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THE ROLE OF POLLEN MORPHOLOGY IN THE IDENTIFICATION AND CLASSIFICATION OF *PLANTAGO* (PLANTAGINACEAE)

ABSTRACT:

Pollen grains of 14 species of *Plantago* (Plantaginaceae) collected from Saudi Arabia were examined using LM and SEM Microscopy. The size, shape, exine ornamentation and structure of aperture allowed the recognition of three distinct pollen types: *Plantago albicans*-type, *Plantago coronopus*-type and *Plantago lanceolata*-type. Key to these types and keys to species under each type were prepared. The results were used to test the taxonomic disposition of the species in existing classifications.

KEY WORDS:

classification, identification keys, *Plantago*, Plantaginaceae, pollen morphology

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INTRODUCTION:

Plantago L. (Plantaginaceae) is a cosmopolitan genus with over 483 species, concentrated in temperate and high-elevation tropical regions (Tutel *et al.*, 2005). *Plantago* species are distributed in all phytogeographical regions either as weeds in cultivation or in the more arid environments of deserts and oases where they represent a highly palatable and nutritious item to grazing animals (El-Gazzar *et al.*, 2009). The plants are mostly annual or perennial herbs, or rarely subshrubs (Pilger, 1937; Meudt, 2012).

Plantago is part of tribe Plantagineae (Albach *et al.*, 2005) enlarged Plantaginaceae, the prevalent genus of the three genera on which family Plantaginaceae is based (Tutel *et al.*, 2005; Boulos, 2005). The subgeneric classification of *Plantago* was carried out by Pilger (1937), Rahn (1978 & 1996), with the updates of Rønsted *et al.* (2002) and Hoggard *et al.* (2003). According to Pilger (1937) the genus is divided into two subgenera: *Euplantago* Harms and *Psyllium* Harms, while Rahn (1978) subdivided the genus into three subgenera including *Plantago*, *Coronopus* Rahn and *Psyllium*, who ranked the Mediterranean species of section *Coronopus* of Pilger (l.c.) as a third subgenus with two sections: *Maritima* and *Coronopus*. The most recent phylogenetic study of *Plantago* by Rahn (1996) relied upon 91 mainly morphological and embryological characters. Hair and seed characters were the most informative for his estimation of the infrageneric relationships. In all, 213 species, grouped in six subgenera and a number of sections and series, (Rønsted *et al.*, 2002). Plantaginaceae are anemophilous, with forate pollen grains with 4 - 15 apertures (Rahn, 1996). Pollen studies clearly indicate that the genus *Plantago* is a homogenous taxon in accordance with the morphology of the genus (Faegri and Iversen, 1992). Pollen characters of *Plantago* were the subject of many previous studies (Basset and Crompton, 1968; Clark and Jones, 1980; Ueber *et al.*, 1988; Perveen and Qaiser, 2004; Klimko *et al.*, 2004; Houghoughi *et al.*, 2016). The genus *Plantago* is represented in flora of Saudi Arabia by 14

species (Migahid, 1996; Collenette, 1999; Chaudhary, 2001).

The present study is an attempt to correlate the pollen characters with the taxonomy of the genus based on pollen morphology of 14 species of the genus *Plantago* collected from Saudi Arabia using light and scanning electron microscopy.

MATERIAL AND METHODS:

Pollen samples of 14 *Plantago* spp. were collected from specimens kept in the herbarium of Qassim University, Saudi Arabia and from fresh materials collected by the authors; collection data of the specimens is given in table 1. Identification of the species was carried out using the floras by Migahid (1996) and Collenette (1999); nomenclature

with full author citation and partial synonymy of the species are presented in table 2. For Light Microscopy (LM) studies, pollen grains were rehydrated in a solution of Aersol-OT 20% for 10 min and then conventionally acetolyzed according to Erdman (1960). Pollen samples for scanning electron microscopy (SEM) were mounted on stubs and coated with gold. Observation and examination were made with JEOL JSM 5400LV Scanning Electron Microscopy operated at accelerated voltage of 15 KV, at electron microscopy Unit, Assiut University, Egypt. measurements are based on at least 20 fully developed grains per specimen. Pollen size and descriptive terminology follows Erdman (1960), Kremp (1965), and Hess *et al.* (2009).

