

# Morphological Characterization of *Pulicaria crispera* (Asteraceae) Achenes of Four Populations Distributed in the Central Region of Saudi Arabia

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**Abstract:** The morphological structure and the different characters of the achenes are important divisive traits for the differentiation of plant species. The main aim of this study was to provide a morphological characterization of *Pulicaria crispera* achenes and to explore the morphological variation and the relationships between its different populations from four different locations in the central region of the Kingdom of Saudi Arabia. Detailed descriptions of the achene surface were given for each taxon. The results indicated that the examined taxa had variations regarding their achene surfaces and these variations have great importance in determining the taxonomic information of the discussed taxa. Achene was characterized in *P. crispera* samples of different study sites by *Carpodium* as well as *Pappus*. It was different between the studied taxa in shape and length, and that would be evaluated as a decisive micromorphological character of this within the species.

**Keywords:** *Pulicaria crispera*, Achene, *Carpodium*, *Pappus*, Saudi Arabia

## 1. Introduction

*Pulicaria crispera* (Forssk.) Benth. ex Oliv, belong *Pulicaria* L. The third largest genus of Asteraceae (Gaertner, 1791). It is a very bushy shrub 30 cm high, with small green, wavy leaves, and fragrant yellow flowers 8 mm in diameter with short ray florets. A very widespread plant throughout the region and somewhat variable, the leaves and stems are sometimes white or gray in color and are not aromatic (Chaudhary, 1999; 2001), and it is one of the most widespread desert plants (Eliebaa *et al.*, 2018). The fruit is achenes, its size reaches 2 mm and is covered with bristles (Zoghet and Al Alsheikh, 1999). There are also small hairs at the apical end of achene. *P. crispera* is a medicinal plant widely used in folk medicine as a carminative and for the treatment of various ailments such as colds, cough, colic, and excessive sweating (Elshierk and AbdElMoniem, 2015; Awadh *et al.*, 2012; Ross *et al.*, 1997). The aerial parts of this plant are used as an insect repellent (Maghraby, *et al.*, 2010) because they contain essential oil, which also showed clear activity against bacteria (Foudah *et al.*, 2015). It is used as an herbal tea, as well as to treat infections (Ghahghaei *et al.*, 2014). The achene characters have been widely used for the taxonomic significance of the family Asteraceae (Kothari *et al.*, 2012). Kulkarni (2013) mentioned in his study of seven species of the Asteraceae including *Pulicaria angustifolia*, showing micromorphological characters of achenes diversity in colour, hilum, pappus, shape, size, spine, surface, and ribs. In addition, Savadkoochi *et al.* (2012) study 12 qualitative and quantitative characters such as achene length, width and colour, ornamentation type and size, length of beak, length and colour of pappus, Their studies concluded ornamentation on achene body cannot be used in separation of taxa at species level as well as sectional rank, whereas ornamentation size showed to be a better tool for separation of species. Since fruit micromorphology. In Kilian (1999) study on a new species discovered in the province of Al Mahra, south eastern of Yemen, holding an intermediate position between *Pulicaria* and *Sclerostephane* is described

as new to science. A comparative study of the morphology and anatomy of achenes and pappus of this species, which is identified as the closest ally of the new species, shows that the peculiar achenes of *Sclerostephane*, which were the decisive reason for its separation from *Pulicaria*, This indicates the phylogenetic importance of the achenes in the phylogenetic division of the new species.

## 2. Material and Method

Achenes of *P. crispera* were collected from several localities of the central region of Saudi Arabia, Each sample was given a code indicating the location from which it was collected to identify it as in table (1). The characteristics of the seeds (shape, color, size) were examined using a stereomicroscope; after that, the seeds were placed directly on small metal stups above a bar. The adhesive on both sides is coated with gold Coating using the JEC - 550 Twin Coater device to study the shapes of the achenes and the characteristics of the delicate outer surface. And the trimmings of the achene parts (Hacioglu, 2012). The achenes were examined with different magnification powers by a scanning electron microscope in the Electron Microscope Unit - Central Research Laboratory - Female University City.

