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A STUDY OF POLLEN MORPHOLOGY FOR SOME PLANTS SPEICES IN Al-HADA AREA IN TAIF PROVINCE

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Abstract

Al-Hada is a small area in Taif province in Makkah region in Saudi Arabia. In this study, we investigated 14 plant species belonging to 13 genera and studied the pollen grains morpgology, the morphological characters are described for each pollen as seen under the scanning electron microscope. The resultant observation indicates that most frequent character is circular polar and equatorial view. The minimum polar axis is 9.08µm and equatorial axis 6.1µm. The maximum polar axis in this group is 37.17µm and equatorial axis 38µm. There were three types of aperture appeared tricolpate, tricolporate and pantoporate. The aim of the current research is to establish a pollen flora for the province for identification purposes.

Key words: Al Hada, Pollen grain, Tricolpate, Tricolporate, Pollen morphology, Palynology.

Introduction

Palynology studies are based on apertures and their forms, numbers, distribution, and position (Nair, 1971). The angiosperms of different pollen types are known by the aperture type and can be classified based on the number of apertures (Sivarajan, 1991). The scanning electron microscope (SEM) and transmission electron microscope (TEM) studies provide valuable data of pollen characters (Blackmore, 1984). The palynology and aeropalynology depend on the pollen morphological studies which also play an essential role in taxonomic studies (Ur'Rahman *et al*., 2019).

After using SEM, there was an increase in palynology research, The pollen characters used in taxonomic and evolutionary studies, all of these studies are mainly based on the pollen characters such as form, number, distribution and position of the apertures which provide a major help to identification of taxa (Sivarajan, 1991).

Pollen morphology gained great importance in plant taxonomy because the pollen shape parameters has effective use in classification purposes (Shaheen *et al*., 2021). Morphological sculpturing and features of pollen exine highly recognizable features by which species or genus may be recognized. in 2022 according to Quamar and others the study of a variety of plants could aid in plant taxonomy and systematics (Quamar *et al*., 2022). Moreover, It will also contribute to defining similarity and the degree of kinship between phylogenetically related plant groups (Quamar *et al*., 2022; Umber *et al*., 2022).

Pollen grains play a crucial part when it comes to identifying plant species. Research study on pollen morphology of anemophilous and entomophilous plants indicated that pollen morphological studies might be useful to specify the difference between anemophilous and entomophilous as plants type of pollination. Anemophilous present more spheroidal shape ,thinner exine and smooth surface ornamentation (Lu *et al*., 2021) The most common way to use pollen characteristics to classify plant species is to study it under light microscope (LM) and SEM despite other techniques such as fluorescence microscopy, flow cytometry, photoacoustic microscopy and more (Holt & Bennett, 2014).

The present study aims to maintain collective data about the morphological characters of the species under study and establish a pollen flora of the area to aid the taxonomic studies and other related fields.

Materials and Methods

Study area: The study area, Al-Hada is located in the Makkah region, Taif province of Saudia Arabia. Al-Hada lies between 21° 22' 66″-21° 20' 77″ N and 40°17'74″-40°15'86″ E 20 km northwest of Taif city with an elevation of 2000 m and an area of 18.36 km². The climate is temperate in summer and cold in winter; the rain season is in winter and spring from January to June (Al-Hajar *et al*., 2020).

Field work: The field work began with mapping and defining the area under study. Then we placed fish nets in each area with quadrates of 200 m². We collected two groups for every plant: one for the LM which we stored in paper bags and the second for SEM and archive purposes (Steers *et al*., 2008).