Table 1. Collection data of specimens representing the 14 *Plantago* species included in the present study.

No.	Species	Collection data of specimens
1	<i>P. afra</i> L.	E. Tolba, 2014, Rhiadh, sand dunes, KSA, Qassim University Herbarium
2	<i>P. albicans</i> L.	L.F. Shalabi, 2015, KSA, Abha-Jazan Road, KSA. Tolba <i>et al.</i> , 2014, KSA, Qassim, Uun Aljawa, 20Km NW of Buraydah.
3	<i>P. amplexicaulis</i> Cav.	M.H.Gazer, 1/2008, Rhiadh, sand dunes, mountains KSA. M.H.Gazer, 2/2010, KSA, Al-Qassim, Unaizah- Buraydah road
4	<i>P. boissieri</i> Hausskn. & Bornm. ex Bornm.	M.H.Gazer, 1/2008, Rhiadh, sand dunes, mountains KSA. M.H.Gazer 3/2010, KSA, Qassim, 15 km E of Buraydah, sandy soil
5	<i>P. ciliata</i> Desf.	M.H.Gazer 1/2008, KSA, Rhiadh- Al-Qassim Road, sand dunes L.F. Shalabi, 2015, Abha-Jazan Road, near Al-Darb, plains, KSA.
6	<i>P. coronopus</i> L.	M.H.Gazer, 1/2008, KSA, Rhiadh- Al-Qassim Road, sand dunes
7	<i>P. crassifolia</i> Forssk.	Shaker. A. 2013, Mekkah region, KSA, Qassim University Herbarium
8	<i>P. crypsoides</i> Boiss.	Al-Ghazali, 2012, Haal- Al-Qassim Road, KSA., Qassim University Herbarium
9	<i>P. cylindrica</i> Forssk.	M.H.Gazer, 1/2008, Rhiadh- Al-Qassim Road, sand dunes, KSA. L.F. Shalabi, 2014, hell slopes at al-Darb providence, north of Jazan region, SW of KSA.
10	<i>P. lagopus</i> L.	Gazer <i>et al.</i> , 2/2010, weeds in Al-Qassim Palm Orchard.
11	<i>P. lanceolata</i> L.	S. Zalat <i>et al.</i> , 2/2015, KSA, Wadi El Rumah NW of Unaiza. Gazer <i>et al.</i> , 3/2014, KSA, Qassim, Uun Aljawa, 20 Km NW of Buraydah.
12	<i>P. major</i> L.	M.H.Gazer, 2/2011, KSA, Al-Qassim, Al Bukria ,20 km W of Buraydah. L.F. Shalabi, 2014, Jazan, at the farms boarders, KSA.
13	<i>P. ovata</i> Forssk.	Gazer <i>et al.</i> , 3/2014, KSA, Qassim, Uun Aljawa, 20 Km NW of Buraydah Y.S. Masrahi, Wadi Lajab, Jazan, KSA.
14	<i>P. psammophila</i> Agnew & Chal.,	M.H.Gazer 3/2014, KSA, Qassim, Buraydah M.H.Gazer 1/2008, Rhiadh, sand dunes, KSA.

Table 2. Synonymy and taxonomic disposition of 14 *Plantago* species according to Pilger (1937), Rahn (1996), and Rønsted *et al.* (2002).

