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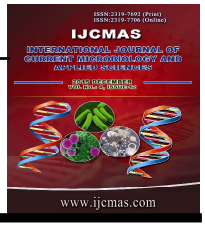

Original Research Article

Leaf Surface Properties of the Genus *Haplophyllum* (Rutaceae) in Jordan

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Keywords

Leaf Surface Properties, Genus *Haplophyllum* , Rutaceae, Jordan

A B S T R A C T

Leaf surface characters of four *Haplophyllum* species; *H. blanchei*, *H. buxbaumii*, *H. poorei* and *H. tuberculatum*, have been investigated using scanning electron microscopy (SEM). Presence of hair, cuticular pattern and characters of stomata shape, size and arrangement has been considered. *H. poorei* and *H. blanchei* have sufficient quantity of hair on both surfaces, while *H. buxbaumii* and *H. tuberculatum* have only in leaf margin. Stomata shapes in all taxa are elliptical and sunken.

Introduction

The genus *Haplophyllum* has 68 species (Townsend, 1986), and reach maximum species diversity in Turkey, Iran and Central Asia (Salvo *et al.*, 2011). The *Haplophyllum* genus is represented by five taxa in Jordan; *H. blanchei*, *H. buxbaumii*, *H. poorei*, *H. tuberculatum* and *H. fruticulosum* (Al-Eisawi, 1982), but our study show that we have only four *Haplophyllum* species in Jordan; *H. blanchei*, *H. buxbaumii*, *H. poorei* and *H. tuberculatum*.

Significance of leaf surface characters was emphasized by some of the studies carried out on the species of some genera and families in Jordan, such as, the family *Umbelliferae* (Al-Eisawi,1977), the genus *Alyssum* (Oran,1985), the genus *Colchicum* (Omar, 1994) the genus *Allium* (Omar, 2006) and the genus *Tulipa* (Al-Hodali, 2011).

Little attention was paid towards leaf surface characters of *Haplophyllum* species.

The leaf surface for some wild plants in Sinai (Egypt) was examined, including *H. tuberculatum*, using scanning electron microscopy (SEM). The study showed that *H. tuberculatum* leaves are simple, obovate, oblong or linear, undulate or flat margin, furnished with prominent glands, crisped hairy at least below (El Nagger and Abdel Hafez, 2003).

Recent revision of the genus in Jordan (Al-Katib, 2013) showed that only four species of Haplophllum are occurring in Jordan, *H. blanchei*, *H. buxbaumii*, *H. poorei*, *H. tuberculatum***.** Pollen morphology of the genus Haplophyllum in has been studied (Al-Eisawi & Al-Khateeb, 2015).

Materials and Methods

Leaf samples were obtained from University of Jordan Herbarium or collected from the field. The leaves were prepared for scanning microscopy (SEM) by the standard methods described by Erdtman (1952). Fresh leaf samples collected from the fields were pressed until drying. Leaf samples were fixed on a clean stub using double sided sticky carbon band, and the stubs were then coated by Platinum by Emitech K550X sputter-coater, and observations were made using SEM (Inspect F50) at different magnifications at the electron microscopy laboratory unit, Hamdi Mango Center, The University of Jordan.

Results and Discussion

H. blanchei Boiss

Fig. 1, 2 Upper and lower leaf surface have a rough texture; thick flake- like waxy pattern. Stomata occurs at both side, arranged in scattered way, stomata number in upper and lower epidermis is nearly the same; in lower and upper epidermis stomata average is 7 stomata per 100 μm square area. Stomata are sunken, elliptic shape. On both sides, the stomata size is nearly the same. Trichomes are simple, long, narrow, cylindrical unbranshed hairs. Hairs number in upper epidermis is less than that in lower epidermis. On both sides high amount of wax depositions and long hairs were detected.

H. buxbaumii (Poir.) G. Don. Fil

Fig. 3, 4 Upper and lower leaf surface have a smooth–rough texture; rough to smooth cuticular pattern. Stomata occurs at both side, arranged in scattered way, stomata number in upper is more than that in lower epidermis; in upper epidermis stomata average is 7 stomata per 100 μm square area and in lower epidermis stomata average is 4 stomata per 100 μm square area. Stomata are sunken, elliptic in shape. On both sides, the stomata size is nearly the same. Trichomes are simple, cylindrical tapering at tips, unbranshed hairs, found on the leaf margin only. On both sides high amount cuticle were detected.

