

Achene surface features in *Potentilla subarenaria* Borbás ex Zimmeter and *P. intermedia* L. non Wahlenb. (Rosaceae)

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Achenes morphology in *Potentilla* L., i.e. *P. subarenaria* Borbás ex Zimmeter and *P. intermedia* L. non Wahlenb. was examined with stereoscope and scanning electron microscope (SEM). Achenes of these taxa varied in shape, size, colour, the surface sculpture and in the dimensions of dorsal ridge and ribs. SEM analyses allowed distinguishing two morphological types of seed coats pattern: ruminate-reticulate sculpture due to well preserved epidermal cells in *P. subarenaria* and tuberculate sculpture in *P. intermedia*. The main taxonomic features of these two taxa are: the microstructure, size, shape and colour of achenes.

Key words: *Rosaceae*, *Potentilla*, achenes, SEM

Introduction

Fruit in *Potentilla* L. named also achene is dry, not dehiscent and monospermous, small in size. Morphological description of achenes of selected species from the genus *Potentilla* were given by many authors before: CLARK and FLETCHER (1909), BRESINSKY (1963), ROUSI (1965), OCKENDON and WALTERS (1970), WERNER and SOULE (1976), LEHT (1989), SOJÁK (1987, 1993), ANDENBERG (1994), KOŁODZIEJEK and GABARA (2007). Within this genus, KELLEY (1953) described the fruit morphology for 11 taxa and included a key for their determination, WERNER and SOULE (1976) described it in 3 taxa, ANDERBERG (1994) in 28 taxa, LEHT (1989) in 24 taxa. However, among these authors, only LEHT (1989), KOŁODZIEJEK and GABARA (2007) presented SEM analysis of selected taxa of *Potentilla*.

It is known that fruit and seeds are very useful in identification and classification of plant taxa (MURLEY 1951, KARCZ 1996, KOŁODZIEJEK and GABARA 2007, ÖZCAN 2004, FAGÚNDEZ and IZCO 2004). Description of achenes in *P. subarenaria* and *P. intermedia* is limited to their length, shape and colour (WOLF 1908, JUZEPCZUK 1941, KELLEY 1953, SZAFER and PAWŁOWSKI 1955, SOJÁK 1995). These features, however, are not sufficient to identify species. Nobody has studied achenes of *P. intermedia* and *P. subarenaria* based on scanning electron microscope (SEM); only ANDENBERG (1994) examined both species

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based on light microscopy (LM). This author described achenes of this taxa as medium in size between 0.8–1.3 mm long, 0.7–0.9 mm wide and 0.4–0.6 mm thick and medium buff and orange-brown in colour.

Many European authors consider *P. intermedia* as hybridogenous species, with *P. argentea* L. and *P. norvegica*, or even other allied species, as the parents. *P. subarenaria* is commonly interpreted as an apomictic species possibly of relatively recent hybrid origin from *P. tabernaemontani* Ascherson and *P. incana* P. Gaertner, B. Meyer et Scherb. (KURTTO et al. 2004).

The aim of the study is to present a morphological analysis of achenes in two *Potentilla* species using a scanning electron microscope (SEM) and to estimate the usefulness of shape, size and fruit surface for the taxonomy of investigated species.

Materials and methods

Nomenclature of *Potentilla subarenaria* Borbás ex Zimmeter and *P. intermedia* L. non Wahlenb. was used according to WOLF (1908). Plant material was obtained from natural populations collected by the author in the area of Poland.

Analysis of qualitative and quantitative characteristics was performed on ripe, fully developed achenes. Some achenes, even at the ripe stage, are distinctly smaller than typical ones and are also deformed – such achenes were deformed and distinctly smaller than typical ones and such achenes were not measured.

Colour of the achenes was determined in the day light on the basis of colour scale recommended by BERGGREN (1969). Dimensions – length, width and thickness of the achenes, width of the aril and width and height of dorsal ridge were measured according to the description presented in figure 1. Morphometric analysis of the achenes, except aril and rib

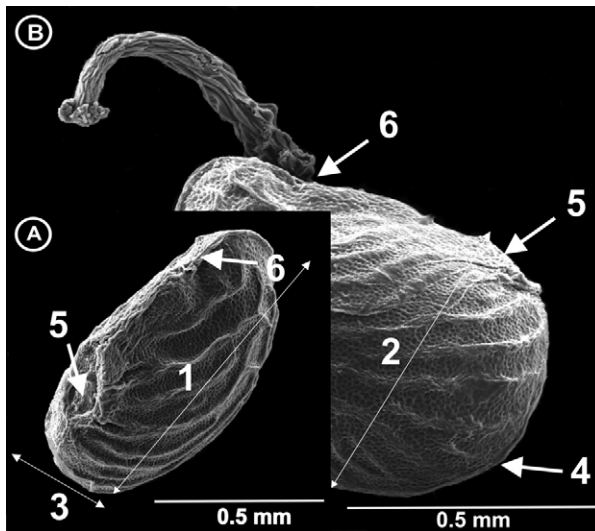


Fig. 1. Achene of *Potentilla* sp.: ventral (A) and lateral (B) view. 1 – length, 2 – width, 3 – thickness, 4 – dorsal ridge, 5 – aril around scar attachment, 6 – style scar.