Species	Subgenus according to Pilger (1937)	Subgenus-section according to Rahn (1996)	Subgenus-section according to Rønsted <i>et al.</i> (2002)
<i>Plantago afra</i> L., Sp. Pl., ed. 2, 168 (1762) = <i>Plantago afra</i> var. <i>parviflora</i> (Desf.) Lewalle Bull. Inst. Sci. Univ. Mohammed V 2: 71 (1977). = <i>Plantago cynops</i> L., Sp. Pl. 116 (1753). = <i>P. parviflora</i> Desf., Fl. Atlant. 1: 141 (1798).	<i>Psyllium</i> (Juss.) Harms & Reiche	<i>Psyllium</i> (Juss.) Harms & Reiche	<i>Psyllium</i> (Juss.) Harms & Reiche
<i>Plantago albicans</i> L. Sp. Pl. 1: 114 (1753)	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.
<i>P. amplexicaulis</i> Cav., Icon. 2: 22 (1793) <i>P. Plantago amplexicaulis</i> subsp. <i>Amplexicaulis</i> Nasir, E. & S. I. Ali (eds). (1980-2005). <i>Fl. Pakistan</i> Univ. of Karachi, Karachi.	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Bauphula</i> Decne.	<i>Albicans</i> Rahn - <i>Bauphula</i> Decne.
<i>Plantago boissieri</i> Hausskn. & Bornm. ex Bornm., Mitth. Thur. Bot. Ver. N. Folge vi. (1894) 60.	*	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.	*
<i>P. ciliata</i> Desf., Fl. Atlant. 1: 137 (1798)	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.
<i>Plantago coronopus</i> L., Sp. Pl. ed. 1: 115 (1753) = <i>Arnoglossum subulatum</i> Gray, Nat. Arr. Brit. Pl. 2: 294, (1821). = <i>Asterogeum laciniatum</i> Gray Nat. Arr. Brit. Pl. 2: 294, (1821) = <i>Coronopus vulgaris</i> Fourr Ann. Soc. Linn. Lyon n.s., 17: 140 (1869).	<i>Plantago</i>	<i>Coronopus</i> (Lam. et DC.) Rahn - <i>Coronopus</i> Lam. et DC.	<i>Coronopus</i> (Lam. et DC.) Rahn - <i>Coronopus</i> Lam. et DC.
<i>P. crassifolia</i> Forssk., Fl. Aegypt. Arab. 31 (1775). = <i>P. maritima</i> L. subsp. <i>crassifolia</i> (Forssk.) Holmboe, in Bergens Mus. Skr., ser. 2, 1(2): 170 (1914).	<i>Plantago</i>	<i>Coronopus</i> (Lam. et DC.) Rahn - <i>Coronopus</i> Lam. et DC.	<i>Coronopus</i> (Lam. et DC.) Rahn - <i>Coronopus</i> Lam. et DC.
<i>P. crypsoides</i> Boiss., Fl. Orient. 4: 888 (1879).	*	<i>Coronopus</i> (Lam. et DC.) Rahn - <i>Coronopus</i> Lam. et DC.	*
<i>P. cylindrica</i> Forssk., Fl. Aegypt.-Arab. 31 (1775).	<i>Plantago</i>	<i>Albicans</i> Rahn	*
<i>P. lagopus</i> L., Sp. Pl., ed. 1, 114 (1753). <i>inica</i> L., Sp. Pl., ed. 2, 1667 (1763).	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Lanceifolia</i> Barne' oud	<i>Albicans</i> Rahn - <i>Lanceifolia</i> Barne' oud
<i>P. lanceolata</i> L., Sp. Pl., ed. 1, 113 (1753).	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Montana</i> Barne' oud	<i>Albicans</i> Rahn - <i>Lanceifolia</i> Barne' oud
<i>P. major</i> L., Sp. Pl., ed. 1, 112 (1753). = <i>P. intermedia</i> Gilib., Hist. Pl. Eur., ed. 2, 1: 125 (1806). = <i>P. major</i> L. subsp. <i>intermedia</i> (Gilib.) Lange, Haandb. Danske Fl., ed. 2: 714 (1859).	<i>Plantago</i>	<i>Plantago</i> - <i>Plantago</i>	<i>Plantago</i> - <i>Plantago</i>
<i>P. ovata</i> Forssk., Fl. Aegypt. -Arab. 31 (1775). = <i>Plantago ispaghula</i> Roxb. ex Fleming Asiat. Res. 11: 174 (1810).	<i>Plantago</i>	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.
<i>Plantago psammophila</i> Agnew & Chal., -Kabi – Notes Roy. Bot. Gard. Edinburgh 25: 56. (1963)	*	<i>Albicans</i> Rahn - <i>Albicans</i> Barn.	*

* Not included

RESULTS:

The results obtained are summarized in table 3 and plates A, B, and C. Pollen grains of the studied species are mostly small to medium sized, eutectate, subprolate to prolate

spheroidal and pantaporate with more or less circular aperture. Depending on the results obtained, the following three pollen types were distinguished among the 14 species (Table 3, plates A, B, & C).