H. poorei C.C. Townsend

Fig. 5, 6 Upper and lower leaf surface have rough texture; rough cuticular pattern at lower epidermis and thick flake- like waxy pattern at upper epidermis. Few stomata, occurs at both side, arranged in scattered way, stomata number in upper and lower epidermis is nearly the same, in lower and upper epidermis stomata average is 3 stomata per 100 μm square area. Stomata are sunken, elliptic in shape. On both sides, the stomata size is nearly the same. Trichomes are simple, short, cylindrical tapering at tips, unbranched hairs. Both sides have lots of short hairs, lower epidermis has hairs more than the upper epidermis.

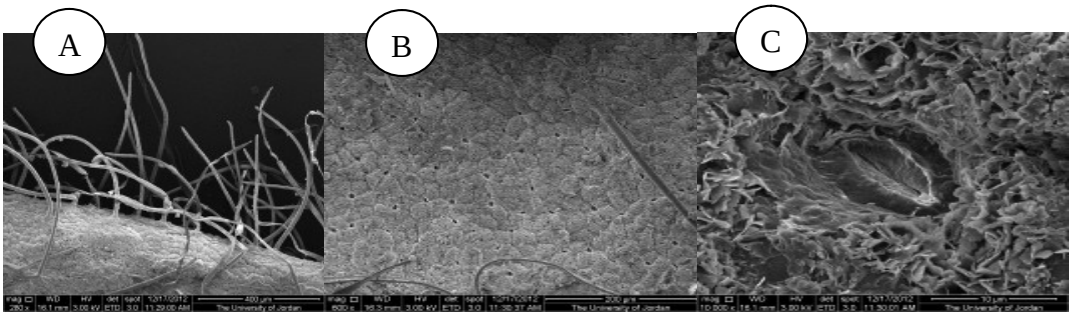
H. tuberculatum (Forssk.) Ad. Juss

Fig. 7, 8 Upper and lower leaf surface have rough texture; thick flake- like waxy pattern, stomata occurs at both side, arranged in scattered way, stomata number in upper epidermis is less than that in lower epidermis, in upper epidermis stomata average is 4 stomata per 100 μm square area and in lower epidermis stomata average is 5 stomata per 100 μm square area. Stomata are sunken, elliptic in shape. On both sides, the stomata size is nearly the same. Trichomes are simple, unbranched hairs, found on the leaf margin only. On both sides high amount of wax depositions were detected.

The study of the leaf surface of the four

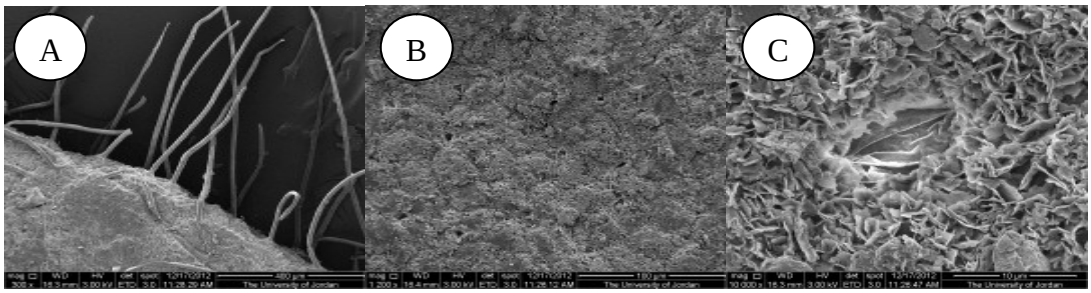
species of *Haplophyllum* in Jordan has proved to give a valuable bisystematic evidence in distinguishing between the species; *H. poorei* and *H. blanchei* have sufficient quantity of hair on both surfaces, while *H. buxbaumii* and *H. tuberculatum* have only in leaf margin. Stomata number in *H. poorei* was the least in comparison with *H. buxbaumii*, *H. blanchei* and *H. tuberculatum.* Stomata shapes in all taxa are elliptical and sunken. However, *H. poorei* stomata are sunken more than *H. blanchei*, *H. tuberculatum* and *H. buxbaumii* stomata, which commensurate with the habitat of each species. Moreover, *H. blanchei* and *H. tuberculatum* have flake-like wax deposition on both surfaces, while *H. poorei* have flake-like wax deposition only in the upper surface, on the other hand *H. buxbaumii* has only cuticular pattern. The aim of this study was to provide new information about the species of the genus *Haplophyllum* (*Rutaceae*) in Jordan.

