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ABUTILON INDICUM (L.) SWEET AND *ABUTILON BADIUM* S. A. HUSAIN & BAQUAR (FAMILY MALVACEAE): A LONG STANDING CONFUSION

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ABSTRACT

The species *Abutilon badium* S. A. Husain & Baquar has since long been widely confused for *Abutilon indicum* (L.) Sweet. The present paper highlights the characters that clearly differentiate between the two species, including the micro-morphological and scanning electron microscope (SEM) studies of the seeds and pollen grains of both the species performed in the present work; such information was not present at the time when *Abutilon badium* was first recognized. This species was originally described as endemic to Pakistan, but it appears to be quite wide-spread. Hybridization may possibly be occurring between the two species.

Key-words: Taxonomic confusion, mericarp morphology, seed and pollen SEM features, geographic range

INTRODUCTION

The genus *Abutilon* belongs to the subfamily Malvoideae of the family Malvaceae. The species *Abutilon badium* was described by Husain and Baquar in 1974 as a new endemic species from Pakistan, distinct from *Abutilon indicum* (L.) Sweet. They provided detailed morphological features which differentiate the two species from each other, after growing the seeds of both species under similar environmental conditions to ascertain that the differences were not environment-induced. However, Abedin (1979) reduced *Abutilon badium* to the synonymy of *Abutilon indicum*; but recently The Plant List (2013) has accepted *Abutilon badium* as a distinct species. The Plant List is an online authentic data-base of plant names, jointly established and continually updated by the Royal Botanic Gardens, Kew and the Missouri Botanical Garden, in collaboration with several other noted taxonomic institutions of the world.

Husain and Baquar (1974) described this species as endemic to Pakistan; however a survey of the recent literature as well as that of the Google Images makes it almost sure that it is not an endemic species but it is quite wide-spread, overlapping with much of the natural geographic range of *Abutilon indicum*. Looking at the close-up photographs in various publications reveals that in several cases the pictures labeled as *Abutilon indicum* actually show the typical characteristics of *Abutilon badium*. The photographs given as *Abutilon indicum* even in Wikipedia (http://en.wikipedia.org/wiki/Abutilon_indicum 9/13/2015) are most probably *Abutilon badium.* Similarly in the Wild Flowers of Bangladesh (Ahmed, 1997), the picture of *Abutilon indicum* actually looks like *Abutilon badium.* The photographs of plant, fruit, and seeds given as those of *Abutilon indicum* in Amalesh *et al.* (2012) are in fact surely of *Abutilon badium*. In the same way various websites showing pictures of Indian medicinal plants have photographs looking like *Abutilon badium*, given as *Abutilon indicum* (http://www.ayurveda-medical-tourism.com/produkt/atibala-abutilon-indicum/ 11/2/2015; www.indiamart.com/yash-herbal-products/herbal-medicine.html, accessed 11/2/2015; http://www.indiamart.com/yogiglobals/raw-herbs.html; https://dravyagunatvpm.wordpress.com/gallery/abutilon-indicum-1-atibala). In two southern India Floras (the Flora of Karnataka and eFlora of Karaikal district) as well, the photographs of *Abutilon indicum* actually seem to be of *Abutilon badium* (http://florakarnataka.ces.iisc.ernet.in/hjcb2/herbsheet.php?id=2764&cat=1, accessed 11/2/2015; http://www.eflorakkl.in/Details.php?id=109, accessed 11/2/2015). In a website on Chinese medicinal plants, the picture given as *Abutilon indicum* also looks like *Abutilon badium* (http://wmwm5600.pixnet.net/blog/archives/200811, accessed 11/2/2015). In a website of Vietnam, several pictures are given as of *Abutilon indicum*, but are actually a mixture of *Abutilon badium*, *Abutilon indicum*, and another species (http://buixuanphuong09blogspot.blogspot.com/2013/03/810-coi-xay.html, accessed 11/2/2015). In a website of Singapore, nine photographs are given under the name *Abutilon indicum*, out of which at least three [bearing the numbers DSC 00353 (10), DSC 01073 (09), and DSC 05819 (10)] actually look like *Abutilon badium* (http://www.natureloveyou.sg/Abutilon%20indicum/Main.html). This survey shows that both the species are widely confused and mixed up not only by the general public but also by the taxonomists, as evident from the example of the two Floras of southern India given above.

