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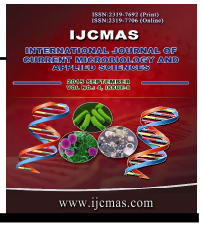

Original Research Article

Palynological Properties of the Genus *Haplophyllum* (Rutaceae) in Jordan

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Keywords

Haplophyllum, Rutaceae, Pollen-grains, Jordan

A B S T R A C T

Pollen morphological characteristics of four *Haplophyllum* species occurring in Jordan; *H. blanchei, H. buxbaumii, H. poorei* and *H. tuberculatum,* have been investigated by both light and scanning electron microscopy (SEM). Data about symmetry, polarity, shape, size, apertures and surface sculpturing are recorded. *H. blanchei* and *H. tuberculatum* pollen grains subprolate shape, while *H. buxbaumii* have prolate to spheroidal shape and *H. poorei* have spheroidal shape. Pollen grains of all species have radial symmetry, with tricolpate aperatures, isopolar, with striate perforated sculpture.

Introduction

The genus *Haplophyllum* has 68 species (Townsend, 1986), with a 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, 2013), but recent revision of this genus in Jordan (Al-Khatib, 2013) showed that only four *Haplophyllum* species are occurring in Jordan; *H. blanchei, H. buxbaumii, H. poorei* and *H. tuberculatum*.

Palynological characters were adopted as taxonomic tool in the revision of many families and genera, such as, the family *Umbelliferae* (Al- Eisawi, 1977), the genus *Crocus* (Kiswani, 1994), the genus *Colchicum* (Omar, 1994), the genus *Iris* (Al-Khader, 1997), the genus *Allium* (Omar, 2006) and the genus *Tulipa* (Al-Hodali, 2011) and others.

Palynological characters were adopted by many scientists including pollen morphology for the family *Rutaceae*. The pollen morphology of the subfamily *Aurantioideae* (*Rutaceae*) was studied. Pollen grains of *Clauseneae* were 3-colporate, microstriate or microstriate to reticulate; whereas pollen grains of *Citreae* were almost always 4/5 colporate with exines varying from microperforate to coarsely reticulate (Grant *et al.*, 2000). Pollen morphology of the genus *Skimmia* (*Rutaceae*) was studied and the pollen grains had striate to striate-reticulate sculpture and variable aperture number (3–7) (Fukuda *et*

al., 2008). Pollen morphology of the genus *Hortia* (*Rutaceae*) was studied – the pollen grains were monads, subprolate to prolate, 3-colporate, with very thick exine and a psilate-perforate pattern of ornamentation (Groppo *et al.,* 2010).

Some scientists studied the pollen grain morphology of the genus *Haplophyllum*. Townsend (1986) made a comparative study on the pollen morphology comparing between the genera *Haplophyllum*, *Ruta* and *Thamnosma*, which was carried out on 14 species of the genus *Haplophyllum* including *H. tuberculatum*, has P/E ratio = 1.19 and with straight tectum. In addition El Nagger and Abdel Hafez (2003), examined the pollen morphology for some wild plants in Sinai (Egypt), including *H. tuberculatum*, the study shows that *H. tuberculatum* pollen grains are isopolar, radially symmetrical, tricolporate, tectum striate or striate to reticulate, circular perforation. Perveen and Qaiser (2005), examined the pollen morphology for 7 species of the family *Rutaceae* from Pakistan, and gave three type of pollen based on the type of tectum, and put *H. tuberculatum* under *Haplophyllum dubium* type which has P/E ratio = 101-138µm, tricolporate prolate- spheroidal shape, striate- reticulate tectum. Akyol *et al.* (2012), examined the pollen morphology for *H. megalanthum* the pollen grains were radial symmetrical, isopolar, tricolporate and the shape differ from subprolate to spheroidal. Nevertheless, studies on pollen morphology for *H. blanchei, H. buxbaumii, H. poorei* have not been conducted before and no literature was located in this regards. Accordingly, the present investigation is introducing the pollen morphology of 4 species of the genus *Haplophyllum* found in Jordan for the first time, recording pollen characteristics using light and scanning electron microscopy.

The aim of this study was to provide new information about the species of the genus *Haplophyllum* (*Rutaceae*) in Jordan and to be sure about the identity of the species occurring within the boundaries of the country since contradicting species recording was given by various authors.

Materials and Methods

Pollen samples were obtained from preserved herbarium specimens at the University of Jordan Herbarium, Amman (AMM) or from specimens freshly collected from the field during the course of study for the revision of *Haplophyum* in Jordan.

