The morphology of hairs in species of *Plantago* L. sectio *Oreades* Decne

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Abstract

The hairs of three taxa of sectio *Oreades* Decne genus *Plantago* have been studied. We have found that hair typical for the majority of representatives of the genus *Plantago*, that is, with a unicellular stalk and head vertically divided into two cells, occur in these studied taxa. Some of the headless hairs occurring here are similar to those occurring in sectio *Arnoglossum* Decne. Rahn's (1978) suggestion of transferring sectio *Oreades* to the subgenus *Psyllium* seems wrong since the representatives of this section, in contrast to subgenus *Psyllium*, do not have hairs with the stalks consisting of several cells and unicellular heads, club-like hairs or iridoid-plantarenalioside. They contain, however, hairs with overlapping cells and iridoid-catapol, which is absent in the taxa of subgenus *Psyllium*.

Key words: genus *Plantago* L., sectio *Oreades* Decne, hairs, scanning electron microscopy

INTRODUCTION

Pilger (1926, 1937) includes three mountain species: *Plantago atrata* Hoppe (syn. *P. montana* Lam.), *P. monosperma* Pourr. and *P. nivalis* Boiss into *Oreades* Decne sectio. In "Flora Europea" (Chater and Cartier 1976) where there is no division into sections, the three above mentioned species are included into the "*P. atrata* group". According to Cartier (1973) these three species form a rich polyploid complex and they are closely allied. The distribution and morphology of this taxa are described by Pilger (1926, 1937),

Cartier (1973) and Chater and Cartier (1976) in "Flora Europea". Only *P. atrata* grows in Poland (Tacik 1967, Szafer et al. 1986). *P. atrata* Hoppe is regarded as polymorphic. Pilger (1937), for instance, mentions four subspecies (subsp. *atrata*, *fuscescens*, *saxatilis* and *spadicea*) within this species and, furthermore, numerous varieties and forms within the subspecies.

The majority of authors (Pilger 1937, Grigoriew 1958, Janchen 1958, Patzak and Rechinger 1965) treat sectio *Oreades* Decne (syn. *Montana* Barn.) as one of the sections of the subgenus *Euplantage* Harms (syn. *Plantago*). Dietrich (1980) regards taxa *Plantago* and *Psyllium* as separate genera and includes sectio *Montana* Barn. into genus *Plantago*. Only Rahn (1978) includes sectio *Oreades* (*Montana*), besides five other sections of the subgenus *Plantago* sensu Pilger, into the subgenus *Psyllium*. As chemotaxonomic studies have shown, sectio *Oreades* Decne is similar to the sections *Bauphula* Decne and *Arnoglossum* Decne because it contains catapol (Andrzejewska-Golec and Świętek 1984).

A previous paper (Andrzejewska-Golec and Świętosławski 1989) presented studies of the hairs of sections: *Bauphula* and *Arnoglossum*. Those results confirmed the distinct character of the taxa of the sections *Bauphula* and *Arnoglossum*. We have decided to study the hairs of sectio *Oreades* and compare the results with those obtained previously.

Pubescence is taken into consideration in determination of the (particular) species of sectio *Oreades* (Pilger 1937, Cartier 1973, Chater and Cartier 1976). But the bibliography on this subject gives little information about the hair morphology of the representatives of this section. The presence of headless hairs with overlapping cells in *P. atrata* was described by Cugini (1877). According to Pilger (1898) there are headless hairs with a thin, "square" basal cell and a whip-like thick-walled cell over it on the leaves of the taxa of the sectio *Oreades*. The author calls attention to the fact that the same types of hairs occur in *P. atrata* as well as in *P. nivalis*. In *P. atrata* the hairs do not play any important role because of the poor pubescence while in *P. nivalis* they absorb water. Pilger (1898) stresses the fact that the hairs described by him are characteristic also for two other sections of the subgenus *Euplantage*: *Arnoglossum* Decne and *Leucopsyllium* Decne.

MATERIAL AND METHODS

We have studied the hairs of the leaf, stalk, bract, calyx and corolla of two taxa of sectio *Oreades*: *P. montana* Lam. (Fig. 1) and *P. fuscescens* Jordan as well as hairs of the leaf of *P. atrata* Hoppe subsp. *sudetica* Holub.

PLATE I

Fig. 1. *Plantago montana* Hoppe from our outdoor culture x 0.3.

The plants were grown from seeds obtained from European botanical gardens in Warsaw, Rostock and Nancy.

The identity of the studied taxa was checked using Pilger's monography (1937), "Flora polska" (Taciak 1967) and "Flora Europea" (Chater and Cartier 1976). The material was collected during florescence (September 1984) and conserved in 70° ethanol. Light microscopic figures were drawn with the use of Abbe's apparatus. The material prepared analogically as in the previous study (Andrzejewska-Golec and Świętosławski 1987) was observed with the use of a scanning electron microscope.