SEM examination: Using field emission (FE) SEM FEG 250, we extract the pollen directly from the dry sample and prepare to be ready for FE-SEM as follows. 1) Before taking the pollen from the stamen, ensure it is completely dry. 2) Separate the stamen from all flower parts by using anatomy needle and storing in small container with forceps. 3) Transport the pollen from the container to the metal stub through the use of a sticky carbon disk which increases the conductivity and tap on the wall of the container to separate the pollens. 4) Applied SEM conditions are a 10.1 mm working distance, with an in-lens detector with an excitation voltage of 20 kV. 5) Transport the stubs to SEM chamber, seal the chamber, and start the process of vacuuming the air from the chamber (Özler *et al*., 2011; Waikhom *et al*., 2014).

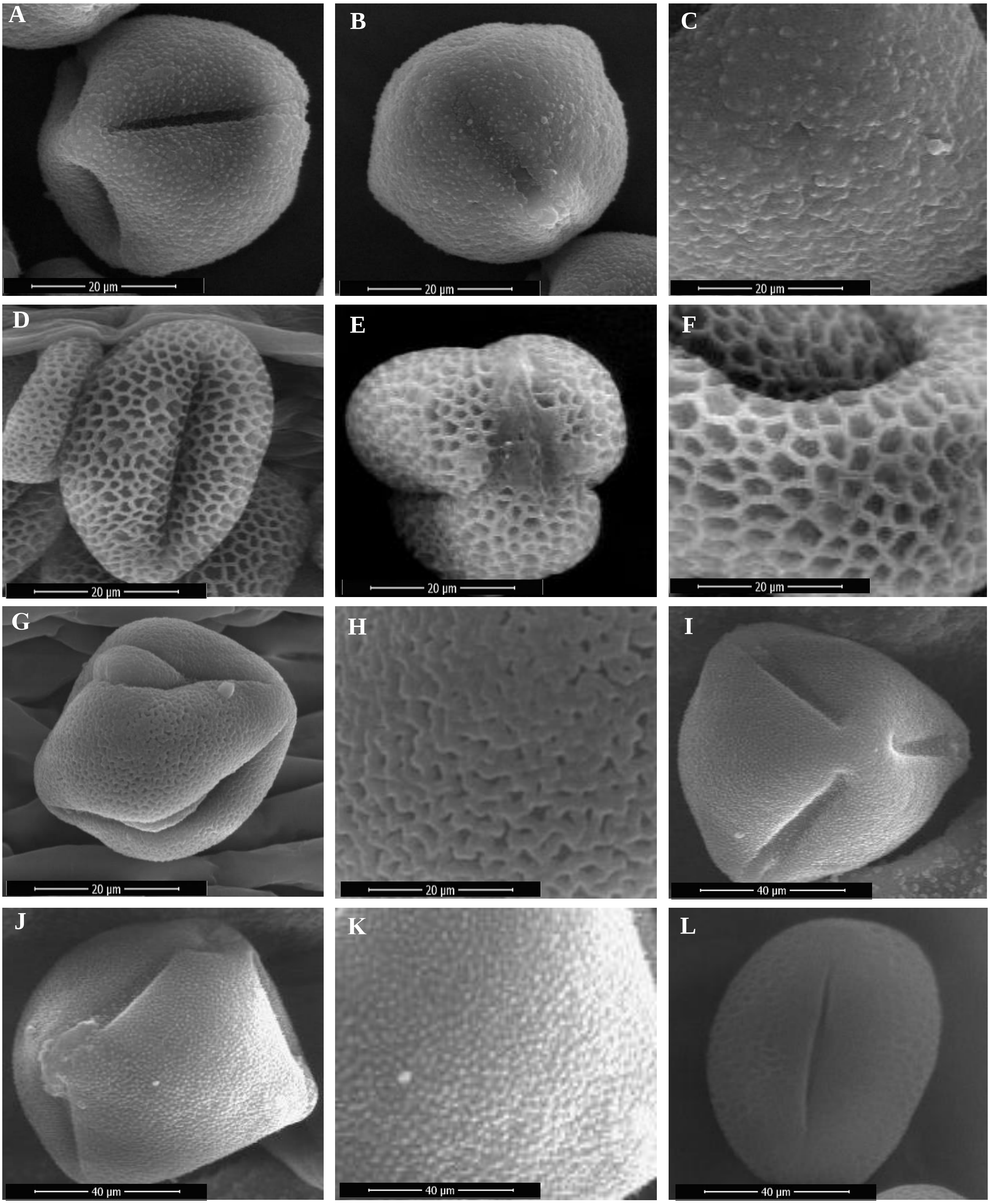

Fig. 1. 5000× magnification for pollen grain under SEM: *Solanum coagulans* (A) polar view, (B) equatorial view, (C) *Fogonia paulagana* (D) equatorial view, (E) polar view, (F) exine. *Argemone ochroleuca* (G) pollen, (H) exine. 2500× magnifications for pollen grain under SEM: *Solanum villosum* (I) polar view, (J) exine, (K) equatorial view. *Gypsophila capillaris* (L) equatorial view.

Pollen grain morphology

***Solanum coagulans*:** Monad is the dispersal form. The mean of polar axis is 13.61 µm, and the mean of equatorial axis is 12.7 µm. The shape class prolate spheraical. The P/E mean is 1.07 µm. There are three colpori, aperture (tricolporate). The surface pattern is granulate scabrate. The exine is intectate (Fig. 1).

Fogonia paulagana: Monad is the dispersal form. The mean of polar axis is 10.37 µm, and the mean of equatorial axis is 7.89 µm. The shape class prolate spheraical. The P/E mean is 1.3 µm. There are three colpori, aperture (tricolporate). The surface pattern is verrucate scabrate . The exine is tectate (Fig. 1).