The pollen grains were prepared for light (LM) and scanning microscopy (SEM) by the standard methods described by Erdtman (1952). For light microscopy, the pollen grains were mounted in glycerin jelly and observations were made using compound light microscope at different magnification (100 X, 400 X, 1000 X). The diameter for 50 pollen grains of each species was measured at (400 X) and the mean value for each was calculated.

For SEM studies, The pollen grains obtained from anthers were scattered on a clean stub using double sided sticky carbon band, and the stubs were then coated by Platinum using Emitech K550X sputter-coater. 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.
Figures 1, 5 (A)
Pollen grains are radially symmetrical, isopolar, tricolporate, looking rhomboidal shape in equatorial view and triangular

shape in polar view. Pollen grains are medium size under light microscope; polar axis (P) is 39.98 µm**,** and the equatorial axis (E) is 32.89 µm. According to the ratio between the length of polar axis and the equatorial axis of pollen (P/E) is 1.21 µm; thus pollen grains are subprolate shape. The colpus is extending to the poles at each end, and they have three convex faces. Sculpture is striate perforated.

H. buxbaumii (Poir.) G. Don. fil.
Figures 2, 5 (B)
The pollen grains are radial symmetrical, isopolar, tricolporate. Pollen grains are rhomboidal shape in equatorial view, and triangular shape in polar view. Pollen grains size is medium in under light microscope; polar axis (P) is 39.7 µm, and the equatorial axis (E) is 35.4 µm. According to the ratio between the polar axis and the equatorial axis of pollen (P/E) is 1.12 µm; thus pollen grains are prolate to spheroidal shape. The colpus extending to the poles. Sculpturing is striate perforated.

H. poorei C.C. Townsend
Figures 3, 5 (C)
Pollen grains are radially symmetrical, isopolar, tricolporate **l**ooking rhomboidal shape in equatorial view, and triangular shape in polar view. Pollen grains are medium in size, under light microscope; polar axis (P) is 38.85 µm, and the equatorial axisr (E) is 36.5 µm. According to the ratio between the polar axis and the equatorial axis of pollen (P/E) is 1.06 µm; thus pollen grains shape is spheroidal. The colpus is extending to the poles at each end. Sculpturing is striate with little perforation, the perforation less than they are in other three species.

H. tuberculatum (Forssk.) Ad. Juss.
Figures 4, 5 (D)

Pollen grains are radially symmetrical, isopolar, tricolporate, looking rhomboidal shape in equatorial view, and triangular shape in polar view. Pollen grains are medium in size; polar axis (P) is 44.92 µm, and the equatorial axis (E) is 37.0 µm. According to the ratio between the polar axis and the equatorial axis of a pollen (P/E) is 1.21 µm; thus pollen grains have subprolate shape. The colpus extending to the pole ends and have three convex faces. Sculpturing is striate perforated to foveolate. The aperture is narrower and deeper than the other three species.

The study of the pollen grains morphology of the four species of *Haplophyllum* in Jordan has proved to give a valuable biosystematic evidence in distinguishing between the species. The pollen grains were radially symmetrical, isopolar, tricolporate, and the same findings were mentioned by El Nagger and Abdel Hafez (2003), Perveen and Qaiser (2005) and Akyol *et al.* (2012). The Shape of *H. blanchei* and *H. tuberculatum* was subprolate while the shape of *H. buxbaumii* was prolate to spheroidal and *H. poorei* was spheroidal (Fig. 1, 2, 3 & 4). The aperatures of *H. tuberculatum* were narrower and deeper than *H. blanchei*, *H. buxibaumii* and *H. poorei*. *H. blanchei* and *H. tuberculatum* have three convex faces while *H. buxbaumii* and *H. poorei* have straight faces. The surface sculpturing pattern was nearly the same in the four species; striate- perforated surface, however; *H. poorei* pollen has less perforation than *H. blanchei*, *H. buxbaumii* and *H. tuberculatum. H. tuberculatum* show a more foveolate to striate surface rather than perforate striate.