The purpose of the present paper is not only to highlight this long standing taxonomic confusion, but also to provide additional data on the differences between these two species to help differentiate them easily and clearly.

MATERIALS AND METHODS

In addition to general morphological studies with the help of hand lens and stereomicroscope, scanning electron microscope (SEM) studies were made on the seeds and pollen grains of both the species. The close-up photographs of mericarps and seeds of both species were also taken in the natural light with the help of a digital camera.

SEM study of seed

Seeds were washed successively in three grades of ethanol (30%, 50% and 70%) for removing dirt from the surface of seeds. Dried seeds were mounted on metal stubs bearing the double-adhesive tape. Gold coating was done in a sputtering chamber (Jeol JEC-1500), and observed and photographed by scanning electron microscope (Jeol JSM 6380A) in the Central Laboratory of the University of Karachi.

SEM study of pollen

Pollen grains from dried plant specimens were dusted directly upon the metal stubs bearing the double-adhesive tape. Gold coating was done in a sputtering chamber (Jeol JEC-1500), and observed and photographed by scanning electron microscope (JEOL: JSM 6380 A) in the Central Laboratory of the University of Karachi.

RESULTS

The detailed differences between *Abutilon badium* and *Abutilon indicum* are compiled in the Table 1. The differences in morphology include those mentioned by Husain and Baquar (1974) as well as those noted down in the present study.

Table 1. The morphological and micro-morphological differences between *Abutilon badium* and *Abutilon indicum.*

S. No.	*Abutilon badium*	*Abutilon indicum*
1.	Sparingly branched, stem usually reddish brown	Densely branched, stem usually green (Fig. 1, D)
2.	Leaves usually dull green	Leaves grass-green
3.	Flowers orange-yellow (Fig. 1, A)	Flowers yellow (Fig. 1, E)
4.	Petals narrowed downwards, valvate in flower, usually showing gaps between them (Fig. 1, A & C)	Petals broad, overlapping in flower (Fig. 1, E)
5.	Mericarps almost black on maturity; apex distinctly awned with 1 – 2 mm long awn (Fig. 1, B & C; Fig. 2, A)	Mericarps golden brown to dark brown at maturity; apex acute but not awned (Fig. 1, F; Fig. 2, B)
6.	Seeds grayish brown, both seed-coat and raphe (the adnate, persistent part of funicle) glabrous (Fig. 2, E,F,G)	Seeds reddish brown, dense tuft of hair present on raphe in the notch near hilum, seed-coat also with sporadic hair near hilum (Fig. 2, C,D,H)
7.	Seed-coat ornamentation comprised of penta- to hexagonal inter-connected warts (Fig. 2, K & L)	Seed-coat ornamentation comprised of broadly conical to stub-like warts with convex top ±circular in outline (Fig. 2, I & J)
8.	Tectum of the pollen grain densely and prominently perforated (Fig. 3, A – D)	Tectum of the pollen grain rugate, sparsely and minutely perforated (Fig. 4, A – D)

DISCUSSION

The species *Abutilon badium* has been widely confused for *Abutilon indicum* in various works, both taxonomic and otherwise, till the present time. This work is intended to resolve this confusion by putting forward the differences between the two species. The characters given in the Table 1 show that the two species can be clearly

