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A NEW SPECIES IN GENUS *ABUTILON* (MALVACEAE) FROM PAKISTAN

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Abstract

In this research paper, a newly identified plant species of the genus *Abutilon* Mill., namely *Abutilon jafrii* F. Naseer, A. Noor & A. Rahman, is described and illustrated for the first time in the province of Sindh, Detailed morphological descriptions of the species along with the micro-morphological examinations of scanning electron microscopy (SEM) for the mericarps, seeds and pollens are presented. Additionally, Macro morphological characteristics including photographs of the plant habit with flowers, fruits, seeds and mericarps are provided. Through gross macro-morphological and micro-morphological investigations such as plant height, leaves texture and colour, pedicel of fruits and flowers, flowers diameter, sepal's size in flowers and fruits, number of seeds per mericarp, pollen tectum exhibit significant differences in characters, which indicate that, it is a distinct species.

Introduction

The genus *Abutilon* Mill. is classified under tribe Abutilinae (Bentham and Hooker, 1862). In a taxonomic revision of the entire family by Hutchinson (1967), the genus was kept under the tribe Abutilieae and sub-tribe Abutilinae. Though, Bates (1968) later removed subtribes and placed them under the tribe Malvae.

The genus *Abutilon* is considered as one of the large and complex genera (Fryxell, 1997 and Takeuchi and Esteves, 2012). It was established by Philip Miller in the year 1754 (Fryxell, 1983) since been recorded in various parts of the world. While several authors have added and reported different species over time in the genus while Christenhusz and Byng (2016) stated that the genus includes approximately 4,225 species. It is supposed to be more or less cosmopolitan in distribution, although it is primarily found in tropical and subtropical regions as a genus of annual and perennial, herbs, under shrubs, or mostly shrubs (Borssum, 1967; Davis, 2002; Mabberley, 1987; Manjunath, 1948 and Taia, 2009).

In the Pakistan, eighteen specific and infra-specific taxa have been recorded (Abedin, 1979) which are belonging to the different southern parts of the country, while only a few species were reported from the northern parts. A total of eleven species have been reported from Karachi & its adjoining areas (Afaq-Hussain *et al*.1988).

Different works have conducted for taxonomic examinations of several species in different regions. Such as Taia (2009) reported five species from Saudi Arabia based on morphological analysis, including leaves, flowers and fruits of the genus. Alzahrani *et al*. (2021) analyzed six species of the genus using morphological characters with a morphometric approach. In Pakistan, Hussain and Baquar (1974) provided a taxonomic study of twelve species, while Abedin (1979) reported eighteen specific and infra-specific taxa. Naseer *et al.* (2015) resolved long-standing confusion between widely spread taxa, namely *A. indicum* and *A. badium* based on critical

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analysis of morphological characters. They accepted *A. badium* as a distinct and separate species as described and mentioned by Hussain and Baqar (1974) and listed as an accepted name in "The Plant List 2013". However, Abedin (1979) in the Flora of Pakistan considered both as the same taxa. Naseer *et al*. (2020) added one more infra-specific taxa in the genus.

For improving systematic position and delimitation of taxa several palynological studies were also carried out on various species from different regions in which Christensen (1986), Perveen *et al*. (1994), El-Nagar (2004), El-Husseini (2006) and Shaheen *et al*. (2009) conveyed important notes about family and genus. In recent years Naseer *et al.* (2015) revised the pollen analysis of two species.

Seeds are often influenced by environmental factors (Zoric *et al.*, 2010), which provides significant data for the delimitation of taxa. The literature provides little information regarding the micro-morphology of seeds, including two species by El-Naggar (2001) and Amallesh *et al.* (2012), Khushk and Vaughan (1986) reported seed data of nine species of the genus. Nasser *et. al.* (2015) examined closely two species namely *A. indicum* (L.) Sweet and *A. badium* S. A. Hussain & Baquar, while Naseer *et al*. (2020) studied one infra-specific taxon *Abutilon pannosum* var. *balochistanicum* in their work.

