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CYPSELA MORPHOLOGY OF *GNAPHALIUM* L. AND ITS ALLIED GENERA (GNAPHALIEAE-ASTERACEAE) FROM PAKISTAN

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Abstract

Cypsela morphology of 8 taxa of the genera *Gamochaeta* Wedd., *Gnaphalium* L., *Homognaphalium* Kirp., and *Pseudognaphalium* Kirp., was examined from Pakistan using light and scanning electron microscopy. The cypsela characters are not only found useful for assessing relationship but they are also useful for the delimitation of taxa except that of the genera *Gnaphalium* and *Pseudognaphalium* as they share common cypsela features and both are placed in one cypsela type.

Introduction

Gnaphalium L. (s.l.) belongs to the tribe Gnaphalieae of the family Asteraceae. This is assemblage of four genera viz. *Gamochaeta* Wedd., *Gnaphalium* L., *Homognaphalium* Kirp., and *Pseudognaphalium* Kirp. In all 8 species are recognized from Pakistan (Qaiser & Abid, 2003).

Cypsela characteristics in a series of the family Asteraceae have been used to address the systematic relationship of various taxa from Pakistan such as Abid & Qaiser (2002) studied the cypsela morphology of *Inula* L. (s.l.) and found that cypsela features support the taxonomic decisions. Similarly, Abid & Qaiser (2007a) made a correlation of cypsela morphological characters for taxonomic interpretation in the tribe Plucheeae. While the cypsela characters in the genus *Pulicaria* Gaertn., and some other remaining genera in the tribe Inuleae were studied by Abid & Qaiser (2007b) and Abid & Zehra (2007) respectively. However, in the tribe Gnaphalieae, the cypsela characters were studied only for the genus *Anaphalis* DC. (Abid & Qaiser, 2007c). Presently the genera *Gamochaeta, Gnaphalium*, *Homognaphalium* and *Pseudognaphalium* are studied for their cypsela morphology to provide the strength for the recognition of these taxa from Pakistan.

Materials and Methods

Eight taxa assembled in four genera namely, *Gamochaeta, Gnaphalium, Homognaphalium and Pseudognaphalium* were studied for cypsela characters from herbarium specimens (Appendix 1) under stereomicroscope (Nikon XN Model), compound microscope (Nikon Type 102) and scanning electron microscope (JSM-6380A). For scanning electron microscopy mature cypselas were directly mounted on metallic stub using double adhesive tape and coated with gold for a period of 6 minutes in sputtering chamber and observed under SEM.

The following characters were studied

Cypsela: Shape, surface, colour, size

Pappus: Bristle's series, shape, number, degree of fusion, colour, size

Appendix 1. List of the voucher specimens.

Taxa	Collector, Number, Herbarium
Gamochaeta pensylvanica	*Abrar Hussain* s.n. (KUH); *Surayya Khatoon* & *A. Ghafoor* 154A (KUH); *Surayya Khatoon* 324 (KUH); *Y. Nasir* s.n. (RAW), *R.R. Stewart* s.n. (RAW); *P.C. Joshi* 1 (RAW)
Gnaphalium polycaulon	*S.I. Ali* 1636 (KUH); *S.M.H. Jafri* 1571 (KUH); *S.I. Ali* s.n. (KUH); *A. Ghafoor* & *M. Qaiser* 463 (KUH); *S. Abedin* & *Abrar Hussain* 9479 (KUH)
Gnaphalium stewartii	*I.I. Choudhri* 40 (RAW); *Inayat* 19742 (RAW); *Mohindar Nath* 442 (RAW); *Mohindar Nath* 441 (KUH)
Gnaphalium thomsonii	*Tahir Ali, M. Qaiser* & *Ajmal Khan* 644 (KUH); *Jan Mohammad* s.n. (KUH); *Walter Koelz* 1244 (RAW)
Homognaphalium pulvinatum	A. Ghafoor & *M. Qaiser* 190 (KUH); *S. Abedin* & *Abrar Hussain* 9509 (KUH); *E. Nasir* s.n. (RAW)
Pseudognaphalium affine	*Y. Nasir* 6824 (KUH); *M. Qaiser* & *A. Ghafoor* 7438 (KUH); *S.M. H. Jafri* 1637 (KUH); *S.I. Ali* 1637 (KUH); *M.A. Siddiqi* & *Y.J. Nasir* 7354 (RAW)
Pseudognaphalium hypoleucum	*R.R. Stewart* s.n. (RAW); *Gatarace* s.n. (RAW)
Pseudognaphalium luteo-album	A. Ghafoor & *S. Omer* 2503 (KUH); *A. Ghafoor* & *S. Omer* 2487 (KUH); *R.R. Stewart* 9610 (KUH); *S.Omer* 407(KUH); *Rasool Baksh* 96 (KUH); *Tahir A*li & *G.R. Sarwar* 2746 (KUH); *S. Abedin* & *Abrar Hussain* 9513 (KUH)

Carpopodium: Shape, position, diameter of carpopodium and diameter of foramen of carpopodium were observed under scanning electron microscope.

