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RESEARCH ARTICLE

Micromorphological study on trichomes of *Oligochaeta ramosa* (Roxb.) wagenitz from semi-arid regions of Barmer, Rajasthan

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Abstract

Trichomes are one of the micromorphological traits that can be examined to help identify of Asteraceae species. The present study is aimed to describe the diversity of trichomes found in *Oligochaeta ramosa* (Roxb.) Wagenitz (Asteraceae). Different glandular and non-glandular trichomes were identified, differing in size and shape. It was found that there were several different-shaped multicellular non-glandular and glandular trichomes. After being examined under a light microscope, the trichomes were categorised into 13 categories for this study. The distinguishing feature of *Oligochaeta ramosa* (Roxb.) Wagenitz consists of glandular and non-glandular trichomes. Non glandular trichomes are simple, multicellular, and long with pointed tips. Besides these, glandular trichomes like sessile and peltate types were also observed in *Oligochaeta ramosa* (Roxb.) Wagenitz. This study revealed the significance of micromorphological data to assist Asteraceae plant identification.

Keywords: Asteraceae, Diagnostic Character, Micromorphology, Trichomes.

Introduction

The family Asteraceae is one of the most diverse groups of angiosperms, with about 23000 species distributed throughout three subfamilies, 17 tribes, and more than 1535 genera (Younsheng and Andrberg 2011). Members of the family are primarily herbaceous, occasionally shrubby, and a few trees. Trichomes refer to the various shapes, structures, and functions of epidermal outgrowth (Esau 1965). According to Cutter (1978), trichomes can develop on any plant part, including the stem, leaves, fruit, and seeds. Ontogenetically, they are surface structures that are either unicellular or multicellular and have both a cell wall and a cell membrane. They occur on the outer surfaces of various plant organs and are derived from epidermal cells (Werker 2000). Their role as protectors against adverse biological, chemical, and physical conditions, as well as their absorbing and secretory activities and influence on pollination and seed dispersal (Prabhakar *et al.* 1985), are all determined by their direct interaction with the environment (Uphof 1962). The glandular and non-glandular forms of trichomes can be differentiated by their basal categorization (Werker *et al.* 1985). Secretion may be possible in both unicellular and multicellular hairs. Secretory trichomes, also known as glandular trichomes, are specialized trichomes that release certain chemical compounds for specific functions (Weinhold and Baldwin 2011). The glandular trichomes are considered to serve as a significant source of essential oils, which are fragrant substances with potential uses in medicine as well as biological significance like attracting pollinators (Giuliani *et al.* 2018). Plants use their secretions for a various essential function, including grazing and pathogen organism defense (Glas *et al.* 2012). Types of trichomes is one of the important traits that have long been used for delimitation of taxa between different plant species and understanding the relationships among them (Prabhakar *et al.* 1985; Ali MA and Al-Hemaid 2011). Furthermore, the

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unique cells present in the epidermis have to supplement taxonomic data, which serves as a basis for both taxonomic and evolutionary investigations (Sari *et al.* 2021). The present study is therefore aimed to identifying, describe and documenting the types of trichomes which may be used as diagnostic and taxonomically important traits in the *Oligochaeta ramosa* (Roxb.) Wagenitz.

Materials And Methods

Collection and identification of species

Healthy and mature individuals of *Oligochaeta ramosa* (Roxb.) Wagenitz (Asteraceae) were collected during regular field visits to various localities of the semi-arid region of Barmer district (Rajasthan). Complete plants, including roots, stems, petioles, leaves, and flowers, were collected from the individuals growing in rocky areas, wastelands, and near water bodies. For epidermal analysis, leaves and a portion of the stem were preserved in the FAA solution (Johansen 1940; Saas 1958). Authentication of collected specimens *Oligochaeta ramosa* (Roxb.) Wagenitz was done using the "Flora of Indian Desert" (Bhandari 1995), "Flora of Rajasthan" (Shetty and Singh 1987-1993), and "Flora of Rajasthan East and Southeast Rajasthan" (Tiagi and Aery 2007). During the plant exploration tour to arid and semi-arid areas of Barmer District (Rajasthan), the senior author collected some wild plants of the family Asteraceae and followed the proper herbarium methodology to prepare the voucher specimens (Jain and Rao 1977). The plant specimens have also been documented in the field using SONY α6100 camera with 90mm macro lens and Samsung S20 FE 5G smartphone. Voucher specimens have been deposited at the herbarium of SRK Government College, Rajsamand, Rajasthan.

