH BEYGOM FAGHIR¹, FARIDEH ATTAR¹, ALI FARAZMAND²,
BARBARA ERTTER³, BENTE ERIKSEN⁴

¹ Central Herbarium of Tehran University,
School of Biology, University College of Science
P.O. Box: 14155-6455, Tehran, Iran
e-mail: marziehfaghir@yahoo.com

² University of Tehran,
Department of Cell & Molecular Biology School of Biology, University College of Science
P.O. Box: 14155-6455, Tehran, Iran

³ University and Jepson Herbaria, University of California, Berkeley
California 94720-2465, USA

⁴ University of Göteborg, Department of Plant Environmental Sciences
Box 461, SE-405 30, Göteborg Sweden

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ABSTRACT

Indumentum types of the leaves in 31 species of *Potentilla* L. (Rosaceae) and four related genera, especially *Tylosperma* Botsch., *Schistophyllidium* (Juz. ex Fed.) Ikonn., *Drymocallis* Fourr. ex Rydb., and *Sibbaldia* L. from Iran were investigated. Indumentum ultrastructure was studied by scanning electron microscopy (SEM). SEM observation revealed three type classes based on leaf indumentum: 1) straight (appressed – erect); 2) straight-erect and crispate, and 3) crispate-floccose. The straight hair character (I type class) is widely distributed among all genera sampled and six sections of *Potentilla*. In contrast the crispate-floccose indumentum (III type class) is confined to all examined species of sections *Speciosae* and *Pensylvanicae*. While some sections especially *Rectae* (straight and straight – crispate hairs) and *Terminales* (straight – crispate and floccose – crispate) possess two indumentum type classes. The present survey shows that indumentum types are of systematic importance and may form good key characters for identification purposes.

KEY WORDS: *Potentilla*, *Tylosperma*, *Schistophyllidium*, *Drymocallis*, *Sibbaldia*, indumentum, ultrastructure, classification, Iran.

INTRODUCTION

The large, complex genus *Potentilla* L. (Rosaceae) consists of several hundred species, mostly herbaceous perennials distributed in arctic and temperate regions of the northern hemisphere. In Iran species of *Potentilla* occur mainly in the northern, northwestern and southern parts of the country, on alpine meadows, rocky places, riverbanks, lakes, streams, pastures and roadsides (Schiman-Czeika 1969; Khatamsaz 1993).

Schiman-Czeika's (1969) treatment of *Potentilla*, in the *Flora Iranica* reported 51 species of *Potentilla* arranged in 18 sections from Iran, Afghanistan, parts of western Pakistan, northern Iraq, Azerbaijan and Turkmenistan. Seven additional species of *Potentilla* were mentioned as "Incertae et incomplete notae". *Duchesnea* Smith., *Comarum* L.

and *Sibbaldia* L. were treated as separate genera. Subsequent changes to Schiman-Czeika's treatment, as compiled by Ertter and Attar (2007), resulted in 58 species of *Potentilla* L., three species of *Drymocallis* Fourr. ex Rydb., two species of *Tylosperma* Botsch., and one species each of *Farinopsis* Chrtek and Soják., *Schistophyllidium* (Juz. ex Fed.) Ikonn., *Dasiphora* Raf., *Duchesnea* J. E. Smith. and *Sibbaldia* L. in the area covered by *Flora Iranica* (Schiman-Czeika 1969).

The nomenclatural implications and adjustments for Europe, North America, and Iran have been addressed respectively by Kurtto and Eriksson (2003), Ertter (2007) and Ertter and Attar (2007).

Most species of *Potentilla* possess different types of indumentum on the leaves as well as other parts. Indumentum types were used as a key character in classification

(e.g., Juzepczuk 1941; Li et al. 2003; Eriksen and Yurtsev 1999; Soják 1986, 1989, 2004, 2007).

Eriksen and Yurtsev (1999) also developed a consistent terminology for ultrastructure-defined indumentum types in *Potentilla*, modified from Radford et al. (1974) and Stearn (1983) and comparable to that used by Soják (e.g., 1986, 1989, 2004, 2007). Detailed illustrations of petiole indumentum are provided in several papers in Soják's series of "Notes on *Potentilla*" (e.g., Soják 1986: 155; 1989: 757; 2007: 319, 321).

The current paper supplements previous studies as a systematic survey of indumentum ultrastructure of species of *Potentilla* and segregate genera in Iran, in order to obtain comparative information useful for understanding the relationships among species of *Potentilla*. The resultant data should serve to provide strong evidence for evaluating the

grouping and classification of the genus, especially given the diversity of *Potentilla* in Iran.

MATERIALS AND METHODS

We studied the indumentum of upper and lower leaf surfaces of 35 species from 10 sections of *Potentilla* and four related genera in Iran representing over half of the species and most of the genera and sections currently known in the area covered by Flora Iranica (Schiman-Czeika 1969; Ertter and Attar 2007).