During a revisionary survey of the genus *Abutilon* from Pakistan, this species was observed with its distinct morphological characteristics. The current paper introduces and recognizes a new species within the genus namely *A. jafrii* F. Naseer *et al*. based on macro and micro-morphology particularly pollen and seed characters. In addition, a concise diagnostic key and comparison table is provided, comparing this new species with its closely related species *A. sepalum* S. A. Hus. & S. R. Baq.

Materials and Methods

Plants were extensively studied in their natural habitat using recently collected fresh specimens.

Study site and collection of material

The plant specimens of newly recognized species in the work were collected and discovered by the first author of the current work from the Karachi University (KU) campus during revisionary work of the entire genus from 2007 to 2023. All necessary field observations were carefully noted i.e. plant height, soil type, habit, the colour of plant parts, flower opening and closing timings, seed dispersal behavior etc. The specimens were preserved in the herbarium of Karachi University (KUH) with all necessary voucher details.

Macro morphological analysis

For the detailed morphological examination of all important qualitative and quantitative features, simple observations were employed of stem, leaves, inflorescence, flower, fruit & mericarp and seeds.

Digital Illustration

The same method was adopted as mentioned in Naseer *et al*. (2015, 2020). Photographs of the plant's habits and other parts have been captured with a photographic camera (Olympus VR-310). The macro-morphological studies were performed with the help of a hand lens and stereomicroscope.

Scanning Electron Microscopy

Scanning electron microscopic (SEM) studies were made for the mericarp, seeds and pollen grains of both species.

For mericarp and seed SEM study

For the scanning electron microscopy (SEM) study preparation of material, mature and healthy seeds were washed successively in three grades of ethanol (30%, 50% and 70%) to remove dirt from the surface of the seeds. Dried seeds and mericarp of the specimen were mounted on separate metallic stubs upon double adhesive tape and coated in a sputtering chamber for a few minutes with gold, then observed by SEM Jeol Japan (JSM-6380A), in the Central Laboratory of the University of Karachi for the SEM study of seeds. The images were captured by scanning electron microscope.

For the pollen SEM study

For the SEM study of pollen grains, dried flower specimens were directly dusted upon metal stubs with double-adhesive tape. The gold coating was done in a sputtering chamber of Jeol JEC-1500, observed and the photographs were captured by scanning electron microscope (JEOL: JSM 6380 A). The voucher specimens were recorded and kept in the Karachi University Herbarium.

Key to species

1+	Stem, petiole and pedicel greyish green, densely covered with hirsute hairs, pedicel joint below the middle, sepals not leathery, mericarps 23-30 in each schizocarp	*Abutilon jafrii*
1-	Stem, petiole and pedicel greenish and velvety, pedicel joint at or above middle, sepals leathery, mericarps 20-48 in each schizocarp	*Abutilon sepalum*

Description of the species

An erect up to 0.6m tall a large shrub. Stem with greyish dense soft hirsute, pubescence and slightly velvety appearance. Leaves 3.2 -5.3cm long and 2.5 - 4.7cm broad, ovate to sometimes old leaves broadly ovate, soft hairs, above velvety dark green to canescent beneath, acute at apex, irregular sharp denticulate to irregular minute dentate, cordate-deep cordate at base, 9-nerves; petiole 2.8-4.5 cm long, dense greyish soft hirsute hairs; stipules deciduous, linear, reflexed,0.40.6cm long. Flower solitary axillary and visible in clusters on the terminal side or racemes to sometimes dichotomously branched, pseudo-raceme, ± 3.5cm across, dark yellow. Flowering pedicel length is almost 0.3-0.6 cm above while about 0.1-0.2cm below the joint, articulation indistinct below the middle near stem and branches. Calyx 5 lobed, densely hairy not leathery, light green to greyish green, acute at apex, sepals 1.2cm long 0.7cm broad, broad ovate; corolla 5 lobed, petals 1.7 cm long, 2.2 cm broad, retuse apex. Fruiting pedicel 0.6-0.9 cm above the joint and 0.4-2 cm below the joint, remain indistinct below the middle near the base of the pedicel (while sometimes observed only in old fruit), covered with dense hirsute hairs; fruiting calyx almost enclosed the fruit, light green-yellowish, sepals 1.3cm long and 0.6-0.7cm broad. Fruit truncate, 1.5-1.8 cm across, ridges and furrows not clear due to dense hair; mericarps 23-30 in each fruit, obtuse at apex, long spreading the almost equal length of cream to yellowish or golden hairs at edges, 0.6-0.9 cm long 0.4-0.6 cm broad, dark shiny brown, single awn, 0.8-0.9cm long. Seeds usually 3 in each mericarp and rarely 2, 2 mm across, ovate, dark brown with dense hairs.