Figure.1 Scanning Electron Micrographs of Lower Epidermis of *H. Blanchei* Leaf Surface



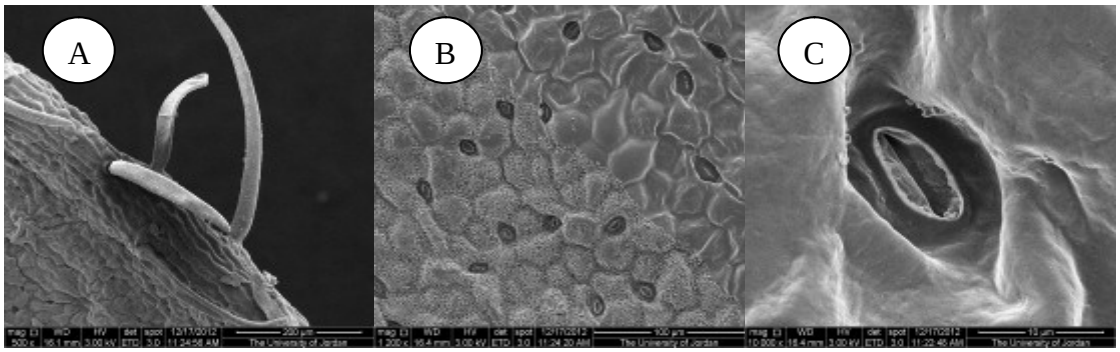
A. Trichomes (300 x). B. Scattered stomata (600 x). C. Sunken stoma (10000 x)

Figure.2 Scanning Electron Micrographs of Upper Epidermis of *H. Blanchei* Leaf Surface



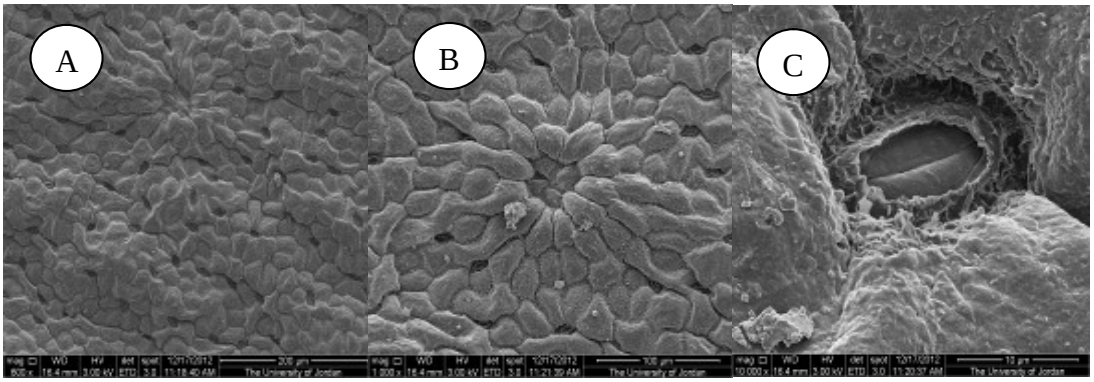
A. Trichomes (300 x). B. Scattered stomata (1200 x). C. Sunken stoma (10000 x)

Figure.3 Scanning Electron Micrographs of Lower Epidermis of *H. Buxbaumii* Leaf Surface



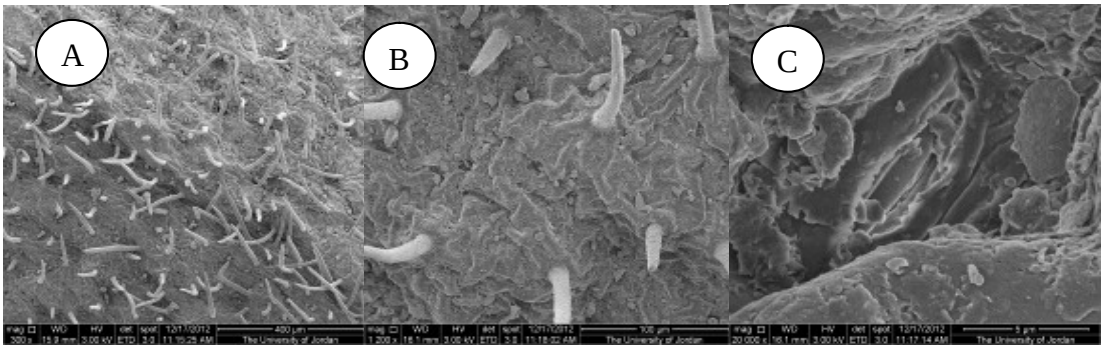
A. Trichomes (300 x). B. Scattered stomata (1200 x). C. Sunken stoma (10000 x)

Figure.4. Scanning Electron Micrographs of Upper Epidermis of *H. buxbaumii* Leaf Surface