Observations

General cypsela characters of *Gnaphalium* L. (s.l.)

Cypselas oblong or oblong–ellipsoid, 0.5-2.0 x 0.25–0.75 mm, yellowish brown, non ribbed, sparsely long papillose or short papillose–clavate or clavate myxogenic hairy or with globose myxogenic twin hairs. Pappus uniseriate bristly, barbellate, free or slightly coherent at base or basally connate in a ring like structure, falling separately or with slight fusion or as a unit, white or cream, 6-12, 2.5 – 5.0 mm long. Carpopodium narrow circular ring without any interruption, subbasal in position, 48-115 µm in diameter. Foramen of carpopodium 32- 80 µm in diameter (Table 1).

Key to the genera

1 + Cypselas with sparsely globose myxogenic twin hairs. Pappus bristles connate at base in a ring like structure, falling as a unit …….. *Gamochaeta*
- Cypselas sparsely papillose or papillose–clavate or clavate myxogenic hairy. Pappus bristles free or slightly coherent at base but never forming a ring like structure, falling separately or with slight fusion …….. 2

2 + Cypselas oblanceolate with short clavate myxogenic hairs …….. *Homognaphalium*
- Cypselas oblong or oblong- oblanceolate, sparsely papillose or papillose-clavate hairy ….…… *Gnaphalium* type (*Gnaphalium* & *Pseudognaphalium*)

Table 1. Cypsela micromorphological characters of *Gnaphalium* L., and its allied genera.

Name of species	Cypsela			
	Shape	Surface (hairs)	Colour	Size (mm)
Gamochaeta pensylvanica	Oblong	Sparsely globose myxogenic twin hairs	Yellowish brown	0.5 x 0.25
Gnaphalium polycaulon	Oblong-oblanceolate	Sparsely short papillose-clavate	Yellowish brown	1.0 x 0.25
G. stewartii	Oblong	Sparsely long papillose	Yellowish brown	1.5-2.0 x 0.75
G. thomsonii	Oblong-oblanceolate	Sparsely short papillose-clavate	Yellowish brown	1.0 x 0.25
Homognaphalium pulvinatum	Oblanceolate	Short clavate myxogenic hairs	Yellowish brown	1.5 x 0.5
Pseudognaphalium affine	Oblong-oblanceolate	Sparsely short papillose-clavate	Yellowish brown	1.0 x 0.25
P. hypoleucum	Oblong-oblanceolate	Sparsely short papillose-clavate	Yellowish brown	1.0 x 0.25
P. luteo-album	Oblong-oblanceolate	Sparsely short papillose-clavate	Yellowish brown	1.0 x 0.25

Name of species	Pappus			
	Bristles	Number	Length (mm)	Colour
Gamochaeta pensylvanica	Barbellate, connate at base in a ring like structure, falling as a unit	10-12	2.5	Cream
Gnaphalium polycaulon	Barbellate, free, falling separately	6-8	2.5	White
G. stewartii	Barbellate, free, falling separately	6-8	4-5	White
G. thomsonii	Barbellate, free, falling separately	6-8	4-5	White
Homognaphalium pulvinatum	Barbellate, slightly coherent at base, falling with slight fusion	6-8	2.5	White
Pseudognaphalium affine	Barbellate, slightly coherent at base, falling with slight fusion	6-8	3.0	Cream
P. hypoleucum	Barbellate, free, falling separately	6-8	3.0	Cream
P. luteo-album	Barbellate, slightly coherent at base, falling with slight fusion	6-8	3.0	White

Name of species	Carpopodium			
	Shape	Position	Diameter of carpopodium (μm)	Diameter of foramen of carpopodium (μm)
Gamochaeta pensylvanica	Narrow circular ring without any interruption	Subbasal	48	38
Gnaphalium polycaulon	Narrow circular ring without any interruption	Subbasal	54	32
G. stewartii	Narrow circular ring without any interruption	Subbasal	115	80
G. thomsonii	Narrow circular ring without any interruption	Subbasal	64	41
Homognaphalium pulvinatum	Narrow circular ring without any interruption	Subbasal	56	44
Pseudognaphalium affine	Narrow circular ring without any interruption	Subbasal	62	39
P. hypoleucum	Narrow circular ring without any interruption	Subbasal	58	35
P. luteo-album	Narrow circular ring without any interruption	Subbasal	75	50

Fig. 1. Scanning Electron Micrographs. *Gamochaeta pensylvanica* : A, cypsela & pappus; B, surface; C, carpopodium. *Gnaphalium polycaulon*: D, cypsela & pappus; E, surface; F, carpopodium. *G. stewartii*: G, cypsela & pappus; H, surface; I, carpopodium. *G. thomsonii*: J, cypsela with pappus; K, surface; L, carpopodium (Scale bar: A,G,J = 100 µm; B, E,H,K,I = 20µm; D=50µm; C,F,L = 10µm).

Gamochaeta Wedd.

It is represented by single species i.e. *G. pensylvanica* (Willd.) Cabrera.