Materials were either newly collected from different parts of Iran from 2005 to 2007 or obtained from Tehran University Herbarium (TUH) and other Iranian herbaria. The voucher specimen of each newly collected species was

TABLE 1. Grouping of species based on types of indumentum; * indicates presence of glandular trichomes.

Species	Section	Group
1 – <i>Potentilla adenophylla</i> *	<i>Aureae</i>	
2 – <i>Potentilla micrantha</i> *	<i>Micranthae</i>	
3 – <i>Potentilla argyroloma</i>	<i>Persicae</i>	
4 – <i>Potentilla aucheriana</i> *	<i>Persicae</i>	
5 – <i>Potentilla bungei</i> *	<i>Persicae</i>	
6 – <i>Potentilla nuda</i>	<i>Persicae</i>	
7 – <i>Potentilla kurdica</i>	<i>Persicae</i>	
8 – <i>Potentilla persica</i>	<i>Persicae</i>	
9 – <i>Potentilla reptans</i>	<i>Potentilla</i>	
10 – <i>Potentilla hirta</i>	<i>Rectae</i>	Sparse to moderately dense (pilose, sericeous, strigose, hirsute)
11 – <i>Potentilla iranica</i>	<i>Rectae</i>	
12 – <i>Potentilla pedata</i>	<i>Rectae</i>	
13 – <i>Potentilla recta</i> *	<i>Rectae</i>	I
14 – <i>Potentilla szovitsii</i>	<i>Rectae</i>	Straight (erect – appressed)
15 – <i>Potentilla supina</i> *	<i>Rivales</i>	
16 – <i>Drymocallis poterifolia</i> *	<i>Drymocallis</i>	
17 – <i>Drymocallis rupestris</i> *	<i>Drymocallis</i>	
18 – <i>Schistophyllidium bifurcum</i> *	<i>Schistophyllidium</i>	
19 – <i>Sibbaldia parviflora</i>	<i>Sibbaldia</i>	
20 – <i>Potentilla pannosa</i>	<i>Persicae</i>	
21 – <i>Potentilla petraea</i>	<i>Persicae</i>	Dense (hirtellous)
22 – <i>Potentilla porphyrantha</i>	<i>Persicae</i>	
23 – <i>Tylosperma lignosa</i>	<i>Tylosperma</i>	
24 – <i>Potentilla crantzii</i> *	<i>Aureae</i>	
25 – <i>Potentilla elvendensis</i>	<i>Persicae</i>	Flexuose (villose)
26 – <i>Potentilla mallota</i>	<i>Persicae</i>	
27 – <i>Potentilla adscharica</i> *	<i>Rectae</i>	
28 – <i>Potentilla radiata</i> *	<i>Rectae</i>	Straight-erect and crispate
29 – <i>Potentilla inclinata</i>	<i>Terminales</i>	II Straight-erect and crispate
30 – <i>Potentilla anserina</i>	<i>Pentaphylloides</i>	
31 – <i>Potentilla argentea</i>	<i>Terminales</i>	
32 – <i>Potentilla meyeri</i>	<i>Terminales</i>	
33 – <i>Potentilla hololeuca</i>	<i>Pensylvanicae</i>	Floccose and crispate
34 – <i>Potentilla polyschista</i>	<i>Pensylvanicae</i>	III Floccose-Crispate (Woolly)
35 – <i>Potentilla speciosa</i>	<i>Speciosae</i>	

deposited in Tehran University Herbarium (TUH). Flora Iranica (Schiman-Czeika 1969) was the primary reference for identifications, with some nomenclatural updates as per Ertter and Attar (2007). Species sampled are listed in Appendix 1 by genus and section, with nomenclatural authorship provided for all species, sections, and genera.