**Table 1:** *P. crispera* specimen collection sites from the central region of Saudi Arabia

#	Sites name	Codes	Location
1	East of Riyadh	ER	N24.859583 E46.840523
2	Nafud al - Dahna	ND	N25.4813250 E46.4524190
3	Rawdat Kuraim	RK	N25.457649 E46.4503860
4	Rawdat Tanhat	RN	N26.111282 E46.482880

## 3. Result and Discussion

After examining *P. crispera* achenes from several localities of the central region of Saudi Arabia, were imagined and recorded the morphological differences including (length and width), color and surface sculpture of achene, length of

the pappus disc and long inner hairs, color and shape of the pappus canopy hairs, and Carpopodium shape as in Table (2) and Figure (1), Biswas *et al.* (2014) explained that the differences in the color of the fruit may be caused by the degree of maturity of the fruits, and according to our results, this may be a reason for the different color of the skin of *P. crispera* samples in the central region than in the northern region of the Kingdom of Saudi Arabia, which was recorded in a light color in Abdel - Hamid (2020) study, This is also due to the different habitats that affect the phenotypic features of wild plants and is called plasticity or phenotypic flexibility, which is the way to respond to a change in environments, in addition to the fact that climatic factors affect the phylotype to produce the phenotype (Lucas *et al.*, 2013).

**a) Achene shap**

Oval to narrowly oblong in a samples of Nafud al - Dahna site (ND), oval and oblong in samples of Rawdat rkuraim (RK) and east of Riyadh (ER), to a narrow oblong in the

samples of Tanhat site (RN), Variations in achenes heteromorphism may be related to environmental factors, such as annual precipitation, temperature, daylight, and their monthly distribution in different calendar years. Achenes heteromorphism has been linked to genetic factors, such as achenes positioning, achenes coat differentiation, and Imbert (2002) study has indicated that seed developmental gene expression. Potentially adaptive seed heteromorphism in desert plant species.

**b) Achene size**

As for the size of the Achene as in table (1), its length ranged between 0.83 - 0.55  $\mu\text{m}$ , and its width ranged between 0.305 - 0.194  $\mu\text{m}$  in all *P. crispera* samples from the four sites studied. The strong association between growth form/plant height) and seed size was found not only among unassisted and wind - adapted species but also among species dispersed by other means as mentioned by (Leishman *et al.*, 1995).

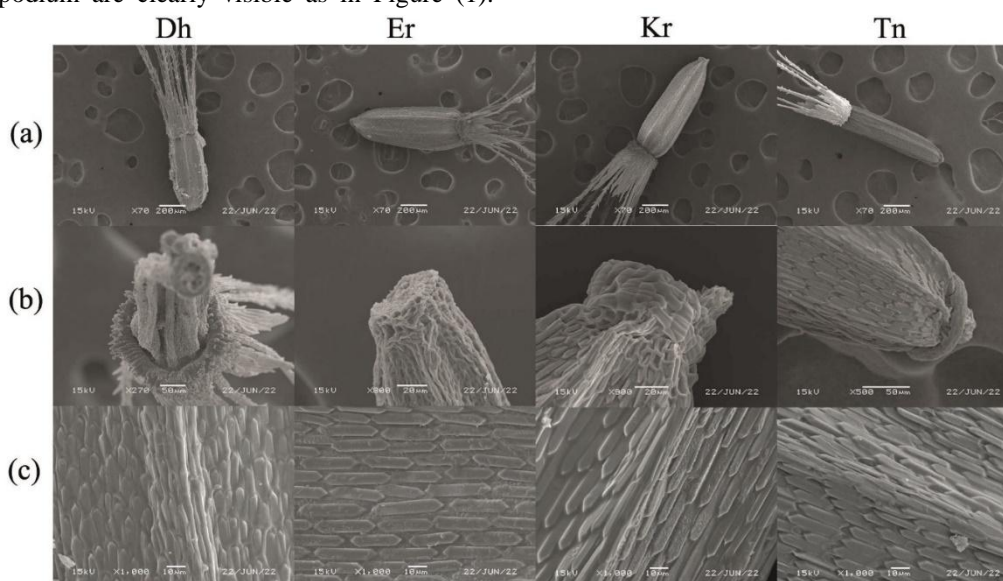
**Table 2:** Qualitative and quantitative characteristics of *P. crispera* achene in the central region of Saudi Arabia

<i>p. crispera</i> sites	Achene			Pappus			Carpodium
	sculpture	Size		Pappus Disc		Length $\mu\text{m}$	
		Width (mm)	Length (mm)	Length ( $\mu\text{m}$ )	shape		
DH	Reticulate	0.277	0.55	277	Dentate crown	27	Hollow base surrounded by a circular ring
ER	Aculeate	0.305	0.833	305	Dentate crown	18	Flat base surrounded by a wide circular ring
RK	Reticulate	0.277	0.833	44	Dentate crown	28	A base with a bump at one end of a circular ring
RN	Reticulate	0.194	0.805	388	Dentate crown	27	prominent base surrounded by a circular ring