dimensions, was made by a stereomicroscope Nikon SMZ 800. At least 30 achenes from five plants were analyzed for each taxon.

For scanning electron microscopy (SEM) samples were mounted on metal stubs, sputtered with technical gold (Pelco S.C 6 coating system), examined and photographed using a Tesla BS 340 scanning electron microscope. Shape of achenes, dimensions of aril and ribs as well as the seed surface pattern were analyzed on 5 photographs for each taxon. The carpological documentation includes SEM figures which represent: outline of the achenes from the lateral side and the seed surface structure from the central part of the lateral surface.

Results

Achenes in *subarenaria* and *P. intermedia* are bilateral, shape ovate, laterally flattened, apex obtuse, curved, base obtuse (Fig. 2). Fruit thickness measured in a straight line perpendicular to the symmetry plane ranges from 0.61 (± 0.02) mm in *P. subarenaria* to 0.85 (± 0.02) mm in *P. intermedia*. The shape of fruit is described to some extent also by the elongation and flattening coefficients given in table 1. Achenes are elongated, i.e. from 1.19 (*P. intermedia*) to 2.04 (*P. subarenaria*) times longer than wide. Flattening of the achenes is usually bilateral, rarely the achenes are \pm equally thick as wide. The most flattened are achenes of *P. subarenaria* (width/thickness ratio = 1.31), the least flattened ones – the achenes of *P. intermedia* (ratio = 1.18).

Two types of achenes are distinguished: large, present in *P. subarenaria* and small, present in *P. intermedia* (Tab. 1). Achene colour varies from red-brown in *P. intermedia* to nut-brown in *P. subarenaria*.

Tab. 1. Colour and dimension of achenes (in mm) in taxons of *P. subarenaria* Borbás ex Zimmeter and *P. intermedia* L. non Wahlenb.

Taxon	Lengh	Width	Thicknes	Lengh/ width	Width/ thicknes	Colour	
						achenes	ribs
<i>P. intermedia</i>	1.19 \pm 0.02	1.00 \pm 0.02	0.85 \pm 0.02	1.19 \pm 0.02	1.18 \pm 0.02	red-brown	pale
<i>P. subarenaria</i>	1.63 \pm 0.01	0.80 \pm 0.01	0.61 \pm 0.02	2.04 \pm 0.02	1.31 \pm 0.02	nut-brown	brown

Scar attachment, i.e. the point of achene attachment to the receptacle is surrounded by an aril slightly visible in *P. subarenaria* or clearly – in *P. intermedia*, with their respective widths being 20 μ m and 40 μ m (Tab. 2).

A clear dorsal ridge about 40 μ m wide and 40 μ m thick was present in achenes of *P. intermedia* (Tab. 2), while unclear one, about 10 μ m wide and 10 μ m thick was observed in *P. subarenaria* (Fig. 2A left).

Ribs seen at achenes surfaces are brown in colour (Tab. 1). Distinct ribs, very sharp in shape were seen in achenes of *P. intermedia* (Figs. 2A, B right), or oval in shape – in *P. subarenaria* (Figs 2A, B left). Width of ribs varied from 20 μ m in *P. subarenaria* up to 80 μ m in *P. intermedia* (Tab. 2). Similarly rib height was the lowest (20 μ m) in *P. subarenaria*, while the largest (40–60 μ m) was in *P. intermedia*.

Tab. 2. Characteristics of achenes in *Potentilla subarenaria* Borbás ex Zimmeter and *P. intermedia* L. non Wahlenb. (SEM).