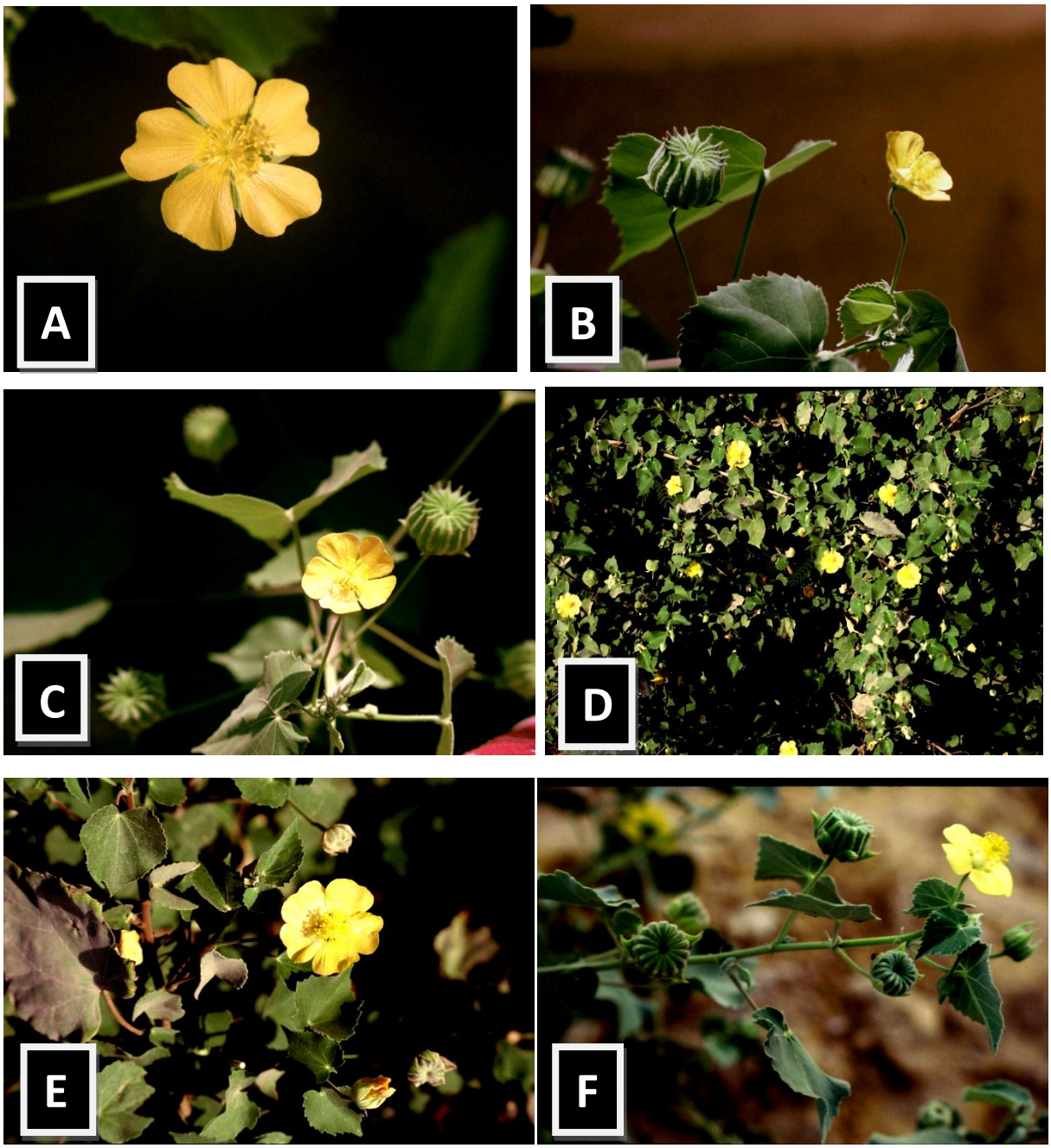

Fig.1. *Abutilon badium*: **A,** flower close-up; **B & C,** flower and fruit. *Abutilon indicum*: **D,** general view of plant showing dense branching; **E,** flower; **F,** flowering and fruiting branch.