Fig.1 Scanning electron micrographs of *H. blanchei* pollen grains A. Equatorial view (8000 x). B. Polar view (7515 x). C. Surface sculpturing (20000 x)

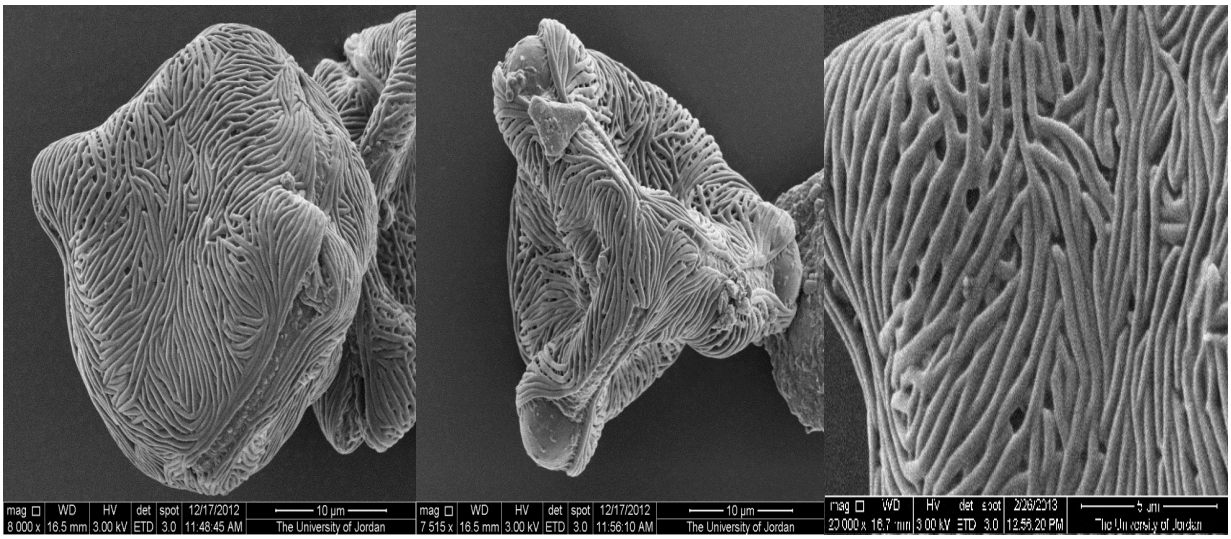


Fig.2 Scanning electron micrographs of *H. buxbaumii* pollen grains A. Polar view (5000 x). B. Equatorial view (5000 x). C. Surface sculpturing (20000 x)

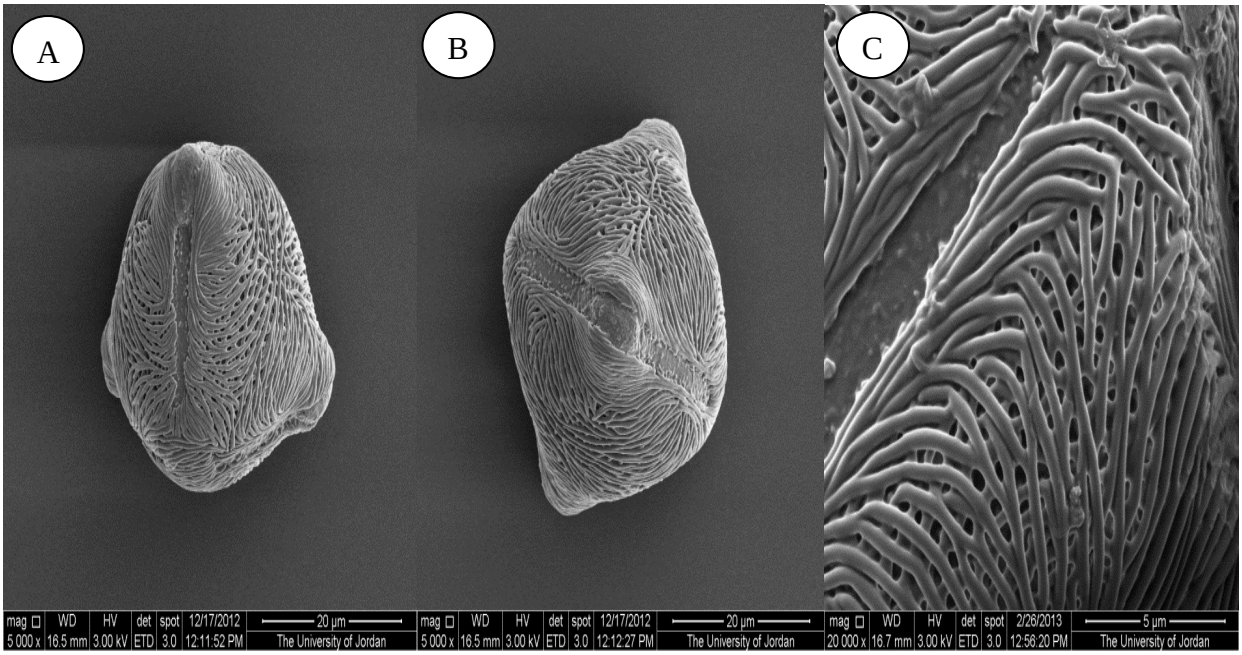


Fig.3 Scanning electron micrographs of *H. poorei* pollen grains A. Equatorial view (5000 x). B. Polar view (5000 x). C. Surface sculpturing (20000 x)