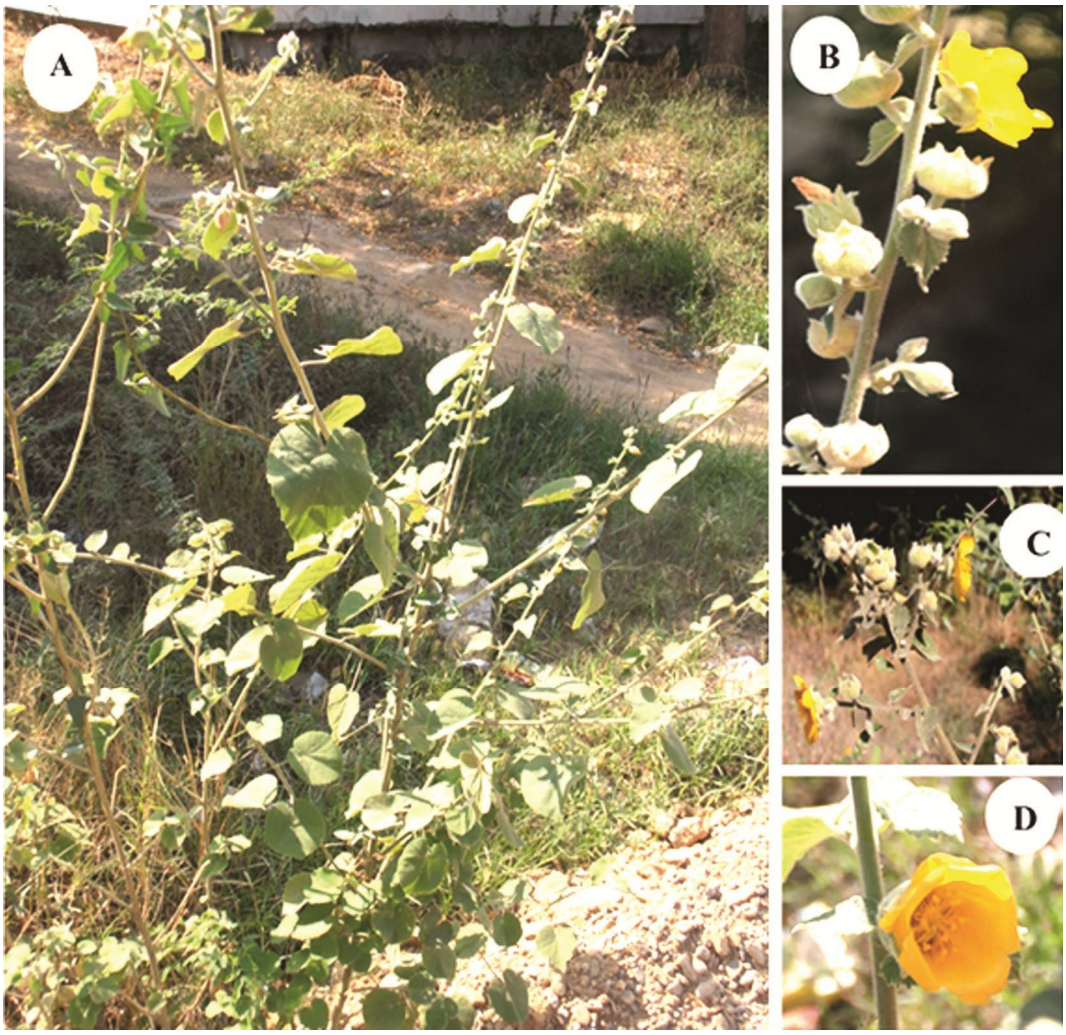

Fig. 1. *Abutilon jafrii* (A) Habit of whole plant (B-C) Arrangement of flowers and fruits on floral axis (D) Yellow flower opening

Holotype*:* Karachi District: F. Naseer, 223 (KUH).

Specimens examined: Karachi University Campus, near the Botany Department, c. 6.5 feet tall, plant parts greyish green in sunny areas, flower dark yellow, pedicel length very short and covered with dense hairs, fruit greyish to yellowish brown at maturity, F. Naseer, 223, 225 (KUH), left area adjacent to chemistry department, c. 6.5 to 7 feet tall, dark green leaves in semi shady area, pseudo-raceme inflorescence, 415, 423, 425, left area near to department of mathematical sciences (KUH).