RESULTS

The results are presented in Table 1 and on figures 2-10. It was found that one type of headed hairs and four types of headless hairs were present in the studied taxa. Microscopic observations were often difficult because fungi hyphas and spores of covered surface of the leaves and scapes (Figs. 9, 10).

HEADED HAIRS (FIGS. 2, 7-10)

Hairs with a unicellular stalk and head divided vertically into two cells had a smooth surface in contrast to the surface of the surrounding epidermis cells which were longitudinally corrugated (Figs. 7-9). Such hairs appeared on the

Table 1
Hair types occurring in sectio *Oreades* Decne

Plant name*	The investigated part of the plant**	Headed hairs	Headless hairs			
			consisting of several cells			multi-cellular (web-like)
			with small “square” cell with		without small “square” cell	
			overlapping cells	characteristically jammed		
<i>P. montana</i>	L	+	—	+	—	+
Lam.	S	+	+	—	—	+
(Warsaw)	B	+	—	+	—	—
syn.	C	—	—	+	—	—
<i>P. atrata</i>	R	—	—	—	—	—
Hoppe						
<i>P. atrata</i>						
Hoppe						
subsp.						
<i>sudetica</i>	L***	+	—	+	—	+
Holub						
(Rostock)						
<i>P. fuscescens</i>	L	+	—	+	—	+
Jordan	S	+	+	—	—	+
(Nancy)	B	+	—	+	—	+
syn.	C	—	—	—	+	—
<i>P. atrata</i>	R	—	—	—	—	—
Hoppe						
subsp.						
<i>fuscescens</i>						

* The origin of seeds, obtained from botanical gardens, in brackets.

** L — leaf, S — scape, B — bract, C — calyx, R — corolla.

*** Other part of the plant have not been investigated.

leaf, scape and bract of *P. montana* and *P. fuscescens*. Their occurrence has also been found on the leaf of *P. atrata* Hoppe subsp. *sudetica* (other parts of the plant have not been studied).

As previous studies have shown, the above-described hairs can be found in the representatives of many sections of genus *Plantago*: *Polyneuron*, *Lamprosantha*, *Coronopus*, *Bauphula*, *Leucopsyllium*, *Hymenopsyllium*, *Psyllium* (Vesque 1885, Fischer 1937, Andrzejewska-Golec and Świętosławski 1987, 1988, 1989, in press).

The length of the headed cells of these hairs varied within one taxon of sectio *Oreades* (Figs. 7, 8). According to Unger (1926) differences in the lengths of these cells exist between species *Plantago major* L. (sectio *Polyneuron* Decne) and *Plantago media* L. (sectio *Lamprosantha* Decne).

Hairs with a three or four-celled head had been seen sporadically noticed in the studied taxa (Fig. 2 H, I).

HEADLESS HAIRS (FIGS. 3-6)

Web-like, 1 cm long (or longer), hairs composed of a dozen or so to several tens of cells could be found on the base of leaves and inflorescence scapes; in *P. fuscescens* they also appeared on the bract base (Fig. 3). Such hairs are

Fig. 2. Headed hairs in the taxa of sectio *Oreades* Decne. A-G — typical hairs from the leaf; A, B — *P. montana* Lam.; C, D — *P. atrata* Hoppe subsp. *sudetica* Holub; E-G — *P. fuscescens* Jordan; H, I — nontypical hairs from the leaf; H — *P. atrata* Hoppe; I. — *P. fuscescens*. Scale bar 0.1 mm.

Fig. 3. Headless hairs in the taxa of sectio Oreades Decne. Web-like hairs from the leaf base. A-D — *P. montana* Lam.; A — base of the web-like hair; C-D — fragments of web-like hairs. E-H — *P. atrata* Hoppe subsp. *sudetica* Holub; E — base of the web-like hairs; F-H — fragments of web-like hairs. *P. fuscescens* Jordan; I-R — joinings of cells of web-like hairs. Scale bar: A — 0.2 mm; B-K — 0.1 mm; L-R — 0.05 mm

Fig. 4. Headless hairs in sectio *Oreades* Decne taxa. A, B — hairs with overlapping cells from the inflorescence scape: A — *P. montana* Lam.; B — *P. fuscescens* Jordan. C-F — hairs with a small basal cell from the leaf of *P. atrata*; C — rarely seen hair with one cell over the basal cell; D — fragments of the hair (base); E — detaching cell; F — hair "trace". Scale bar A-C — 0.2 mm; D-F — 0.1 mm

Fig. 5. Headless hairs in sectio *Oreades* Decne taxa *P. fuscescens* Jordan: A — top of the headless hair from the leaf, B and C — characteristic joinings of cells of headless hairs from the leaf. Scale bar A and C — 0.1 mm; B — 0.05 mm

common in the representatives of the genus *Plantago* (Pilger 1937, Andrzejewska-Golec and Świętosławski 1987, 1988, 1989, in press).