***Argemone ochroleuca*:** Monad is the dispersal form. The mean of polar axis is 17.95 µm, and the mean of equatorial axis is 14.61 µm. The shape class sub prolate. The P/E mean is 1.04 µm. There are three colpori, aperture (tricolporate). The surface pattern is reticulate. The exine is tectate (Fig. 1).

Solanum villosum: Monad is the dispersal form. The mean of polar axis is 13.34 µm, and the mean of equatorial axis is 12.76 µm. The shape class sub prolate. The P/E mean is 1.04 µm. There are three colpori, aperture (tricolporate). The surface pattern is rugulate. The exine is tectate (Fig. 1).

Gypsophila capillaris: Monad is the dispersal form. The mean of polar axis is 9.32 µm, and the mean of equatorial axis is 5.58 µm. The shape class prolate. The P/E mean is 1.9 µm. There are three colpi, aperture (tricolpate). The surface pattern is microreticulate. The exine is tectate (Figs. 1-2).

***Tecoma capensis*:** Monad is the dispersal form. The mean of polar axis is 18.66 µm, and the mean of equatorial axis is 16.79 µm. The shape class prolate spheraical. The P/E mean is 1.1 µm. There are three colpori, aperture (tricolporate). The surface pattern is fevolate. The exine is intectate (Fig. 2).

Datura innoxia: Monad is the dispersal form. The mean of polar axis is 23.97 µm, and the mean of equatorial axis is 25 µm. The shape class oblate spheraical. The P/E mean is 0.9 µm. There are three colpi, aperture (tricolpate) The surface pattern is striate. The exine is semitectate (Fig. 2).

***Nerium oleander*:** Monad is the dispersal form. The mean of polar axis is 16.21 µm, and the mean of equatorial axis is 15.05 µm. The shape class prolate spheraical. The P/E mean is 1.07 µm. There is one pore, aperture (porate). (Fig. 2).

***Convolvulus arvensis*:** Monad is the dispersal form. The mean of polar axis is 26.53 µm, and the mean of equatorial axis is 30.91 µm. The shape class oblate spheraical. The P/E mean is 0.8 µm. There are three colpi, aperture (tricolpate) membrane ornamentation. The surface pattern is scabrate. The exine is tectate (Fig. 2).