differentiated from each other even on the basis of morphological characters only if open flower and mature fruits are available. The petals in both species are twisted in bud like in all the members of Malvoideae, but in *Abutilon badium* this aestivation does not persist after the opening of flower because the petals are narrowed towards base thus do not overlap each other; becoming valvate in flower. Usually the petals are narrow enough to show gaps between them. In case of *Abutilon indicum*, on the other hand, the petals are quite broad that keep overlapping each other even after the opening of flower. Besides this, the colour of petals in the later species is bright yellow while orange-yellow in the former. These characters of flower are quite persistent among the populations of the two species and enough to differentiate between them. However in practice the open flower may not always be available and in case of dried herbarium specimens, flower is usually not pressed in its natural appearance due to its delicate petals. In such cases, the other characters are helpful, like the shape and colour of the mature mericarps. The

character of stem colour, mentioned as (reddish) brown by Husain and Baquar (1974) in *Abutilon badium* and green in *Abutilon indicum*, was not found to be consistent in the present study as in certain cases, *Abutilon indicum* also showed reddish brown stem. However, the scanning electron microscope (SEM) studies conducted in the present work decisively support the distinct status of *Abutilon badium* as compared to *Abutilon indicum*. The SEM studies on the pollen and seed of these two species had not been done earlier. The seed coat in both species has an ornamentation of prominent warts, but their shapes and other features are quite distinct from each other in the two species, as mentioned in the Table 1. Besides this, the raphe in case of *Abutilon badium* seed is almost glabrous while in case of *Abutilon indicum*, the raphe bears a dense tuft of hair in the notch near hilum. The pollen grains of *Abutilon badium* have distinctly and densely perforated tectum, which is not only distinctly different from the pollen of *Abutilon indicum*, but from all the other species' pollen found in Pakistan (personal observation, unpublished).