Epidermal studies

An epidermal strip of healthy, mature leaves and stems was obtained. To produce the epidermal peels of the abaxial and adaxial surfaces of the leaves as well as the stems, a small piece of leaf/stem was soaked in concentrated HNO_3 in a petri dish for a duration of roughly 6 to 12 hours. A pair of forceps was then used to shift them into water in a petri dish. A sharp razor blade was used to scrape off fragile slices of epidermis carefully. Using a soft canal hair brush and water, the loose cells were removed from the epidermal peels until the desired epidermis underneath was reached. The epidermal peels were removed and placed on a sterilized glass slide and stained with 1% aqueous safranin solution for five minutes and slides were, mounted in 10% glycerol. All slides were examined under a light microscope and photomicrographs were taken with a SONY α6100 digital camera and a Samsung smartphone with X4, X10 and X40 objective lenses. Trichome description is followed as described by Metcalf and Chalk (1979) and Inamdar *et al.* (1990).

Results

Taxonomic description

Family: Asteraceae
Common Name: Oont kantalo
Flowering & fruiting: September – March
Collector(s) Name: Vimala
Collection locality: Open wasteland areas of Barmer rural
Voucher No.: HBSRKGCR63
Basionym: Cardus ramosus Roxb.
Synonym(s): Volutarella ramosa (Roxb.) Santapau; Amberboa ramosa (Roxb.) Jafri
Native: India
Habit: A 30 cm tall, erect herb with puberulous, striated, dichotomously branching branches. Leaves: Simple or lyrate, sessile, powdery, gland-dotted, obovate to spathulate, alternating at the base, with acute, distant apiculate tips. Inflorescence: Head single terminal head, pink, spiny, homogamous, and free of rays. Involucre bracts: 5–6 seriate, elliptic to oval, white tomentose at the dorsal surface, spinescent at the tip. Container: glabrous, pale, and flat. There are around 25 flowers, corolla 15mm, glabrous, cylindrical, and lobed. Pappus multiseriate at various heights. Achenes: 2– 4 mm, glabrous, angled, with an oblique basal areole (Figure 1).