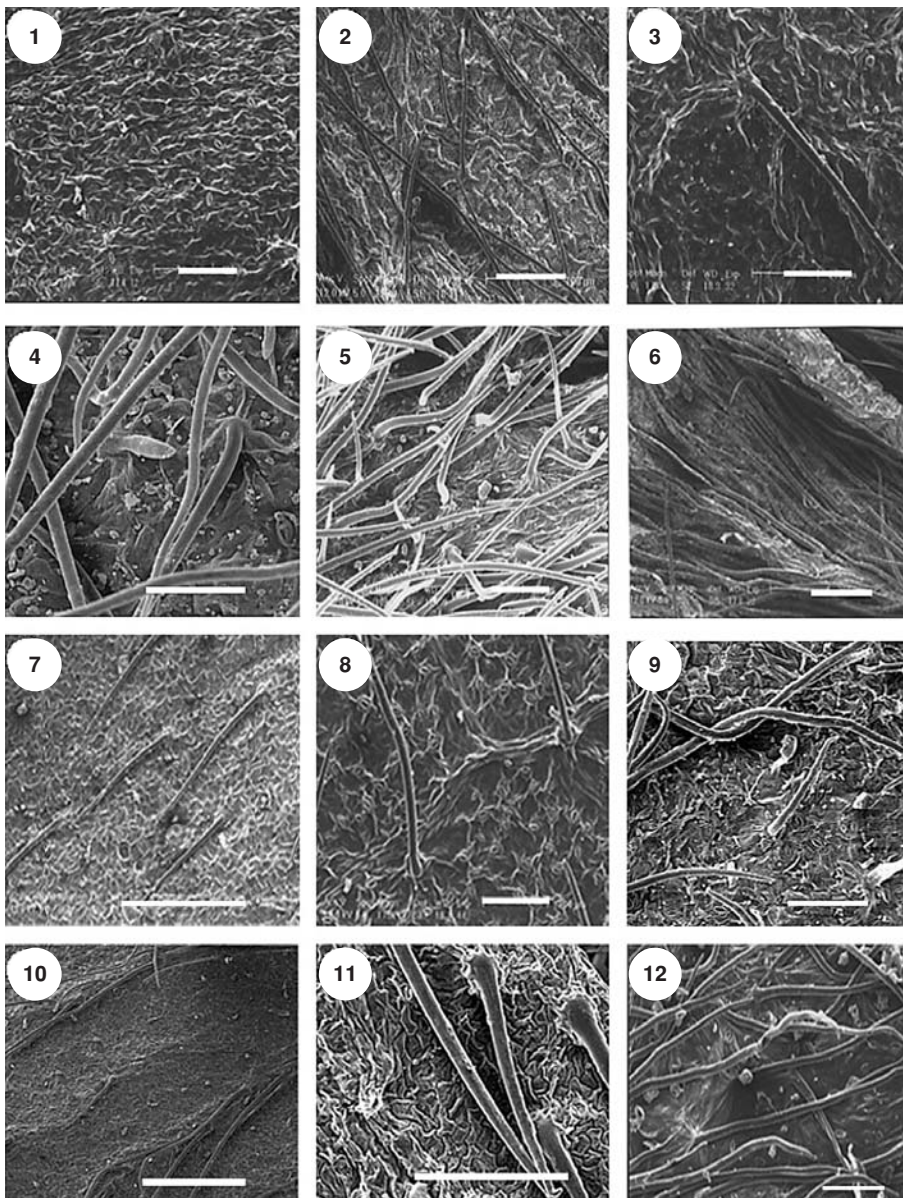
Specimens were prepared for scanning electron microscopy (SEM) using protocols derived from Nation (1983), Slížová et al. (2003) and Adams et al. (1987). Leaves (or a portion of them) were washed in boiling water-detergent and fixed overnight in glutaraldehyde 2.5% (prepared in Sorensen's phosphate buffer of 0.1%). The tissue was then washed in three changes of buffer (five minutes each) and one change of water (five minutes). Dehydration was carried out using a series of ethanol washes (70%, 85%, 95% and 100%). At this stage, tissues were immersed in hexamethyldisilazane for 5 minutes and then air-dried at room temperature. Dried materials were mounted on SEM stubs by double-sided adhesive tape of silver paint and finally coated with gold in a sputter coater. Scanning electron microscopy was carried out using a Vega Tescan Razi instrument. The terminology of indu-

mentum ultra structures and types follows mainly that of Eriksen and Yurtsev (1999).

RESULTS

Scanning electron microscopy revealed three types of leaf indumentum: 1) straight hairs (appressed – erect); 2) straight – crispate, and 3) crispate-floccose. Distribution of species by indumentum type classes is shown in Table 1.

Type I. The straight hair characters are widely distributed among all genera sampled and six sections of *Potentilla*, especially *Schistophyllidium* (*Schi. bifurcum* (L.) Ikonn.), *Sibbaldia* (*S. parviflora* Willd.), *Drymocallis* (*D. poteriifolia* (Boiss.) Soják., *D. rupestris* (L.) Soják.), *Tylosperma* (*T. lignosa* (Willd.) Botsch.), and *Potentilla* sect. *Rectae* (*P. hirta* L., *P. iranica* (Rech.f.) Schiman-Czeika, *P. pedata* Nestl., *P. recta* L., *P. szovitsii* Th.Wolf.), *P. sect. Persicae* (*P. argyroloma* Boiss. and Hohen., *P. aucheriana* Th.Wolf., *P. bungei* Boiss., *P. elvendensis* Boiss., *P. kurdica* Boiss. and Hohen., *P. mallota* Boiss., *P.*



Figs 1-12. Scanning electron micrographs of straight hairs on leaves of *Potentilla* (lower surface). Type class I, straight indumentum category A) **Fig. 1.** *Potentilla adenophylla*, **Figs 2 and 3.** *Potentilla micrantha*; **Fig. 4.** *Potentilla argyroloma*; **Fig. 5.** *Potentilla bungei*; **Fig. 6.** *Potentilla nuda*; **Fig. 7.** *Potentilla persica*; **Fig. 8.** *Potentilla reptans*; **Fig. 9.** *Potentilla iranica*; **Figs 10 and 11.** *Potentilla recta*; **Fig. 12.** *Potentilla supina*. Figs 1-3, 5-9 and 12 – scale bar = 100 µm; Fig. 4 – scale bar = 50 µm; Fig. 10 – scale bar = 500 µm; Fig. 11 – scale bar = 200 µm.