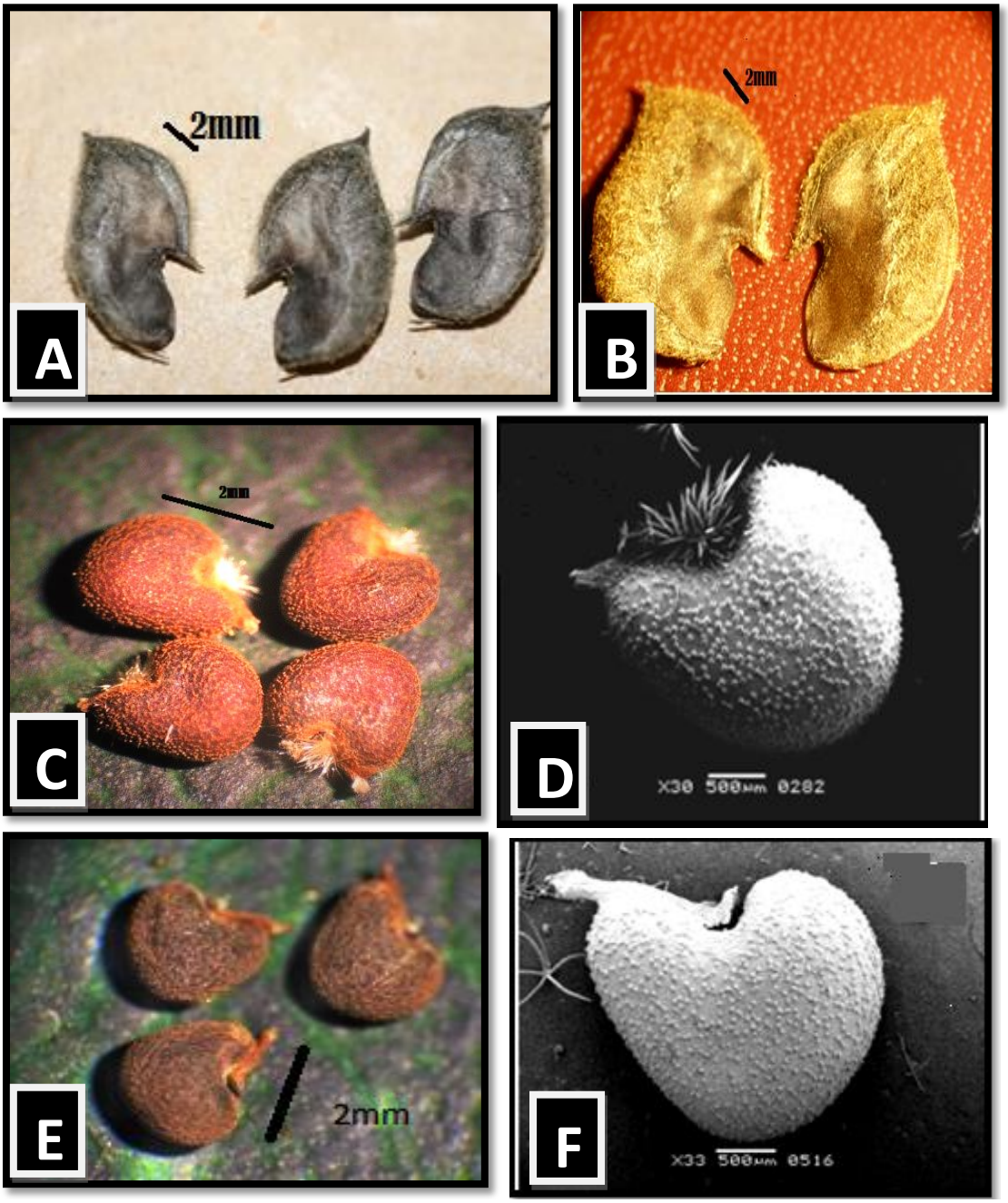

Fig.2. Mericarps in the natural light: **A,** *Abutilon badium*; **B,** *Abutilon indicum*. Seeds of *Abutilon indicum*: **C,** under the natural light; **D,** SEM picture of the whole seed; Seeds of *Abutilon badium*: **E,** under the natural light; **F,** SEM picture of the whole seed.