***Echium angustifolium*:** Monad is the dispersal form and the symmetrical is heteropolar. The mean of polar axis is 7.73 µm, and the mean of equatorial axis is 6.89 µm. The shape class subprolate. The P/E mean is 1.1 µm. There are three colpori, aperture (tricolporate). The surface pattern is foveolate. The exine is tectate (Figs. 2-3).

***Schinus molle*:** Monad is the dispersal form. The mean of polar axis is 15.72 µm, and the mean of equatorial axis is 9.84 µm. The shape class prolate spheraical. The P/E mean is 1.5 µm. There are three colpori, aperture (tricolporate). The surface pattern is striate. The exine is semitectate (Fig. 3).

Bougainvillea glabra: Monad is the dispersal form. The mean of polar axis is 15.07 µm, and the mean of equatorial axis is 13.34 µm. The shape class subprolate.

The P/E mean is 1.1 µm. There are three colpi, aperture (tricolpate). The surface pattern is reticulate. The exine is tectate (Fig. 3).

***Pelargonium zonale*:** Monad is the dispersal form. The mean of polar axis is 32.35 µm, and the mean of equatorial axis is 30.12 µm. The shape class prolate spheraical. The P/E mean is 1.07 µm. There are three colpi, aperture (tricolpate). The surface pattern is rugulate. The exine is semitectate (Fig. 3).

Chenopodium vulvaria: Monad is the dispersal form. The mean of polar axis is 11.04 µm, and the mean of equatorial axis is 10.25 µm. The shape class prolate spheraical. The P/E mean is 1.07 µm. There are multipores structure, aperture (pantoporate). The surface pattern is scabrate. The exine is tectate (Fig. 3).

The main morphological characters studied here are the diameter, pollen, and shape class due to nature of SEM examined photos. The 13 genera covered are *Solanum*, *Fogonia*, *Argemone*, *Gypsophila*, *Tecoma*, *Datura*, *Nerium*, *Convolvulus*, *Echium*, *Schinus*, *Bougainvillea*, *Pelargonium*, and *Chenopodium*. Most of the species polar axis is under 32 nm, The shape class is prolate spheraical & subprolate. Two with oblate spheraical shape class *Datura innoxia* and *Convolvulus arvensis*, *Gypsophila capillaris* has prolate shape class. The P/E ratio mean (0.9–0.8) observed in *Datura innoxia* and *Convolvulus arvensis* (Fig. 2). The aperture type of pores, colpus, and colporus are examined in all species. The pollen characters of *Solanum villosum* (Fig. 1) were studied in many papers (Lashin, 2011; Lashin, 2012; El-Ghamery, 2018; Mohsen & Badr, 2019). The P/E ratio in all of them was 1.02–1.04 with ratio 1.9 which is above the result in this paper. El-Ghamery and Mohsen also discussed *Solanum coagulans* (Fig. 1), and the same result was shown in Mohsen's paper and the P/E ratio reading is above the result here (El-Ghamery *et al*., 2018; Mohsen & Badr, 2019).

The characters of *Datura innoxia* in El-Ghamery's paper were similar to the result in this paper (El-Ghamery, 2018), and the shape class oblate spheraical but the P/E ratio is above with 1.1, but in (Preveen, 2007), the ratio was 0.8–0.9 which is the same as this paper, Chaturvedi in 1999 discussed *Argemone ochroleuca* (Fig. 1) P×E. The result was near 23×24, and it is more than 17×14 as shown in Table 1 (Chaturvedi, 1999). The *Fogoina* genus represent similarity between the species under this genus in Taia and others research. The mean of polar axis is 9–14 µm, and the mean of equatorial axis is 9–6 µm (Taia *et al*., 2021).