Table 3. Data matrix based on 10 quantitative and qualitative characters for 14 *Plantago* species. P = polar diameter; E = equatorial diameter; S = sunken; R = raised; + = present; - = absent.

Species	P (µm)	E (µm)	P/E ratio	Shape	Aperture diameter (µm)	Annulus	No. of Apertures	Oper-culum	Aperture level	Tectum ornamentation
<i>P. afra</i>	21.25-25	18.75-23.75	1.05-1.13	Prolate spheroidal	1.5-2.27	-	4-6	+	S	Granulate
<i>P. albicans</i>	18.58-26.76	16.83-24.76	1.08-1.10	Prolate spheroidal	1.3-2	—	7-16	+	S	Verucate
<i>P. amplexicaulis</i>	17.22-28.49	16-25.61	1.08-1.11	Prolate spheroidal	2.3-2.8	+	6-15	+	R	Verucate
<i>P. boissieri</i>	16.5-24.87	15.5-21.95	1.06-1.13	Prolate spheroidal	1.3-2.3	+	4-9	+	R	Areolate
<i>P. ciliate</i>	16.09-28.26	16.09-27.74	1.00-1.03	Prolate spheroidal	1.5-2.6	-	8-12	+	S	Granulate
<i>P. crassifolia</i>	20.68-29.46	18.00-24.98	1.14-1.17	Subprolate	1.5-3	-	7-18	+	S	Verucate
<i>P. coronopus</i>	25.11-27.18	21.78-22.57	1.15-1.20	Subprolate	1.25-2.36	+	5-9	+	R	Areolate
<i>P. crypsoides</i>	19.77-24.23	17.89-21.17	1.10-1.14	Prolate spheroidal	1.15-2.37	+	5-8	—	R	Verucate
<i>P. cylindrica</i>	19.09-25.51	19-22.27	1.00-1.14	Prolate spheroidal	3.1-3.9	+	5-9	+	R	Verucate
<i>P. lagopus</i>	25.88-8.92	23.88-4.73	1.15-1.17	Subprolate	1.5-3.2	-	6-14	+	S	Granulate
<i>P. lanceolata</i>	18.48-28.97	15.28-21.81	1.20-1.32	Subprolate	2.1-2.8	+	7-13	+	R	Granulate,
<i>P. major</i>	16.54-24.97	16.12-20.98	1.03-1.19	Prolate spheroidal to subprolate	2.3-2.9	—	4-8	+	S	Areolate
<i>P. ovate</i>	17.38-25.42	17-22.19	1.02-1.13	Prolate spheroidal	1.5-2.1	+	5-10	+	R	Verucate
<i>P. psammophila</i>	25.78-28.98	22.24-27.81	1.04-1.16	Prolate spheroidal to subprolate	3.2-3.5	—	4-8	+	R	Verucate

Key to the Pollen Type

1a. Tectum verucate(1)
Plantago albicans -type

1b. Tectum not as above.....2

2a. Tectum areolate. (2) *Plantago coronopus*–type

2b. Tectum granulate (3) *Plantago lanceolata*–type

(1) *Plantago albicans*-type (Plate A)

Tectum ornamentation: Eutectate verucate with granulate verrucae- **Shape:** subprolate to prolate spheroidal- **Aperture:** Annulate or non-annulate, operculate or non-operculate, sunken or raised, number of aperture 4-18- **Measurements:** Polar diameter: $\pm$ (17.22 - 29.46) μm , Equatorial diameter: $\pm$ (16 - 27.81) μm , P/E ratio: (1.00 - 1.17), Aperture diameter: $\pm$ (1.3 - 3.9) μm .