nuda Boiss., *P. pannosa* Boiss. and Hausskn., *P. persica* Boiss. and Hausskn., *P. petraea* Willd., *P. porphyrantha* Juz.), *P. sect. Potentilla* (*P. reptans* L.), *P. sect. Micranthae* (*P. micrantha* Ramond ex DC.), *P. sect. Rivales* (*P. supina* L.) and *P. sect. Aureae* (*P. crantzii* (Crantz) Beck ex Fritsch., *P. adenophylla* Boiss. and Hohen.). Type I is further divided into three categories:

Type I category A) Sparse to moderately dense (pilose, sericeous, strigose, hirsute)

Type I category B) very dense (hirtellous)

Type I category C) exceptionally long and flexuous (villose).

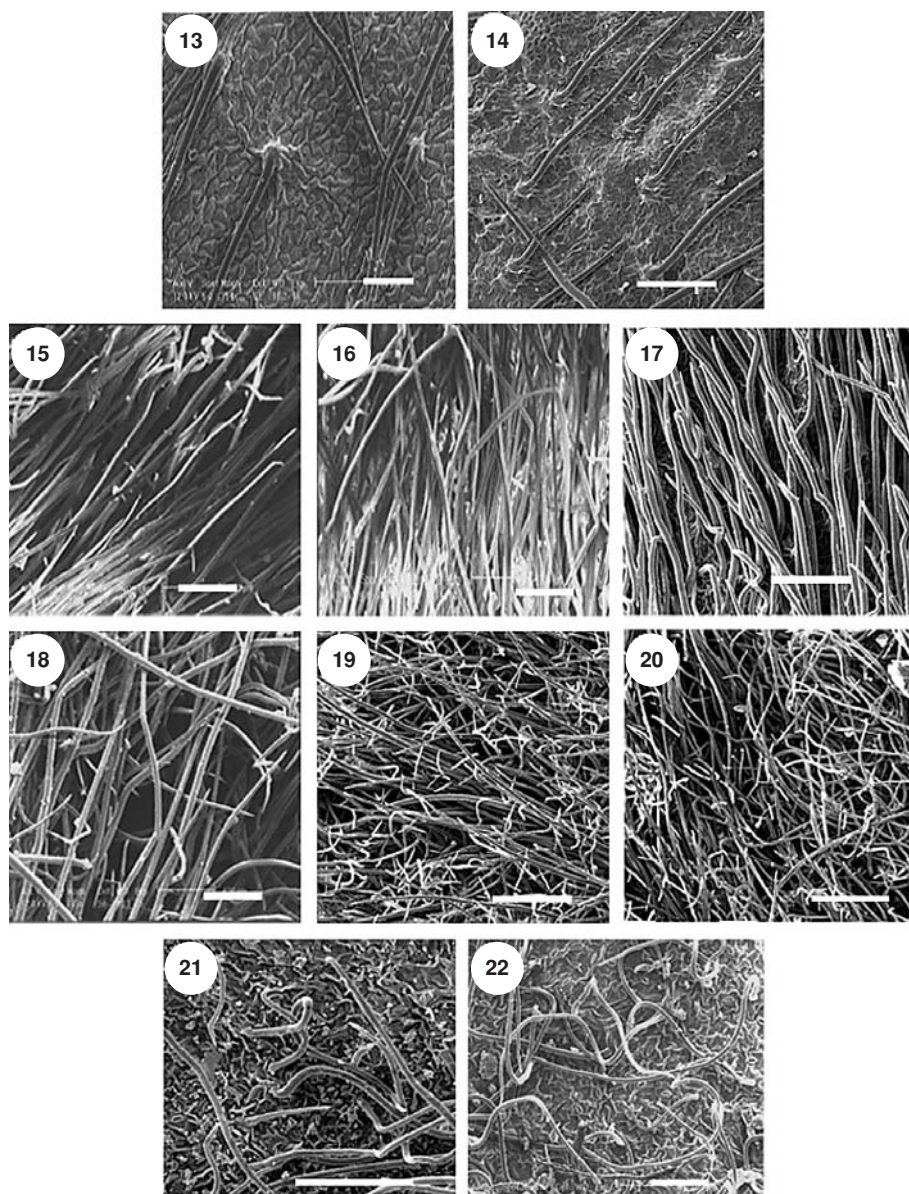
Category A) indumentum, is present in following samples: *Potentilla adenophylla* Boiss. and Hohen (Fig. 1) of *P. sect. Aureae*, *P. micrantha* Ramond ex DC.), (Figs 2 and 3) of *P. sect. Micranthae*, *P. argyroloma* Boiss. and Hohen. (Fig. 4), *P. aucheriana* Th.Wolf., *P. bungei* Boiss. (Fig. 5), *P. kurdica* Boiss. and Hohen., *P. nuda* Boiss. (Fig. 6), *P. persica* Boiss. and Hausskn. (Fig. 7) of *P. sect. persicae*, *P. reptans* L. (Fig. 8) of *P. sect. Potentilla*, *P. hirta* L., *P. iranica* (Rech.f.) Schiman-Czeika. (Fig. 9), *P. pedata*