Hairs consisting of several cells with a small "square" basal cell and jamming scape cells occur on the leaf in the three studied taxa (Figs. 4C, F, 5). Moreover, their presence has been also noticed on the bract in *P. montana* and *P. fuscescens* and also on the calyx of *P. montana* (Fig. 6B-E). Similar hairs appear in the representatives of sections *Arnoglossum* and *Leucopsyllium* (Pilger 1898, Andrzejewska-Golec and Świętosławski 1988, in press). They differ from hairs described by Pilger (1898) in the number of cells and the presence of jamming cells. Hairs consisting of several overlapping cells appear only on the inflorescence scape (Fig. 4A, B). Similar hairs were previously described in the representatives of sections: *Coronopus* and *Arnoglossum* (Unger 1926, Andrzejewska-Golec and Świętosławski 1987, 1989). Simple hairs consisting of several cells have been observed only on the calyx of *P. fuscescens*.

Fig. 6. Headless hairs from the bract and elements of the flower: A — from the bract of *P. atrata* Hoppe; B, C — from the calyx of *P. atrata* Hoppe; D — fragment of the hair (base) from the bract of *P. fuscescens* Jordan; E — hair from the bract of *P. fuscescens* Jordan; F, G — hairs from the calyx of *P. fuscescens* Jordan. Scale bar 0.1 mm

PLATE II

Figs. 7, 8. *P. montana* Lam. Hair with unicellular stalk (1) and two-celled head (2) on a leaf; surrounding cells (3), a stomatal apparatus (4), x 1000

PLATE III

Fig. 9. *P. montana* Lam. Spores of fungi on surface of epidermis and hair of the leaf, x 1000.

Fig. 10. Spores of fungi on surface of hair, x 2000

DISCUSSION

The representatives of sectio *Oreades* like taxa *Bauphula* Decne and *Arnoglossum* Decne (subgenus *Plantago* sensu Pilger) have headless hairs with a small "square" cell and contain iridoid-catalpol (Andrzejewska-Golec and Świątek 1984). In contrast to the representatives of sections *Bauphula* and *Arnoglossum*, they do not contain morel-like hairs. The occurrence of hairs with a unicellular stalk and two-celled head makes the taxa of sectio *Oreades* similar to those of sectio *Bauphula* and the presence of headless hairs with overlapping cells on the stalk makes them similar to sectio *Arnoglossum*. The taxa of sectio *Oreades* have not got the hairs with multicellular stalk and the unicellular head characteristic for the representatives of subgenus *Psyllium* (Andrzejewska-Golec and Świątosławski — in press). They also do not contain iridoids characteristic for subgenus *Psyllium* (Andrzejewska-Golec and Świątek 1984).

On the basis of our present study as well as of our previous studies it can be assumed that Rahn's idea of enlarging subgenus *Psyllium* by sectio *Oreades* Decne (*Montana* Barn.) and other sections: *Leucopsyllium* Decne, *Hymenopsyllium* Decne (Andrzejewska-Golec and Świątosławski 1988), *Arnoglossum* Decne, *Bauphula* Decne (Andrzejewska-Golec and Świątosławski 1989), from subgenus *Plantago* sensu Pilger is incorrect. It seems that taxon *Psyllium* is distinct from the remaining taxa of the genus *Plantago* L. (Pilger 1937, Grigoriew 1958, Chater and Cartier 1976, Tzvelev 1979, Dietrich 1980, Kuzmanov et. al. 1984, Andrzejewska-Golec and Świątosławski — in press).

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Morfologia włosków w gatunkach rodzaju Plantago L. sekcja Oreades Decne

Streszczenie

Zbadano włoski trzech taksonów sekcji *Oreades* Decne rodzaju *Plantago* L. Stwierdzono występowanie typowych dla przedstawicieli większości sekcji rodzaju *Plantago* L. włosków o jednokomórkowym trzonku i główce podzielonej pionowo na dwie komórki. Spośród włosków bezgłówekowych występują włoski, jak u przedstawicieli sekcji *Arnoglossum* Decne.

Propozycja przeniesienia sekcji *Oreades* do podrodzaju *Psyllium* (Rahn 1978) wydaje się niesłuszna. Przedstawiciele tej sekcji bowiem, w odróżnieniu od taksonów podrodzaju *Psyllium* (Juss.) Harms, nie mają włosków o wielokomórkowym trzonku i jednokomórkowej główce, włosków maczugowatych, a także irydoidu-plantarenalozynu. Mają natomiast włoski o komórkach nakładających się oraz irydoid katalpol — czego brak u taksonów podrodzaju *Psyllium*.