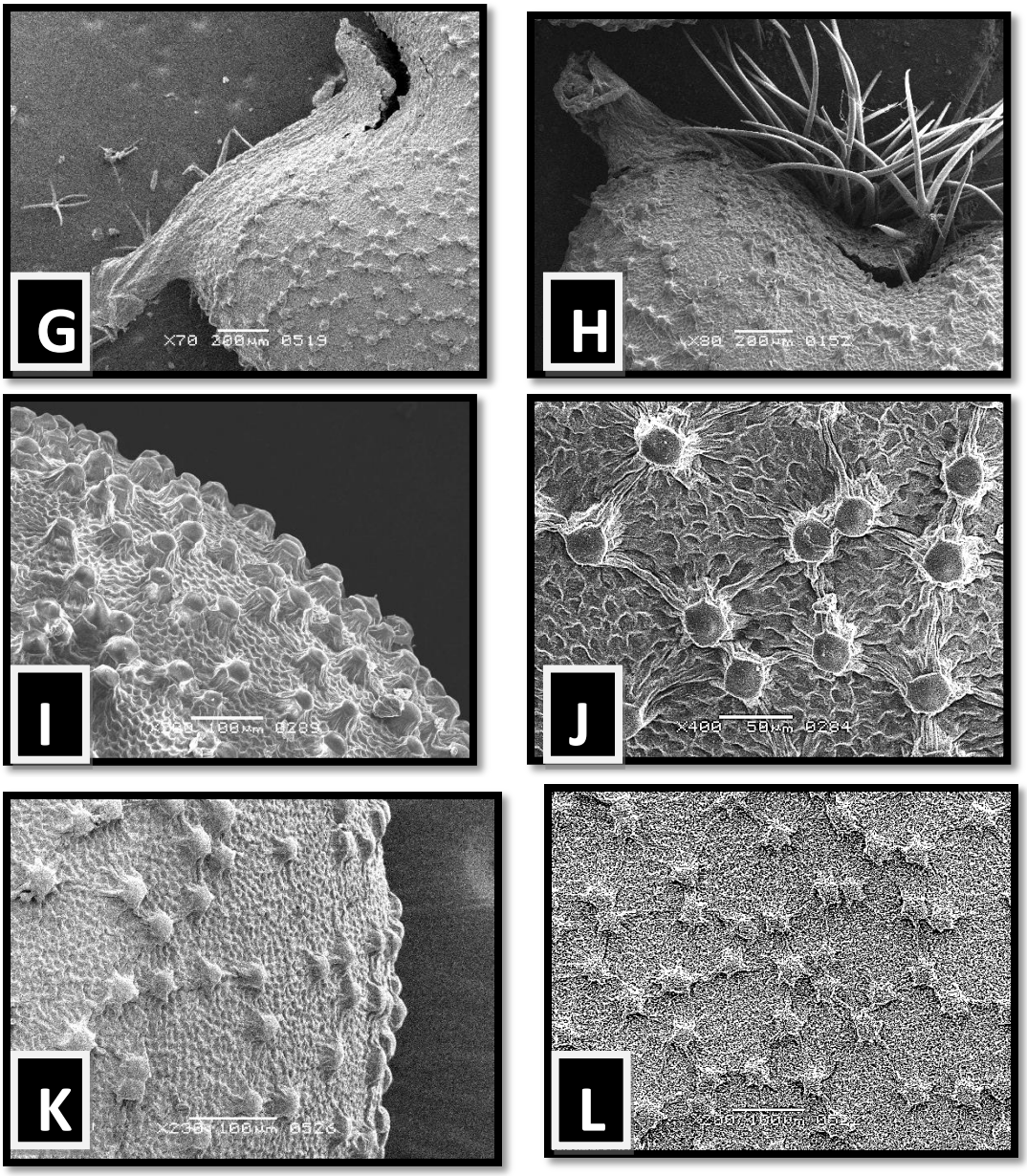

Fig.2. (Continued) SEM pictures of seed parts: **G,** raphe of *Abutilon badium*; **H,** raphe of *Abutilon indicum*; **I & J,** surface pattern of *Abutilon indicum* seed coat; **K & L,** surface pattern of *Abutilon badium* seed coat.

The references mentioned above in the Introduction indicate that *Abutilon badium*, rather than being endemic to Pakistan, is actually quite widespread. Distributed almost all over India, it extends at least up to Singapore and southeastern China in the south-east Asia through Bangladesh, Thailand, etc. Thus, it overlaps with most of the geographic range of *Abutilon indicum.* With this overlapping, the chance of hybridization between the two species cannot be ruled out; though not yet reported. However, it is indicated by the presence of certain intermediate forms, particularly the shape of mericarp in certain specimens of *Abutilon indicum* approaches near to the mericarp shape of *Abutilon badium.* Nevertheless the colour of mature mericarps is always distinctly different in the two species.

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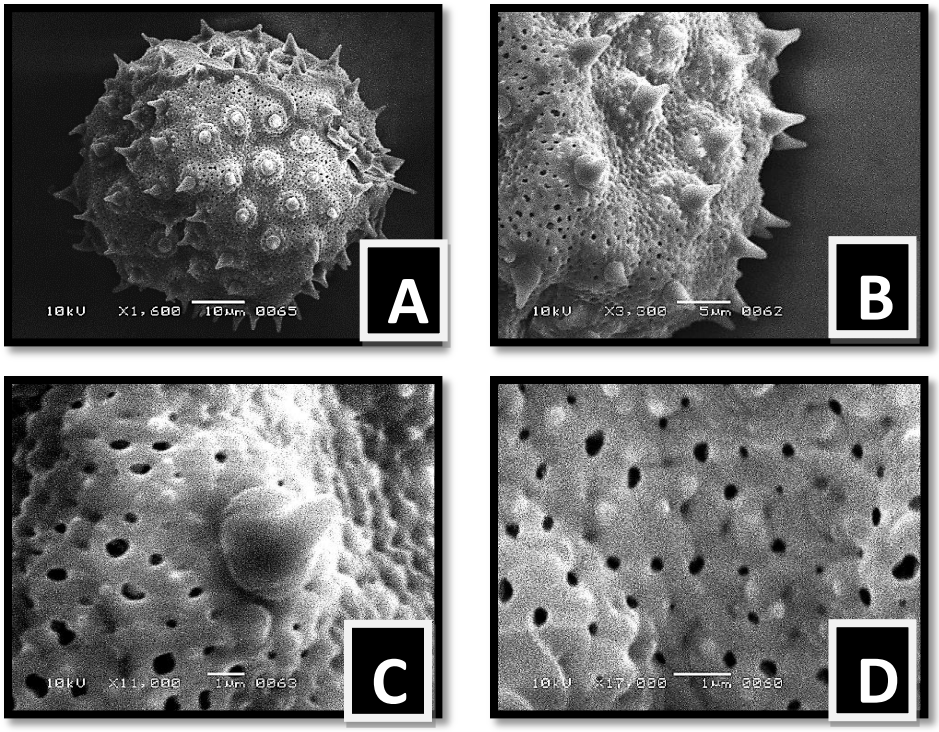