**c) Carpopodium**

Carpodium is a structure surrounding the abscission zone, the basal part of the Achene, from the receptacle, and it is a characteristic among *P. crispera* samples collected from different sites. It appeared circular with a flat end and a wide ring of cells in (ER) samples, circular with a bump at one end of the ring in (RK) samples, and circular with a hollow base for a wide cell ring in (ND) samples, while in (RN) samples it was circular and had The base consists of broad cells forming a prominent ring, and the outlines of the cell wall in Carpopodium are clearly visible as in Figure (1).

Funk *et al.* (2009) reported that the carpopodium may consist of one to several rows of cells and can be distinguished by the shape of its cells and the texture of their surface, in addition to the fact that it can be indistinct or absent. Carpopodium may be completely symmetrical, but it is often not symmetrical, however, its shape mostly depends on the position of the achene on the epithelium, and this is consistent with the appearance of the difference in the base of the carpopodium in achene for all *P. crispera* samples in our study, consistent with Sundberg (1985).

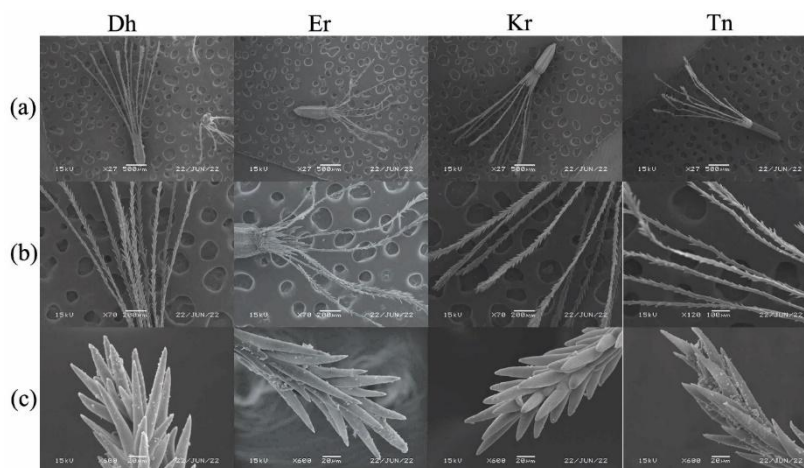


**Figure 1:** Variation in of *P. crispera* achenes in the studied populations using scanning electron microscopy (SEM). (a) Achene; (b) Carpopodium; (c) sculpture

**d) Pappus**

Pappus in all *P. crispata* specimens from different study sites had two rows of bristles, in the upper part of the achene where the outer row developed into a small toothed crown of bristles of different lengths at Pappus Disc surrounding the inner row of bristles. It agrees with Rahman *et al.* (2011) on *P. vulgaris* Pappus are in two rows, inner row of barbellate bristles while outer row of short membranous scales. And its length ranged between 0.44 - 0.277  $\mu\text{m}$ , and the inner row

consisted of 10 protruding long capillary appendages that are somewhat attached to the base, and their length ranged between 18 - 275  $\mu\text{m}$ . These Pappus are usually equal in length on one achene, but they differ on different achenes, as shown in Table (2) and Figure (2). The evaluated cypselae and pappus characters are useful not only in assessing relationships within this group but also in delimiting genera and species (Ozcan and Demir, 2022)



**Figure 2:** Variation of *P. crispata* achenes in the populations studied SEM. (a) Top and Disc of Pappus; (b) Shape of bristles; (c) Top of Pappus

**e) Coat sculpture**

Achene fruit surface cells appeared in all studied samples for the four sites parallel to the longitudinal axis of the fruit, and it had a distinctive carving in the form of aculeate of hexagonal cells in one level which agreed with Abdel - Hamid (2020) in his study on achene surface morphology of 15 taxa of Asteraceae collected from Al - Jouf and Al - Ula regions in northern Saudi Arabia. but in samples (ER) the edges of the cells seemed prominent and clear, while the rest of the samples had a reticulate carving, and the cells are overlapping and the edges of the cell are raised relative to the center of the cell, with a smooth structure that does not contain trichomes, as in Figure (1), Just as mentioned by Gabr (2015) describing *P. undulata* achenes, This pattern may be the result of environmental conditions or the degree of ripeness of the achene (Karanović *et al.*, 2016).

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