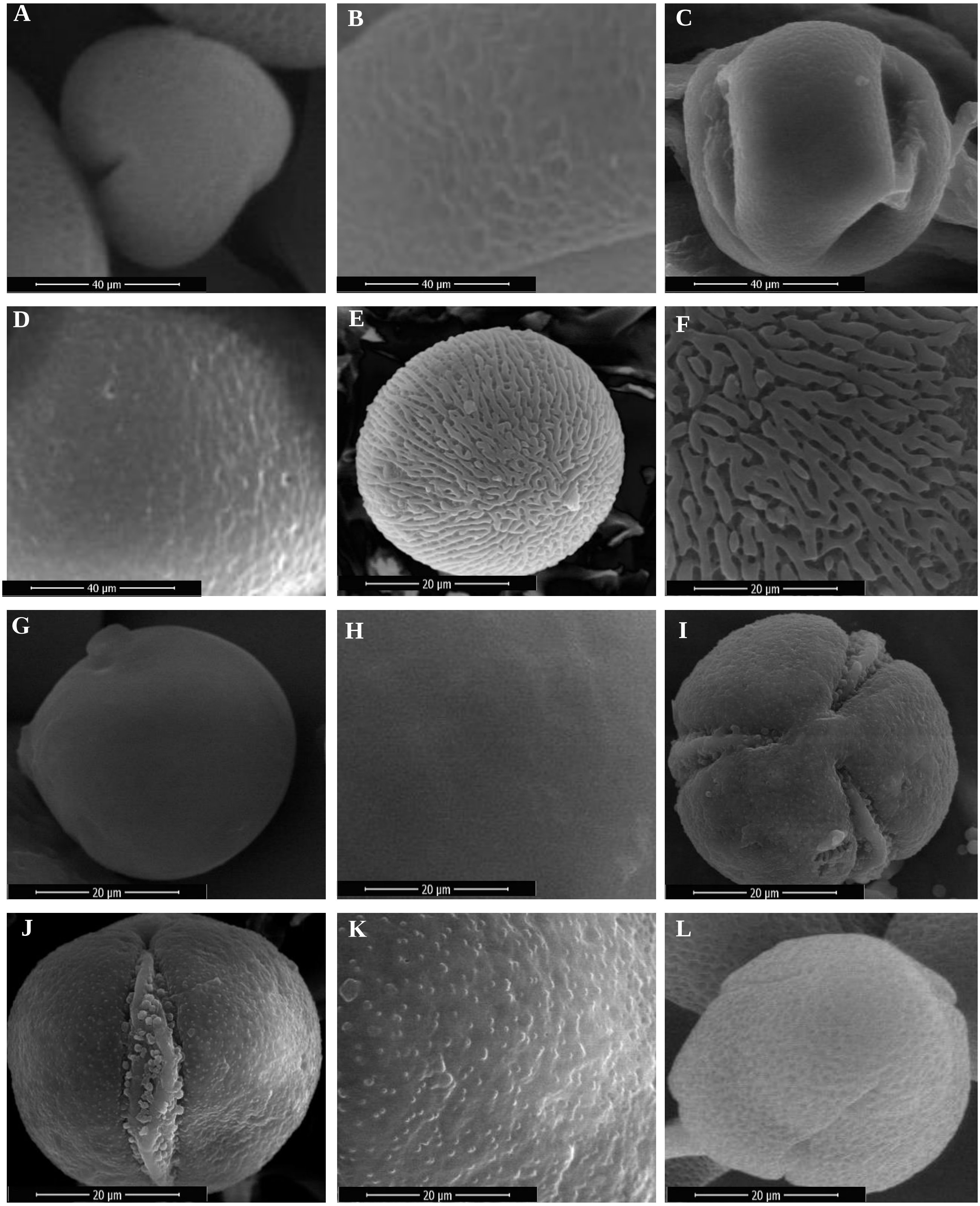

Fig. 2. 2500× magnifications for pollen grain under SEM: *Gypsophila capillaris* (A) polar view, (B) exine. *Tecoma capensis* (C) pollen, (D) exine 5000× magnification for pollen grain under SEM: *Datura innoxia* (E) pollen, (F) exine. *Nerium oleander* (G) pollen, (H) exine. *Convolvulus arvensis* (I) polar view, (J) equatorial view, (K) exine *Echium angustifolium* (L) polar view.