Nestl., *P. recta* L. (Figs 10 and 11) of *P. sect. Rectae*, *P. supina* L. (Fig. 12) of *P. sect. Rivales* and three related genera: *Schistophyllidium* (*Schi. bifurcum* (L.) Ikonn. (Fig. 13), *Sibbaldia* (*S. parviflora* Willd.) (Fig. 14) and *Drymocalis* (*D. poterifolia* (Boiss.) Soják. (Figs 30 and 32) *D. rupestris* (L.) Soják.) (Figs 33 and 34).

Category B) indumentum is observed in *Potentilla pannosa* Boiss. and Hausskn. (Fig. 15), *P. petraea* Willd. (Fig. 16), *P. porphyrantha* Juz. of *P. sect. Persicae* and one related genus: *Tylosperma* (*T. lignosa* (Willd.) Botsch.) (Fig. 17).

Category C) indumentum is found in the following sections and species: *Potentilla crantzii* (Crantz) Beck ex Fritsch. (Fig. 18) of *P. sect. Aureae* and *P. elvendensis* Boiss. (Fig. 19) and *P. mallota* Boiss. (Fig. 20) of *P. sect. Persicae*.

The ultrastructural study revealed that straight erect hairs are unicellular, mostly with smooth surfaces. No obviously verrucose hairs were noted in the species studied. The erect hairs that are placed on basal cells project more or less perpendicularly from the leaf surface. In certain species, e.g. *P. bungei* Boiss. the basal cell is long with sessile small tubercles (Fig. 5).



Figs 13-22. Straight indumentums. Type class I category A). **Fig. 13.** *Schistophyllidium bifurcum*; **Fig. 14.** *Sibbaldia parviflora*. Type class I category B) very dense (hirtellous); **Fig. 15.** *Potentilla pannosa*; **Fig. 16.** *Potentilla petraea*; **Fig. 17.** *Tylosperma lignosa*. Type class I category C) exceptionally long and flexuous **Fig. 18.** *Potentilla crantzii*; **Fig. 19.** *Potentilla elvendensis*; **Fig. 20.** *Potentilla mallota*. Type class II, straight-erect and straight-crispate indumentums; **Fig. 21.** *Potentilla adscharica*; **Fig. 22.** *Potentilla radiata*.

Figs 13, 15-22 – scale bar = 100 μ m; Fig. 14 – scale bar = 200 μ m.

Type II. This type consists of taxa with both straight-erect and crispate hairs and includes some representatives of *P.* sect. *Rectae* (e.g. *P. adscharica* Sommier & Levier ex R.Keller, *P. radiata* (Th.Wolf) Juz.) and *P.* sect. *Terminales* (e.g. *P. inclinata* Vill.).

Type III. This type includes floccose – crispate (Figs 23 and 24) hairs (giving rise to a woolly indumentum) and is found in *P.* sect. *Pentaphylloides* (*P. anserina* L.), *P.* sect. *Terminales* (*P. argentea* L. and *P. meyeri* Boiss.), *P.* sect. *Pensylvanicae* (*P. hololeuca* Boiss. ex Lehm., *P. polyschista* Boiss.) and *P.* sect. *Speciosae* (*P. speciosa* Willd.).

In *P. anserina* L. a mixture of loosely floccose and crispate hairs is present especially on the lower surface of the leaves (Fig. 25). In most taxa crispate hairs were mixed with either straight or floccose hairs. In *P. argentea* L. (Fig. 26) and *P. speciosa* Willd. (Fig. 29) highly compact floccose indumentum with sparse crispate hairs formed tufted wool on the lower or either sides of the leaves.

Glandular trichomes commonly occur on the leaves of *Potentilla* either as the dominating pubescence or intermingled with other hair types. The small size indumentum often are covered with dense wool and are hardly distinguishable.

Glandular trichomes in studied species of *Potentilla* consist of a one to two celled stalk and single head (e.g. *P. aucheriana* Th.Wolf., *P. recta* L., *P. micrantha* Ramond ex DC. and *P. bungei* Boiss.) (Figs 35-38). While in genus *Drymocallis* (*D. poterifolia* (Boiss.) Soják. and *D. rupestris* (L.) Soják.) (Figs 30-34) longer glandular hairs composed of a three to five celled stalk and single head are observed.