Species included: *P. albicans*, *P. amplexicaulis*, *P. crassifolia*, *P. crypsoides*, *P. cylindrica*, *P. ovata* and *P. psammophila*

Key to the species in *Plantago albicans* pollen type

1a. Annulus present2

1b. Annulus absent4

2a. Operculum absent..... *P. crypsoides*

2b. Operculum present3

3a. Aperture diameter less than 2.1 μm ...*P. ovata*

3b. Aperture diameter more than 2.1 μm 4

4a. Aperture diameter 2.3-2.8 μm ...*P. amplexicaulis*

4b. Aperture diameter more than 3 μm*P. cylindrica*

5a. Aperture raised.....*P. psammophila*

5b. Aperture sunken.....6

6a. Pollen shape prolate spheroidal.....*P. albicans*

6b. Pollen shape subprolate...*P. crassifolia*

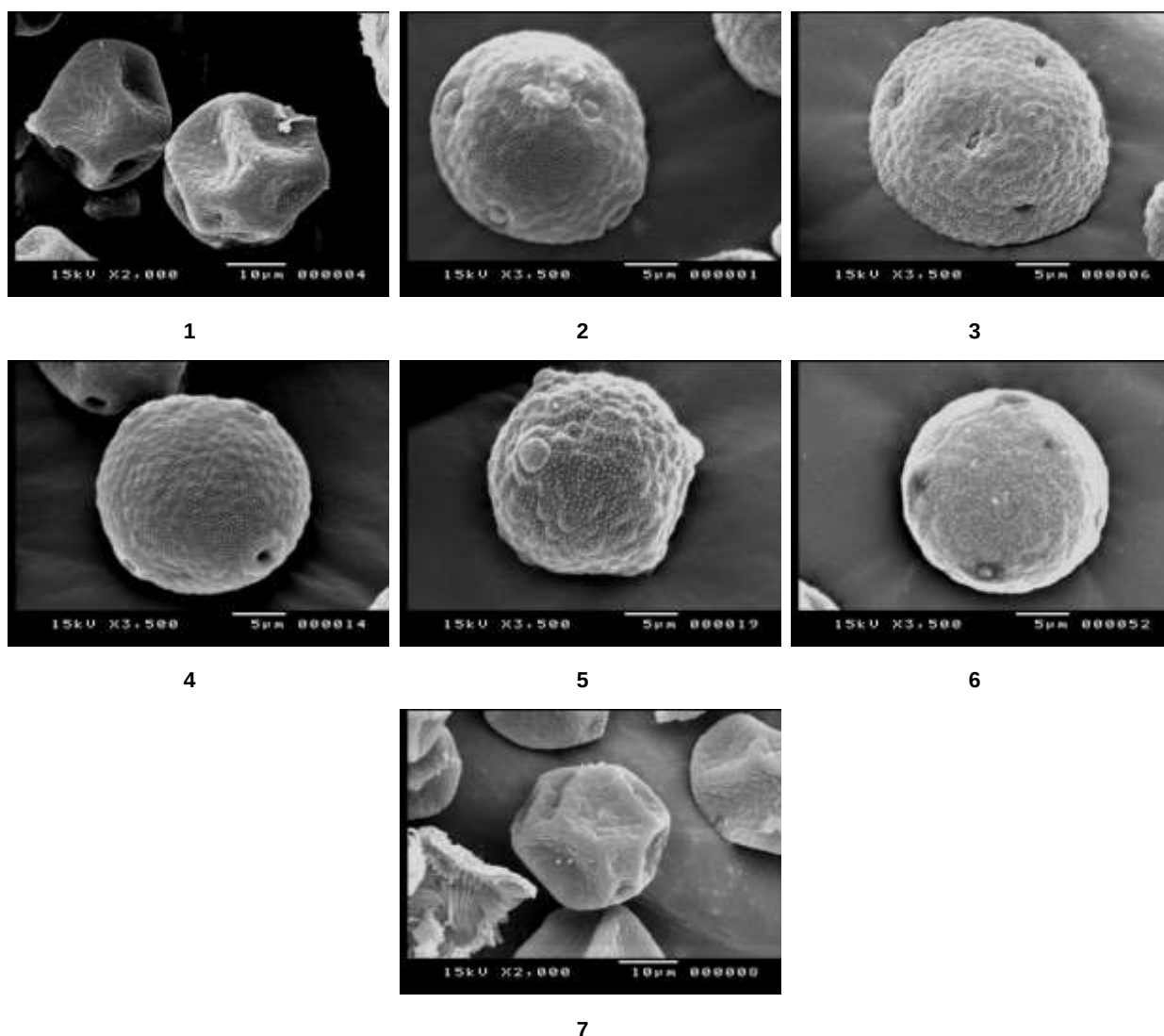


Plate (A) Scanning electron micrographs of *Plantago albicans*-type; 1. *P. albicans*, 2. *P. amplexicaulis*, 3. *P. crassifolia*, 4. *P. crypsoides*, 5. *P. cylindrica*, 6. *P. ovata*, 7. *P. psammophila*