Fig.3. SEM pictures of *Abutilon badium* pollen: **A,** the whole pollen grain; **B,** closer view of surface; **C,** further magnified view of spine, showing prominent perforations in the tubercle; **D,** exine surface in between the spines, showing prominent perforations and minute, sparse granules, while the rugose pattern is not much prominent.

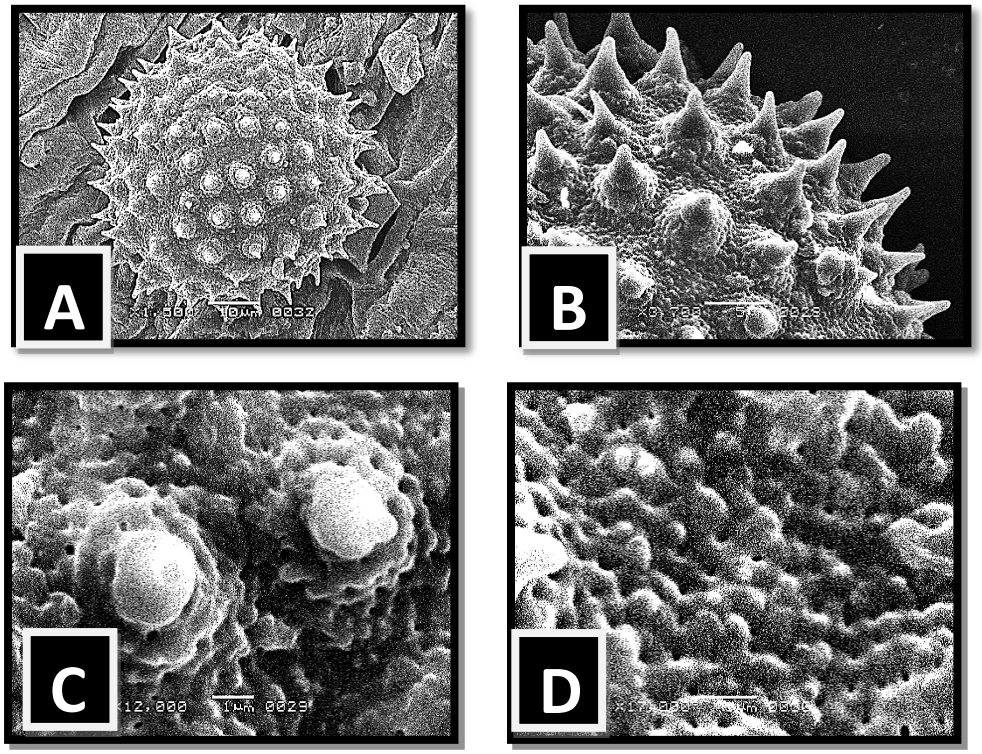

Fig.4. SEM pictures of *Abutilon indicum* pollen: **A,** the whole pollen grain; **B,** closer view of surface; **C,** further magnified view of spines, showing minute perforations in tubercles; **D,** exine surface in between spines, showing minute perforations, rugose pattern, and minute and sparse granules.

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