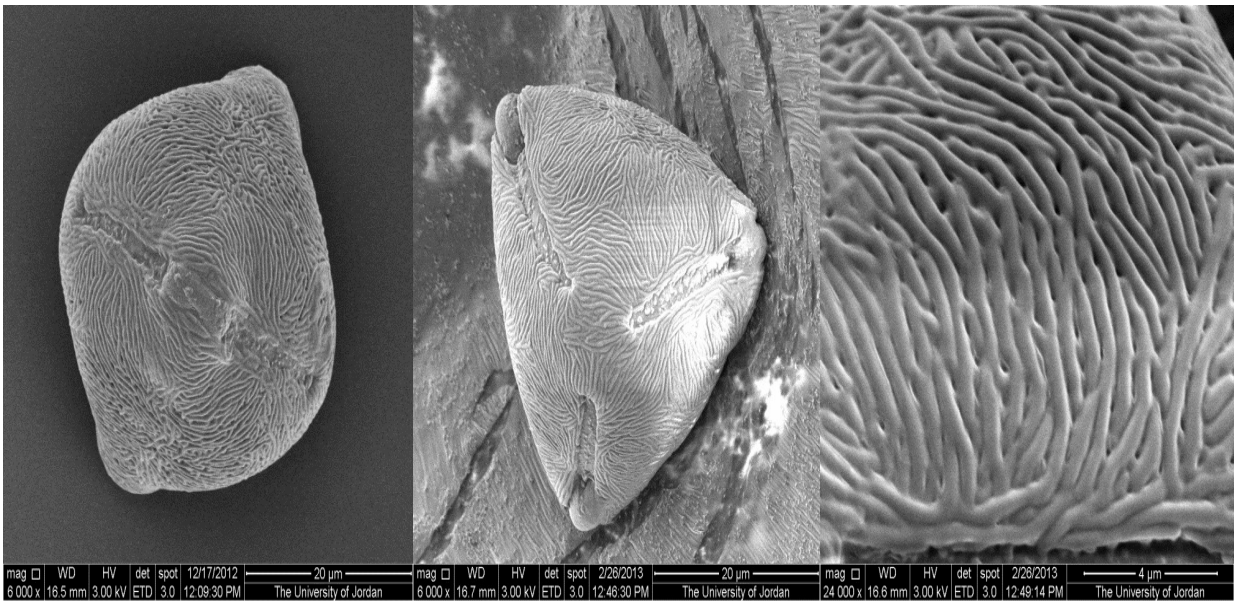


Fig.4 Scanning electron micrographs of *H. tuberculatum* pollen grains A. Equatorial view (6000 x). B. Polar view (5000 x). C. Surface sculpturing (20000 x)