(2) *Plantago coronopus*-type (Plate B)

Tectum ornamentation: Eutectate, areolate with granulate areolae- **Shape:** subprolate to prolate spheroidal- **Aperture:** Annulate or non-annulate, operculate, sunken or raised, number of aperture 4 – 9 - **Measurements:** Polar diameter: $\pm$ (16.5 - 27.18) μm , Equatorial diameter: $\pm$ (15.5 - 22.57) μm , P/E ratio: (1.03 - 1.20), Aperture diameter: $\pm$ (1.25 - 2.36) μm .

Species included: *P. boissieri*, *P. coronopus* and *P. major*

Key to the species in *Plantago coronopus* pollen type

- 1a. Aperture sunken; annulus absent . *P. major*
- 1b. Aperture raised; annulus present2
- 2a. Pollen shape prolate spheroidal....*P. boissieri*
- 2b. Pollen shape subprolate *P. coronopus*

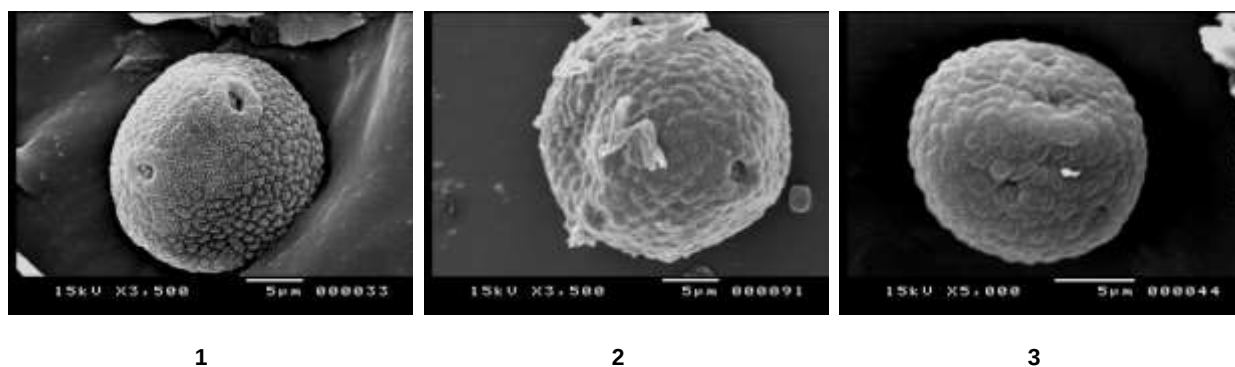


Plate (B) Scanning electron micrographs of *Plantago coronopus*-type; 1. *P. boissieri*, 2. *P. coronopus*, 3. *P. major*

(3) *Plantago lanceolata*-type (Plate C)**Tectum ornamentation:** Eutectate, granulate**- Shape:** subprolate to prolate spheroidal**Aperture:** Annulate or non-annulate, operculate, sunken or raised, number of apertures 4 -14 - **Measurements:** Polar diameter: $\pm$ (16.09 - 28.97) μm , Equatorial diameter: $\pm$ (15.28 - 27.74) μm , P/E ratio: (1.00 - 1.32), Aperture diameter: $\pm$ (1.5 - 3.2) μm .**Species included:** *P. afra*, *P. ciliata*, *P. lagopus*, and *P. lanceolata***Key to the species in *Plantago lanceolata* pollen type**

- 1a. Annulus present..... *P. lanceolata*
 1b. Annulus absent2
 2a. No. of apertures 4-6 *P. afra*
 2b. No. of apertures 6-14.....3
 3a. Pollen shape prolate spheroidal .. *P. ciliata*
 3b. Pollen shape subprolate..... *P. lagopus*