DISCUSSION

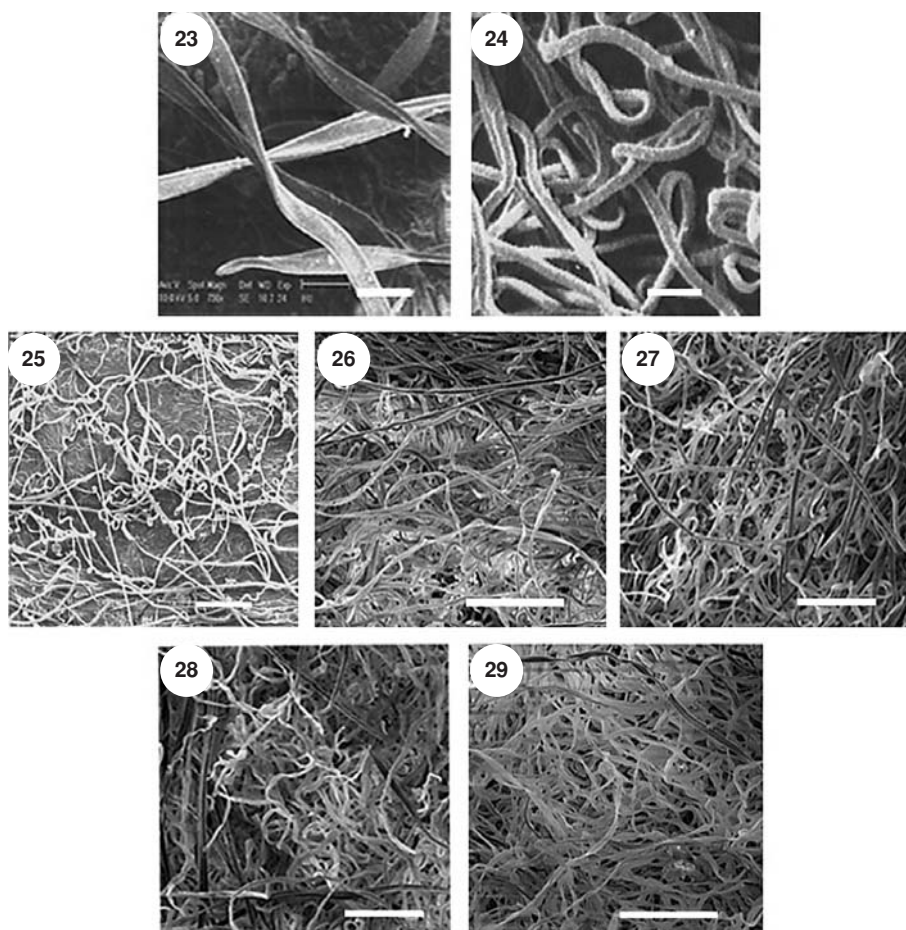
The present survey showed that majority of species from different sections of *Potentilla* (*Micranthae*, *Persicae*, *Potentilla*, *Rivales*) and four related genera (*Drymocallis*, *Schistophyllidium*, *Sibbaldia*, *Tyloperma*) which include all the type I taxa, lack crispate – floccose-hairs (woolly indumentum). In contrast species of *Potentilla* sect. *Pentaphylloides*, *P.* sect. *Pensylvanicae* and *P.* sect. *Speciosae* have only crispate-floccose indumentum (woolly indumentum) (type III). However some sections possess two indumentum type classes e.g. *P.* sect. *Rectae* (straight and straight – crispate hairs, I and II type classes) and *P.* sect. *Terminales* (straight – crispate and floccose – crispate, II and III type classes).

Eriksen and Yurtsev (1999) used straight and woolly indumenta (composed of crispate – floccose hairs) as key characters for grouping of species of section *Niveae*.

Types I and III identified in the present survey correspond to the straight and crispate – floccose hair types coined by Eriksen and Yurtsev (1999).