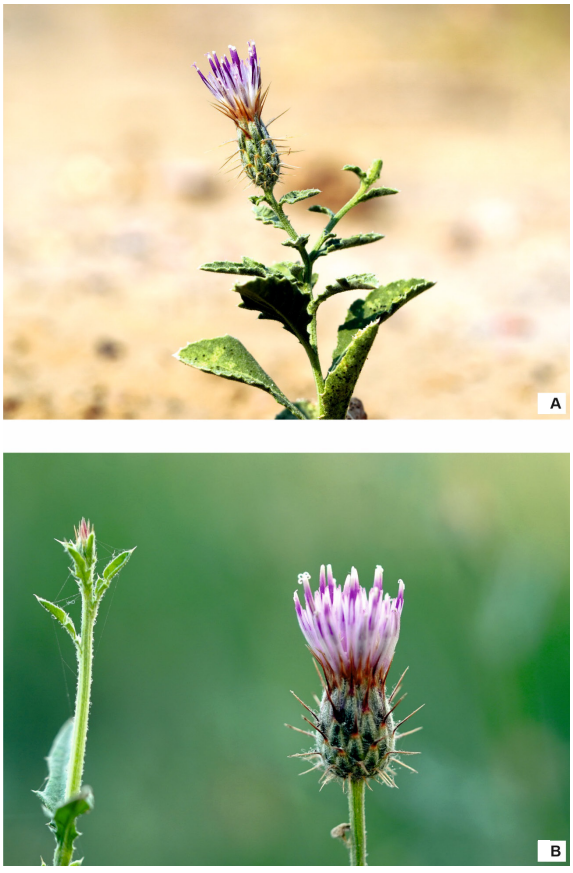

Figure 1: *Oligochaeta ramosa* (Roxb.) Wagenitz: (A) Habit, (B) Inflorescence

Table 1: Morphology of trichomes in *Oligochaeta ramosa* (Roxb.) Wagenitz

Trichomes position	*Types of trichomes*
Abaxial surface	Non-glandular: Uniseriate filiform trichome with elongated apical cells (Figure 2A)
	Non-glandular: Uniseriate filiform branched trichome (Figure 2B)
	Non-glandular: Uniseriate 5–celled trichome (Figure 2C)
	Non-glandular: Four–celled, conical–shaped (Figure 2D)
	Non-glandular: Seven–celled with a blunt end (Figure 2E)
	Non-glandular: Three–celled with a blunt end (Figure 2F)
	Glandular: Capitate trichome, ellipsoidal, pointed end (Figure 2G)
	Glandular: Capitate trichome, 7–celled unbranched (Figure 2H)
	Glandular: Peltate trichome- ball-shaped multicellular structure (Figure 2I)
Adaxial surface	Non-glandular: Cone–shaped, 3-celled, simple base (Figure 2J)
	Glandular: Biseriate base, capitate head (Figure 2K)
Stem	Non-glandular: Cone-shaped, multicellular, broad–shaped trichome (Figure 3A)
	Non-glandular: Uniseriate filiform multicellular trichome with elongated apical cells (Figure 3B)
	Glandular: Capitate head, 3-celled, short trichome (Figure 3C)
	Glandular: Multicellular capitate head (Figure 3D & 3E)
	Glandular: Peltate trichome, multicellular, ball–shaped (Figure 3F & 3G)

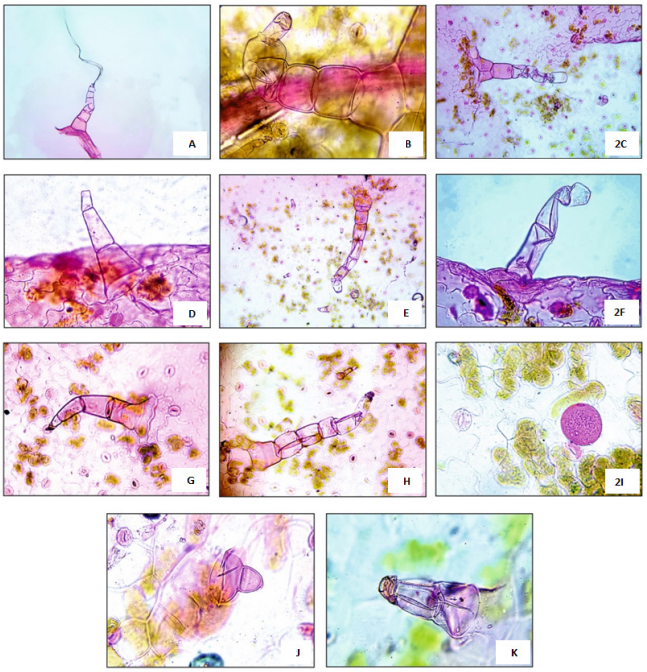

Figure 2: Trichome diversity in *Oligochaeta ramosa*: Abaxial surface of leaves (A–I); Adaxial surface of leaves (J–K)
Magnification: (A–H, K: X100; I & J: X400)

Micromorphology of trichomes

Plants of *Oligochaeta ramosa* (Roxb.) Wagenitz showed a diversity of trichome forms. As displayed in Table 1, Figures 2 and 3, glandular and non-glandular trichomes have been recorded on the stem surface as well as the abaxial and adaxial surfaces of leaves. The number of trichomes varies with their density. Compared to the adaxial surface and the stem surface, the abaxial layer of leaves had a greater number of trichome density. In comparison with mature leaves, younger leaves have more trichomes.