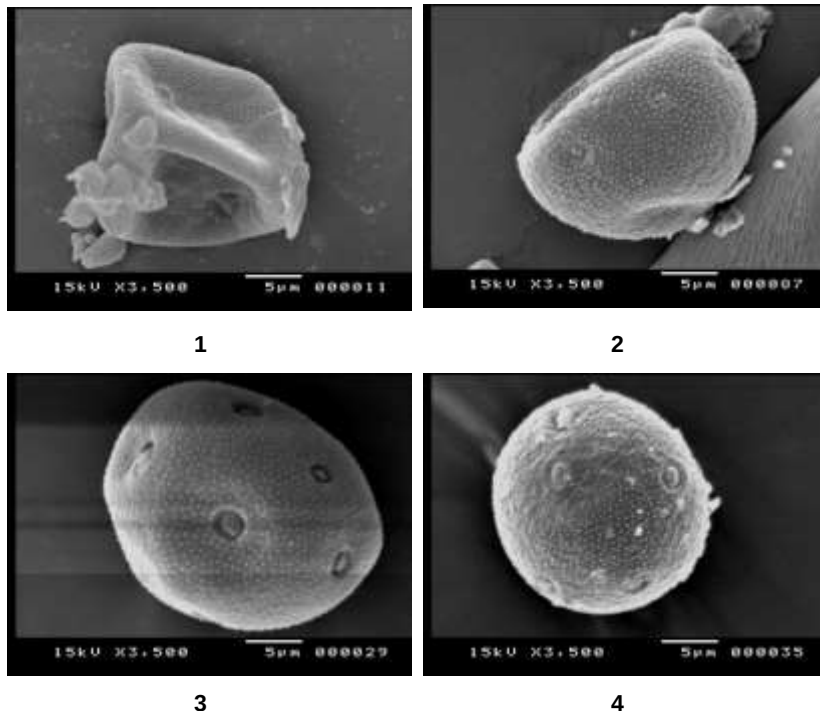


Plate (C) Scanning electron micrographs of *Plantago lanceolata*-type;
P. afra, 2. *P. ciliata*, 3. *P. lagopus*, 4. *P. lanceolata*

DISCUSSION:

Pollen grains of the 14 *Plantago* species under investigation showing subprolate to prolate spheroidal shapes, annulate to non-annulate, operculate or non-operculate and pantaporate. Based on tectum ornamentation, three distinct pollen types are recognized: *Plantago albicans*-type, *Plantago coronopus*-type and *Plantago lanceolata*-type. These pollen types are readily distinguished by their verucate, areolate and granulate tectum, respectively.

The *Plantago albicans*-type comprises 7 species: *Plantago albicans*, *P. amplexicaulis*, *P. cylindrica*, *P. ovata*, *P. psammophila*, *P. crassifolia*, and *P. crypsoides*. The grouping of the five species; *Plantago albicans*, *P. amplexicaulis*, *P. cylindrica*, *P. ovata*, and *P. psammophila* under the same pollen type seems to support their placement in subgenus *Albicans* by Rahn (1996) based on morphological, embryological and chemical data (Table 2). *P. crassifolia* and *P. crypsoides* grouped under the subgenus *Coronopus*, section *Coronopus* (Table 2), which conflicted with our results, so the study

suggests the reclassification of these two species to be included in subgenus *Albicans* according to the pollen morphological characters.

On the other hand, *Plantago coronopus*-type comprises 3 species: *P. major*, *P. boissieri* and *P. coronopus*, this result disagrees with Rahn (l.c) system that placed them in different subgenera (Table 2). The remaining four species: *P. afra*, *P. ciliata*, *P. lagopus* and *P. lanceolata* are grouped in *Plantago lanceolata*-type, which confirmed the close relationship between *P. lagopus* and *P. lanceolata* using macromorphological variations and morphometric characters (Shalabi and Abou-El-Enain, 2013). Results by Rønsted *et al.* (2002) based on molecular data indicated that subgenus *Albicans* is paraphyletic to subgenus *Psyllium sensu stricto* and should be included in a broader subgenus *Psyllium*; this suggestion is supported here by grouping *P. lanceolata*, *P. lagopus*, and *P. ciliata* (subgenus *Albicans*) together with *P. afra* (subgenus *Psyllium*) in subgenus *Psyllium sensu lato*. (Table 2).