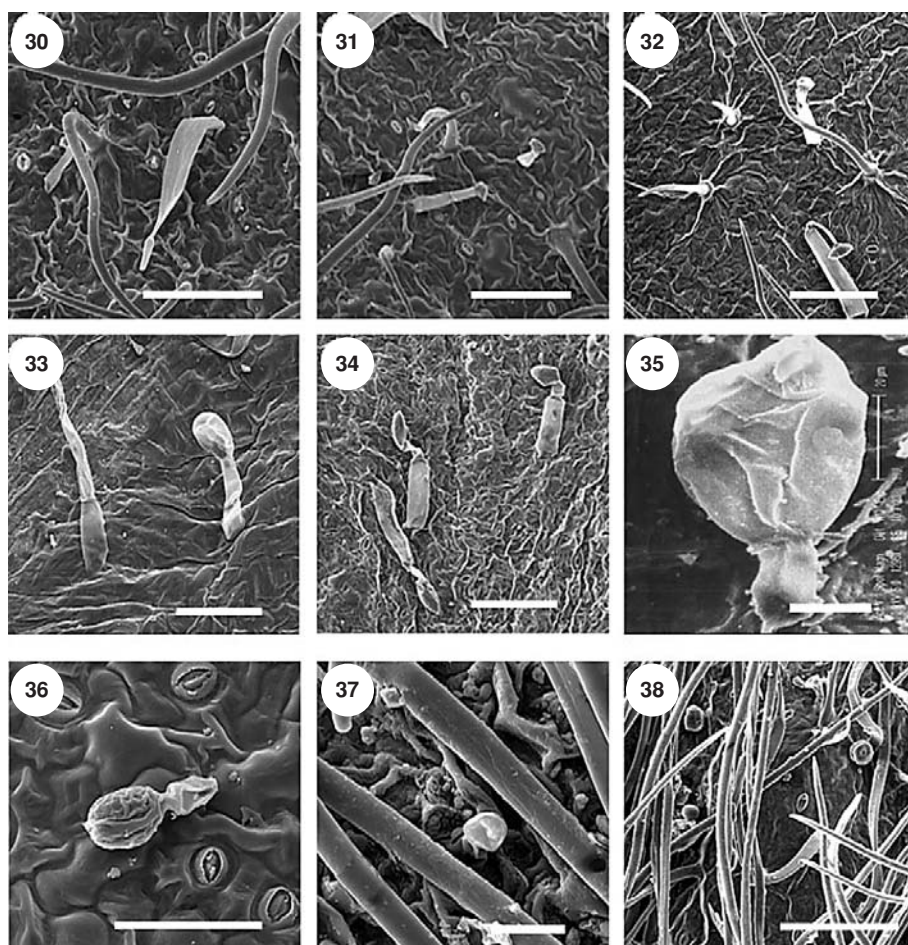
There are some morphological affinities between Iranian taxa with woolly indumentum and those of *P.* sect. *Multifidae*, *P.* sect. *Niveae* and *P.* sect. *Argenteae* of former subgenus *Hypargyrium* (Juzepchuk 1941).

In certain genera, especially *Drymocallis* (Figs 30-34) gland types are of systematic importance and informative (Sojak 2004; Erterter 2007). In the species of Iran, presence or absence of glands along with indumentum types plays important role in classification of *Potentilla* sect. *Rectae* and its species especially *P. hirta* L., *P. iranica* (Rech.f.)



Figs 23-29. Type class III, Floccose – crispate indumentum, **Fig. 23 and 24.** Floccose and crispate indumentum of *Potentilla argentea*; **Fig. 25.** *Potentilla anserina*; **Fig. 26.** *Potentilla argentea*; **Fig. 27.** *Potentilla hololeuca*; **Fig. 28.** *Potentilla polyschista*; **Fig. 29.** *Potentilla speciosa*.

Figs 23 and 24 – scale bar = 20 μ m; Figs 25-29 – scale bar = 100 μ m.



Figs 30-38. Glandular trichomes: **Figs 30-32.** *Drymocallis poterifolia*; **Figs 33 and 34.** *Drymocallis rupestris*; **Fig. 35.** *Potentilla aucheriana*; **Fig. 36.** *Potentilla recta*; **Fig. 37.** *Potentilla micrantha*; **Fig. 38.** *Potentilla bungei*.

Fig. 35 – scale bar = 20 μ m; Figs 30-34 and 36-38 scale bar = 100 μ m.

Schiman-Czeika, *P. pedata* Nestl. and *P. recta* L. (Figs 10 and 11) (Schiman-Czeika 1969).

The present survey shows that indumentum types carry important systematic information and form good key characters for identification purposes.