Discussion

Trichomes are immensely complexly distributed. First, there are a variety of trichomes; second, there are apparent variations in the density of trichome types when viewed both separately and collectively; and third, there are variations in the distribution of trichome types on stem and both surfaces of leaves of *Oligochaeta ramosa* (Roxb.) Wagenitz plant species and these factors together produce complexity. Many workers (Adedeji 2007, Rollins and Shaw

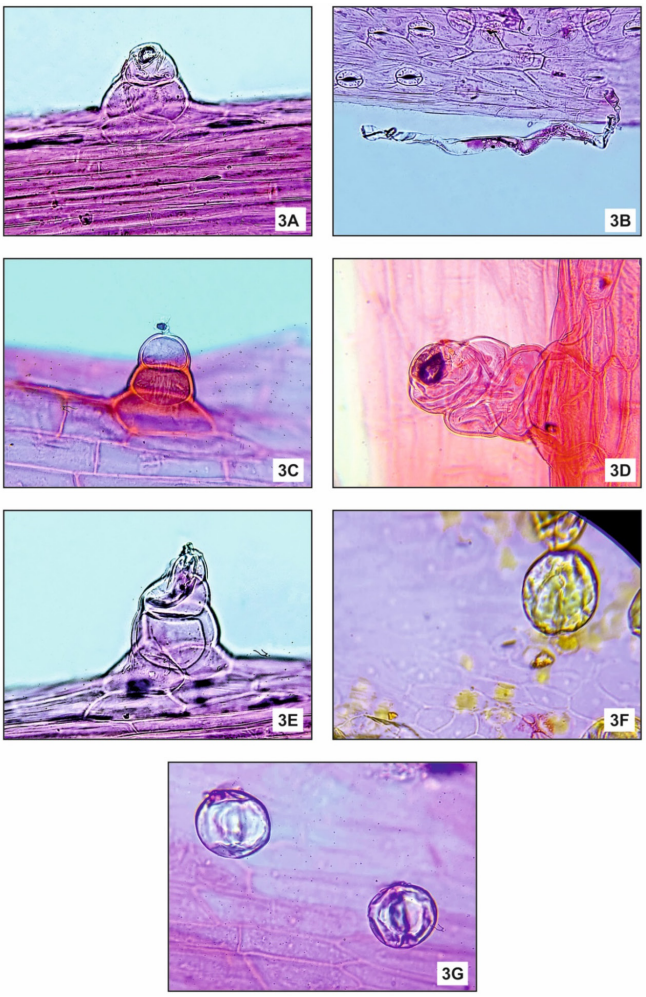

Figure 3: Trichome diversity in *Oligochaeta ramosa*: Surface of stem (A–G)
Magnification: (3A–3E: X100; 3F & 3G: X400)

1973, Wagner *et al*. 2004) have concluded the specific value of trichome studies. The trichomes of *Oligochaeta ramosa* (Roxb.) Wagenitz are both glandular and non-glandular in type. While glandular trichomes are peltate, ball-shaped, multicellular, and have a capitate head, non-glandular trichomes are multicellular, with long hairs that are unbranched and short cone-shaped. The ability of glandular trichomes to synthesize, store, and secrete secondary metabolites that aid in protecting plants from biotic stressors such as insect predation has received much attention (Ranger and Hower 2001). As an aspect of classification, Perveen *et al.* (2016) revealed that seventeen species belonging to the Asteraceae family exhibited trichomes that varied in size and shape.

Various trichome types have been documented in the data presented, exhibiting significant variations in structure. Identification of different taxa within the same family could be made easier by studies on trichome morphology.

Conclusion

This investigation showed that there are differences in the types of trichomes at various taxonomic levels. The present study is therefore helped at identifying, describing and documenting the leaf and stem trichome characters that diagnostic and taxonomically important in the family Asteraceae.

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