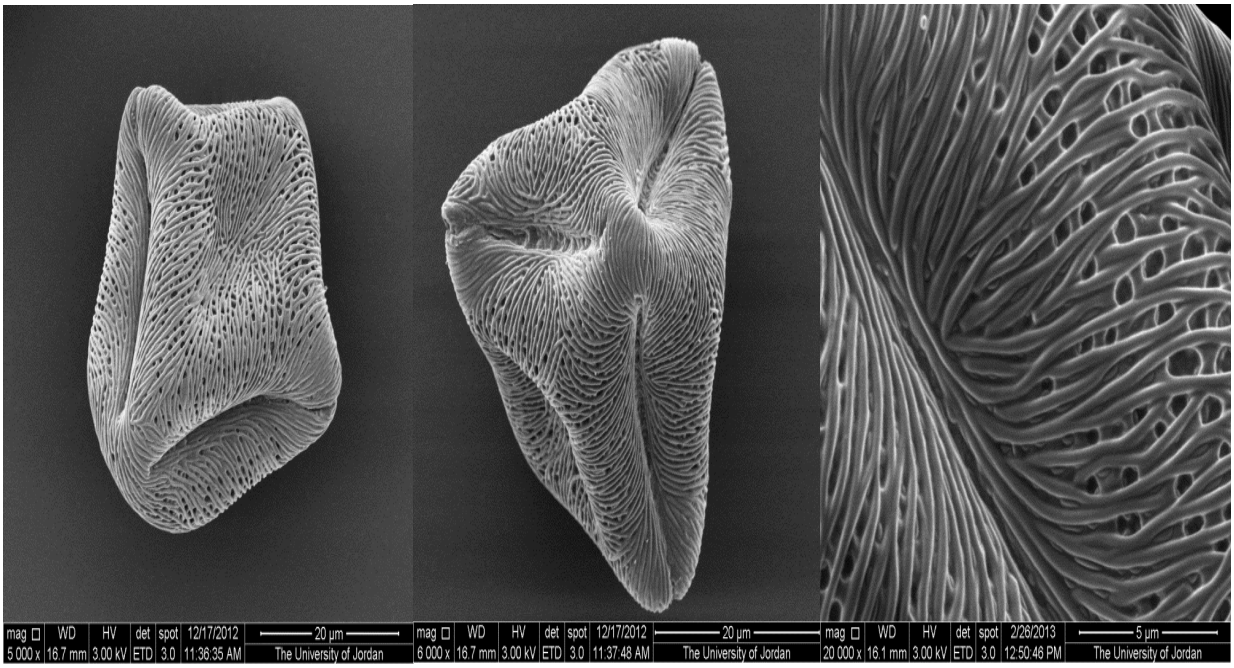
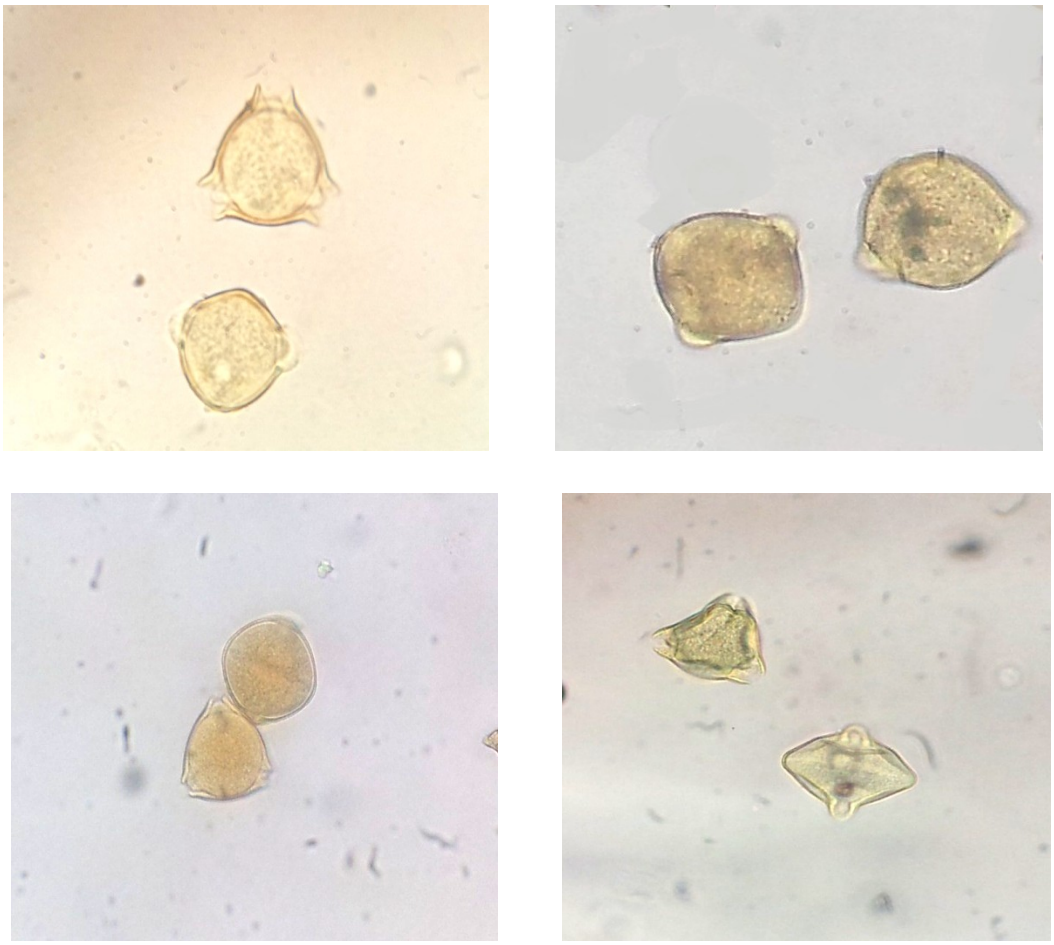


Fig.5 Pollen grains of A. *H. blanchei*, B. *H. buxbaumii*, C. *H. poorei*, D. *H. tuberculatum* in different views under light microscope



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