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APPENDIX 1

	IRAN: Province, Collector, Date	Accession No.
1. Schistophyllidium (Juz. ex Fed.) Ikonn.		
1. <i>Schi. bifurcum</i> (L.) Ikonn.	Guilan, Asalem-KhalKhal road, Faghir, 6.6.2006	36600 (TUH)
2. Tylosperma Botsch.		
2. <i>T. lignosa</i> (Willd.) Botsch.	Tehran, Tehran-Shemshak road, Ghahreman & Mozaffarian, 20.7.88	6212 (TUH)
3. Drymocallis Fourr. ex Rydb.		
3.1 <i>D. rupestris</i> (L.) Soják.	Mazandaran, Firooskooh, Attar, 12.6.2006	39000 (TUH)
3.2 <i>D. poterifolia</i> (Boiss.) Soják.	Fars, Abadeh, Termeh & Izadyar, 7.6.1969	36855 (IRAN)
4. Sibbaldia L.		
4. <i>S. parviflora</i> Willd.	Guilan, Asalem-KhalKhal road, Termeh & Mousavi, 19.5.74	36839 (IRAN)
5. Potentilla L.		
5.1 <i>P. sect. Pentaphylloides</i> Tausch.		
6. <i>P. anserina</i> L.	Mazandaran, Firooskooh, Attar, 27. 6.2005	39001 (TUH)
5.2 <i>P. sect. Pensylvanicae</i> Poeverl.		
7. <i>P. polyschista</i> Boiss.	Mazandaran, Kelardasht, Termeh & mousavi, 13.8.72	36854 (IRAN)
8. <i>P. hololeuca</i> Boiss. ex Lehm.	Mazandaran, Kelardasht, Takhtsoliman Termeh & mousavi, 13.8.72	36806 (IRAN)
5.3 <i>P. sect. Terminales</i> (Döll) Gren. & Godr.		
9. <i>P. argentea</i> L.	Guilan, Siyahkal, Faghir, 16.6.06	36586 (TUH)
10. <i>P. meyeri</i> Boiss.	Guilan, Siyahkal, Faghir, 16.6.06	36585 (TUH)
11. <i>P. inclinata</i> Vill.	Guilan, Siyahkal, Spili, Larikhani, Saidi, 13.5.93	33466 (TUH)
5.4 <i>P. sect. Aureae</i> (Rydb.) Juz.		
12. <i>P. crantzii</i> (Crantz) Beck ex Fritsch.	Mazandaran, Ramsar, Samamous monts., Faghir, 22.7.06	36631 (TUH)
13. <i>P. adenophylla</i> Boiss. & Hohen.	Tehran, Gachsar, Dizin Ghahreman & Mozaffarian, 4.8.88	6987 (TUH)
5.5 <i>P. sect. Rectae</i> (Th. Wolf) Juz.		
14. <i>P. recta</i> L.	Guilan, Damash-Jirandeh, Faghir, 16.6.2006	36598 (TUH)
15. <i>P. pedata</i> Nestl.	Guilan, Siyahkal, Faghir, 16.6.2006	36588 (TUH)
16. <i>P. hirta</i> L.	Mazandaran, Chlous road, Faghir, 16.7.2006	36627 (TUH)
17. <i>P. iranica</i> (Rech.f.) Schiman-Czeika	Guilan, Asalem-KhalKhal road, Faghir, 16.6.06	36605 (TUH)
18. <i>P. adscharica</i> Sommier & Levier ex R. Keller	Azarbaijan, Kalibar, Attar & Dadjou, 17.7.93	17184 (TUH)
19. <i>P. szovitsii</i> Th. Wolf.	Guilan, Damash-Jirandeh, Faghir, 16.6.06	36593 (TUH)
20. <i>P. radiata</i> (Th. Wolf) Juz.		
5.6 <i>P. sect. Rivales</i> Poeverl.		
21. <i>P. supina</i> L.	Qazvin, Alamout Ghahreman & Mozaffarian, 11.8.91	9963 (TUH)
5.7 <i>P. sect. Persicae</i> (Th. Wolf) Juz.		
22. <i>P. bungei</i> Boiss.	Kordestan, Marivnan-Paveh, Maroufi, 21.3.2003	6494 (TUH)
23. <i>P. elvendensis</i> Boiss.	Fars, Abadeh, Termeh, 5.7.79	36763 (IRAN)
24. <i>P. argyroloma</i> Boiss. & Hohen.	Tehran, Gachsar, Dizin, Ghahreman & Mozaffarian, 4.8.88,	6985 (TUH)
25. <i>P. persica</i> Boiss. & Hausskn.	Lorestan, Khoramabad, Attar & Mirtj, 27.7.88	24898 (TUH)
26. <i>P. kurdica</i> Boiss. & Hohen.	Kordestan, Sanandaj, Hanagalanvillage, Maroufi, 1.6.2007	8060
27. <i>P. pannosa</i> Boiss. & Hausskn.	Hamedan, Alvand southern slope, Mozaffarian, 8.7.88	64940 (TUH)
28. <i>P. mallota</i> Boiss.	Kordestan, Sanandaj, Maroufi & Kargar, 10.6.2007	8128
29. <i>P. nuda</i> Boiss.	Yazd, Chenaran, Ardakan-Hezarmasjed, Termeh, 1, 8.8.77	36827 (IRAN)
30. <i>P. aucheriana</i> Th. Wolf.	Mazandaran, Kelardasht, Khoramdasht, Faghir, 12.8.2006	36630 (TUH)
31. <i>P. porphyrantha</i> Juz.	Ardabil, Sabalan monts., Termeh, 15.7.71	36761 (IRAN)
32. <i>P. petraea</i> Willd.	Mazandaran, Ramsar, Samamous monts., Faghir, 22.7.2006	36632 (TUH)
5.8 <i>P. sect. Potentilla</i>		
33. <i>P. reptans</i> L.	Guilan, Siyahkal, Faghir, 16.6.2006	36639 (TUH)
5.9 <i>P. sect. Speciosae</i> (Th. Wolf) Juz.		
34. <i>P. speciosa</i> Willd.	Azarbaijan, Ormiyeh, Ghahreman & Mozaffarian, 29.6.97	20056 (TUH)
5.10 <i>P. sect. Micranthae</i> Soják.		
35. <i>P. micrantha</i> Ramond ex DC.	Guilan, Asalem-Khalkal, Faghir, 6.6.06	36602 (TUH)