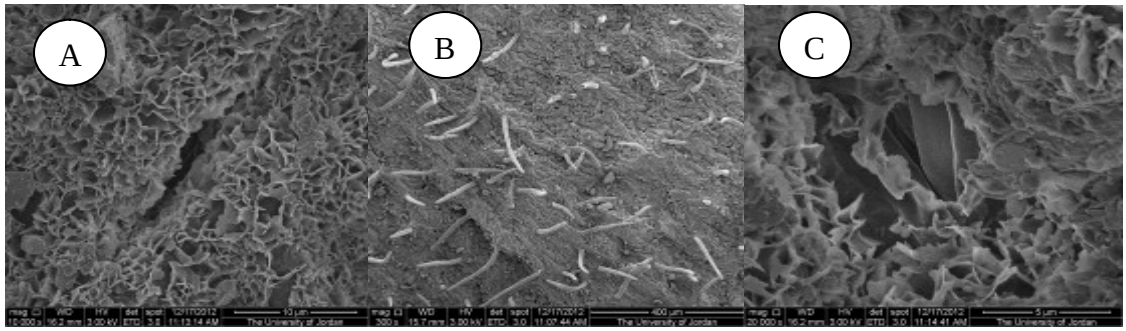
A. Scattered stomata (600 x). B. A gland (1200 x). C. Sunken stoma (10000 x)

Figure.5 Scanning Electron Micrographs of Lower Epidermis of *H. Poorei* Leaf Surface



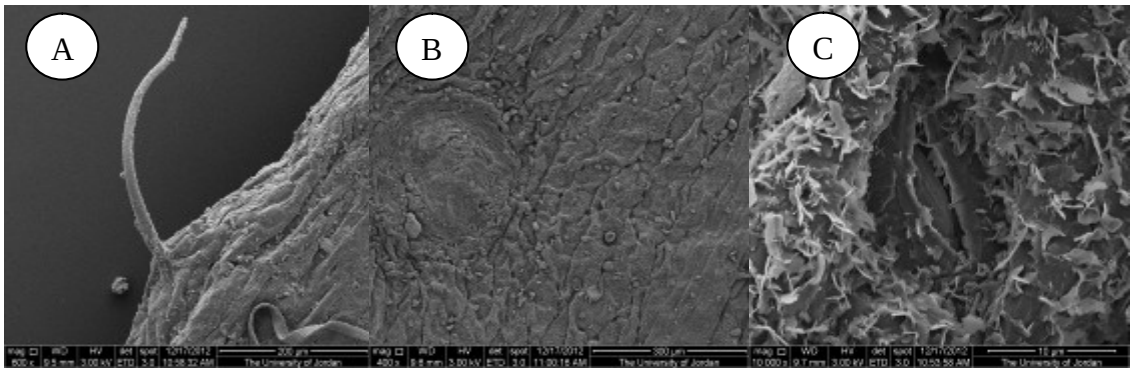
A. Trichomes (300 x). B. Scattered stomata (1200 x). C. Sunken stoma (10000 x)

Figure.6 Scanning Eectron Micrographs of Upper Epidermis of *H. Poorei* Leaf



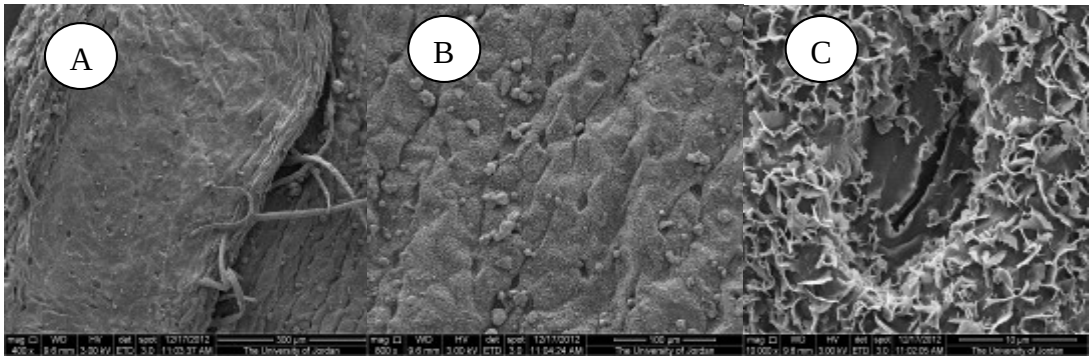
A. Trichomes (300 x). B. Sunken stoma (10000 x). C. Sunken stoma (20000 x)

Figure.7 Scanning Electron Micrographs of Lower Epidermis of *H. Tuberculatum* Leaf surface



A. Trichomes (600 x). B. Scattered stomata (400 x). C. Sunken stoma (10000 x)

Figure.8 Scanning Electron Micrographs of Upper Epidermis of *H. Tuberculatum* Leaf Surface



A. Trichomes (600 x). B. Scattered stomata (400 x). C. Sunken stoma (10000 x)

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