Taxon	Aril		Dorsal ridge			Surface sculpture	Ribs (μm)	
	Width μm	Width μm	Thickness μm	Width μm	Height μm			
						<i>P. intermedia</i>	conspicuous	40
<i>P. subarenaria</i>	inconspicuous	20	inconspicuous	10	10	ruminate-reticulate	20	20

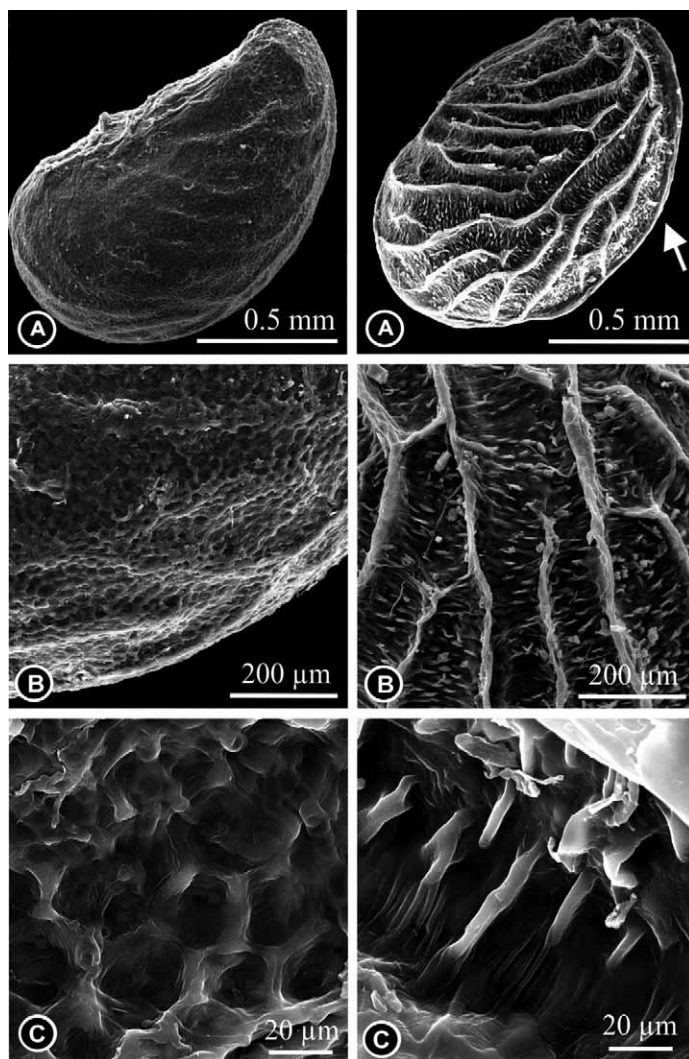


Fig. 2. Surface sculpture of the achenes of *Potentilla subarenaria* Borbás ex Zimmeter (left A, B, C figures) and *P. intermedia* L. non Wahlenb. (right A, B, C figures), at different magnifications; $\times 200$ (A), $\times 1000$ (B) and $\times 3000$ (C). Arrow indicates dorsal ridge.

Based on the features of the arrangement of cells and cell outline, two types of seed coats pattern were identified:

– ruminante-reticulate sculpture; among distinct and sharp ribs well preserved epidermal cells, hexagonal in shape were visible. Seed coats of this type were characteristic of *P. subarenaria* (Figs 2B, C left);

– tuberculate sculpture, characterized by wrinkles and ridges irregular, most of them running in one direction. This type of seed coats was typical for *P. intermedia* (Figs 2B, C right).

Discussion

Scanning electron microscopic analysis of achenes from *P. subarenaria* and *P. intermedia* allowed to distinguish new additional features such as aril, dorsal ridge and aril dimensions, useful in taxonomy of this taxa. These features of achenes in addition to the morphology of leaves (WOLF 1908, JUZEPCZUK 1941, BALL et al. 1968, SOJÁK 1995) proved to be of high systematic importance in taxonomy of *Potentilla* species. The most useful diagnostic characteristic in determination of *P. subarenaria* and *P. intermedia* is surface sculpture.

My investigations in taxa from *Potentilla* L., i.e. *P. subarenaria* and *P. intermedia*, revealed differences in colour and shape of achenes, as well as in their sizes. According to my measurements the lengths of achenes *P. intermedia*, 1.19 mm, were similar to those described by SOJÁK (1995) and ANDENBERG (1994), 0.8–1.3 mm.

The identification of immature achenes is hardly practical. Many of the species whose achenes are prominently ridged or wrinkled when mature are completely smooth when young. On the other hand, the style scar is more likely to be easily located in young achenes, and in many species the style may still persist.

Sites and collection of *P. subarenaria* and *P. intermedia*:

P. subarenaria – Śląsk prov., Góry Towarne hills near Kusięta village (Wyżyna Częstochowska upland) 50°45'N/19°16'E, xerothermic grassland;

P. intermedia – Łódź prov., Nowosolna village near Łódź 51°42'N/19°37'E, gravel-pit; Śląsk prov., Olsztyn village near Częstochowa (Wyżyna Częstochowska upland) 50°46'N/19°16'E, roadside.

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