We found in *Nerium oleander* that the mean of polar axis is 16.21 µm and the mean of equatorial axis 15 µm (Table 1). Then, we found that another study differs from our measures in that the mean of equatorial axis is calculated from 30 to 40 µm which leads us to the effect of climate factors on pollen production (Sukkaewmanee, 2015). Some other studies recorded the same examination for pollen grain like our result about the *Convolvulus* genus in 2011 (Aykurt & Sümbül, 2011).

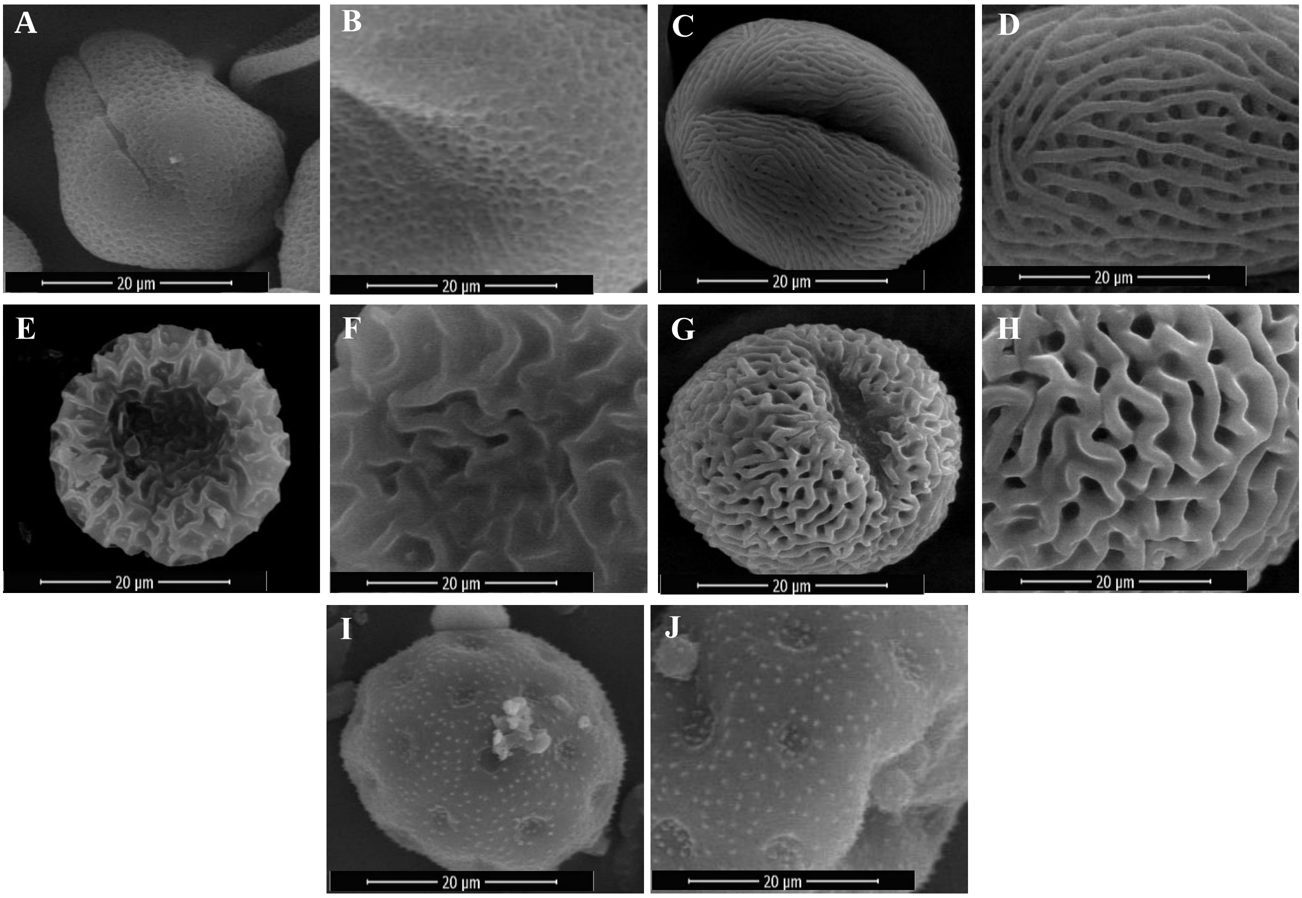

Fig. 3. 5000× magnifications for pollen grain under SEM: *Echium angustifolium* (A) equatorial view, (B) exine. *Schinus molle* (C) pollen, (D) exine *Bougainvillea glabra* (E) pollen, (F) exine. *Pelargonium zonale* (G) pollen, (H) exine. *Chenopodium vulvaria* (I) pollen, (J) exine.

Table 1. Represent the pollen morphological features of examined species.

S. No.	Name of species	P Polar length in µm	E Equatorial diameter in µm	P / E × 100	Shape class	Aperture	Tectum
1.	*Solanum coagulans*	11.81(13.61)14.84	11.29 (12.7) 14.35	1.07	Prolate spheraical	Tricolporate	Granulate scabrate
2.	*Fogonia paulagana*	9.08(10.37)11.4	6.62 (7.89) 9.37	1.04	Prolate spheraical	Tricolporate	Verrucate scabrate
3.	*Argemone ochroleuca*	15.75(17.94) 23.3	12.29 (14.61) 17.6	1.3	Sub prolate	Tricolporate	Reticulate
4.	*Solanum villosum*	11.86(13.34) 14.27	11.68 (12.76) 13.38	1.2	Sub prolate	Tricolporate	Rugulate