Cypselas oblong, 0.5 x 0.25 mm, sparsely globose myxogenic twin hairy. Pappus bristles connate at base in a ring like structure, falling as a unit, cream, 10-12, 2.5 mm long. Carpopodium 48 µm in diameter. Foramen of carpopodium 38 µm in diameter (Fig. 1A-C).

Fig. 2. Scanning Electron Micrographs. *Homognaphalium palvinatum*: A, cypsela & pappus; B, surface; C, carpopodium. *Pseudognaphalium affine*: D, cypsela & pappus; E, surface; F, carpopodium. *P. hypoleucum*: G, cypsela & pappus; H, surface; I, carpopodium. *P. leuto-album*: J, cypsela & pappus; K, surface; L, carpopodium (Scale bar: A,J = 100µm; D, G= 50µm; B, C, E, F, H, I, K, L = 10µm).

Homoganaphalium Kirp.

It is represented by single species i.e., *H. pulvinatum* (Delile) Fayed & Zareh

Cypselas oblanceolate, 1.5 x 0.5 mm, short clavate myxogenic hairy. Pappus bristles slightly coherent at base,falling with slight fusion, white, 6-8, 2.5 mm long. Carpopodium 56 µm in diameter. Foramen of carpopodium 44 µm in diameter (Fig. 2A-C).

***Gnaphalium* type:** On the basis of cypsela features, the genus *Pseudognaphalium* Kirp., could not be distinguished from the genus *Gnaphalium* L., so both the genera are placed here within *Gnaphalium* type.

Cypselas oblong or oblong-oblanceolate, 1-2 x 0.25 -0.75 mm, sparsely papillose or short papillose-clavate hairy. Pappus bristles free or slightly coherent at base, falling separately or with slight fusion, 6-8, 2.5–5 mm long. Carpopodium 54-115 µm in diameter. Foramen of carpopodium 32-80 µm in diameter.

Gnaphalium L. is represented by 3 species viz., *G. polycaulon* Pers., *G. stewartii* C.B. Clarke ex Hook f. and *G. thomsonii* Hook f. (Fig. 1D-L).

Key to the species

1 + Cypselas oblong, sparsely long papillose, 1.5–2.0 mm long. Carpopodium 115 µm in diameter. Foramen of carpopodium 80 µm in diameter ……..… *G. stewartii*
- Cypselas oblong–oblanceolate, sparsely short papillose-clavate, 1 mm long. Carpopodium 54–64µm in diameter. Foramen of carpopodium 32–41µm in diameter ……..…… 2

2 + Pappus bristles 2.5 mm long. Carpopodium 54µm in diameter. Foramen of carpopodium 32 µm in diameter …….. *G. polycaulon*
- Pappus bristles 4-5 mm long. Carpopodium 64 µm in diameter. Foramen of carpopodium 41 µm in diameter ……...……. *G. thomsonii*

The genus *Pseudognaphalium* Kirp., comprises 3 species in Pakistan viz., *Pseudognaphalium affine* (D.Don) Anderb., *P. hypoleucum* (DC.) O.M. Hilliard & B.L. Burtt, *P. leuto-album* (L.) O.M. Hillaird & B.L. Burtt (Fig. 2D-L).

Key to the species

1 + Pappus bristles white. Carpopodium 75 µm in diameter. Foramen of carpopodium 50 µm ……..……. *P. leuto-album*
- Pappus bristles cream. Carpopodium 58-62 µm in diameter. Foramen of carpopodium 35-39 µm in diameter ……...…… 2

2 + Pappus bristles free, falling separately …… *P. hypoleucum*
- Pappus bristles slightly coherent at base falling with slight fusion ……... *P. affine*

Results and Discussion

In most of the previous taxonomic treatments the genus *Gnaphalium* L. was treated in a broader sence and rest of the genera like *Gamochaeta* Wedd., *Homognaphalium* Kirp., and *Pseudognaphalium* Kirp., were treated as congeneric with *Gnaphalium* L (s.l.). Hilliard & Burtt (1981), Fayed & Zareh (1989), Anderberg (1991), Bremer (1994), and Qaiser & Abid (2003) treated them as independent genera and placed them under *Gnaphalium* group. On the basis of cypsela characters the genera *Gamochaeta* and *Homognaphalium* are clearly segregated. Whereas, the two genera *Gnaphalium* and *Pseudognaphalium* could not be separated from each other due to similar cypsela

characters. *Gamochaeta* is characterized by the cypselas with globose myxogenic twin hairs and basally connate bristles in a ring like structure falling as a unit. In the other genera cypselas having papillate or papillate-clavate or clavate myxogenic twin hairs and pappus bristles are free or slightly coherent but never falling as a unit. Amongst them the genus *Homognaphalium* remains distinct due to short clavate *myxogenic* twin hairs on cypselas. It is also noteworthy that within the *Gnaphalium* type both genera viz., *Gnaphalium* and *Pseudognaphalium* although sharing common cypsela characters but their species can easily be delimited due to their distinct cypsela features. Therefore, the cypsela characters are not only found useful for assessing relationship but they are also useful for the delimitation of taxa of *Gnaphalium* L. (s.l.).

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