The result obtained by Shalabi and Abou-El-Enain (2013) confirmed our results by clustering *P. amplexicaulis* and *P. ovata* (subgenus *Albicans*) together with *P. afra* (subgenus *Psyllium*). On the other hand, the clustering of *P. albicans*, *P. cylindrica*, *P. crassifolia*, and *P. crypsoides* because of their morphological and morphometric characters (Shalabi and Abou-El-Enain, 2013) supports grouping them in the *Plantago albicans*-type.

Comparison between our present results and those reported in previous studies on *P. coronopus* pollen confirmed the data of pollen diameter given by Klimko (2004), but it was smaller than that reported by Erdman (1961), Clarke and Jones (1977) and Hoggoughi *et al.* (2016). While the number of apertures matches the results of Clarke and Jones (1977) and Klimko (2004). In contrast, Erdman (1961) and Ubera *et al.* (1988) reported fewer numbers of apertures than our results. The pore diameter in our study was at the same range with that reported by Klimko (2004), while it was smaller than that observed by Erdman (1961) and Clarke and Jones (1977).

The measurements of *P. lanceolata* pollen size and aperture diameter in the present study appear at the same range with that recorded by Perveen and Qaiser (2004) and Klimko (2004), while the number of apertures was less than that mentioned by Clarke and Jones (1977) and Klimko (2004); but apertures recorded in a greater number than Erdman (1961) and Ubera *et al.* (1988). Otherwise, P/L ratio was in fewer values than what measured by Klimko (2004) and Hoggoughi *et al.* (2016).

Concerning *P. major*, pollen grains have smaller size than that recorded by Clarke and Jones (1977), Erdman (1961), Klimko (2004), and Perveen and Qaiser (2004), while it was at the same range with those of Ubera *et al.* (1988) and Ahmed *et al.* (2010). Apertures appear slightly narrower than those recorded by Clarke and Jones (1977) and Klimko (2004), but reported nearly at the same range by Perveen and Qaiser (2004) and Ubera *et al.* (1988). The number of apertures recorded in this study matches that recorded by Erdman (1961) and Perveen and Qaiser (2004), but less than that mentioned by Clarke and Jones (1977) and Klimko (2004). Faegri and Iversen (1992) reported that the pores are ill defined and without operculum, whereas Clarke and Jones (1977) described the aperture as little sunken, margin ill defined, rather irregular, annulus absent and operculum ill-defined and these results are confirmed by the results of this study. Pollen size of *P. ovata* matches with the result by Ahmed *et al.* (2010), but appears smaller than that recorded by Perveen and Qaiser (2004) and Ubera *et al.* (1988).

Intra-specific variation is not uncommon in the characters of plants, and palynological characters are no exception. This might account for the discrepancies between some of the results obtained in the present study and their counterparts in previous investigations. Furthermore, such discrepancies are too small to affect the use of the recorded characters in constructing keys to the species, as well as in testing the validity of existing systems of classification of the genus.

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مورفولوجيا حبوب اللقاح ودورها في تعريف وتصنيف جنس لسان الحمل (الفصيلة الحملية)

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تقسيم الأنواع محل الدراسة الى ثلاث مجموعات لأنواع حبوب اللقاح. تم وضع مفتاح تعريفى للمجموعات الثلاثة وكذلك مفتاح تعريفى للأنواع تحت كل مجموعة. وقد راجعت الدراسة الوضع التصنيفى للأنواع محل الدراسة تحت جنس لسان الحمل.

تم دراسة صفات حبوب اللقاح لأربعة عشر نوعا تنتمي لجنس لسان الحمل في المملكة العربية السعودية باستخدام الميكروسكوب الضوئي والميكروسكوب الإلكتروني الماسح. أظهرت النتائج المبينة على صفات الطرز المظهري والزركشة للقشرة الخارجية لحبة اللقاح