5.	*Gypsophila capillaris*	8.07(9.32)10.86	4.9 (5.58) 6.1	1.6	Prolate	Tricolpate	Microreticulate
6.	*Tecoma capensis*	16.77(18.66) 20.01	12.52 (16.79) 19.13	1.11	Prolate spheraical	Tricolporate	Fevolate
7.	*Datura innoxia*	21.02(23.97)24.4	21.99 (25) 28.7	0.9	Oblate spheraical	Tricolpate	Striate
8.	*Nerium oleander*	14.8(16.12)17.76	13.73(15.05)16.83	1.07	Prolate spheraical	Porate	-
9.	*Convolvulus arvensis*	23.04(26.53)30.3	23.9 (30.91) 38	0.9	Oblate spheraical	Tricolpate	Scabrate
10.	*Echium angustifolium*	6.06(7.33)9.08	5.01 (6.89) 8.07	1.2	Subprolate	Tricolporate	Foveolate
11.	*Schinus molle*	10.13(10.27)11.56	9.03 (9.89) 10.97	1.12	Prolate spheraical	Tricolporate	Striate
12.	*Bougainvillea glabra*	14.04(15.07)16.64	10.9 (13.34) 15.88	1.2	Subprolate	Tricolapte	Reticulate
13.	*Pelargonium zonale*	29.47(32.35)37.12	26.84 (30.12) 35.18	1.09	Prolate spheraical	Tricolpate	Rugulate
14.	*Chenopodium vulvaria*	9.9(11.04)11.88	9.29 (16.25) 11.33	1.07	Prolate spheraical	Pantoporate	Scabrate

Conclusions

The studied taxa represent the wild plants in the area, the small diameter of the pollen grains is observed, the circular polar view also is common in the wild life form of pollen. Despite the verity of pollen characters among same species collected and studied from different geographical areas. The similarity is represented. There is no doubt about the importance of adopting pollen as an essential taxonomic element.

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