Ecology*:* Sandy soil

Etymology*:* Name of species is dedicated to our one of the honorable taxonomist "S. M. H. Jafri", who was editor of Flora of Karachi.

Phenology*:* Flowers open after 4 o'clock evening in summer while at 3-4 o'clock in winter.
Distribution: Pakistan: Karachi (Fig. 3)

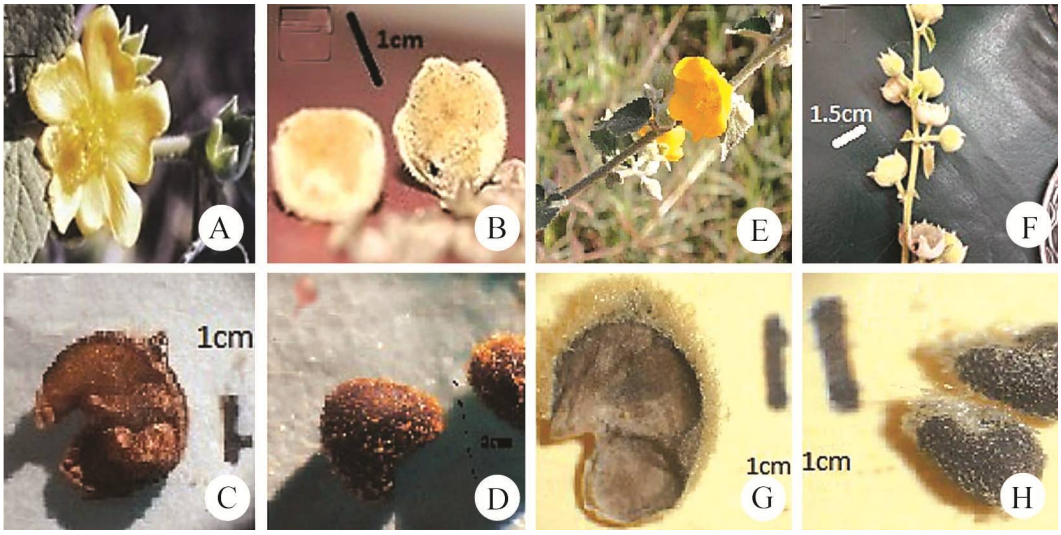

Fig. 2. Comparison between *A.sepalum* and *A. jafrii* in various parts: ***Abutilon sepalum*** (A) Flower in natural habitat (B) Fruit with dense hairs (C) Mature mericarp with showing apex (D) Seeds; *Abutilon Jafrii* (E) Flower in natural habitat (F) fruiting branch (G) Mericarp (H) Seeds

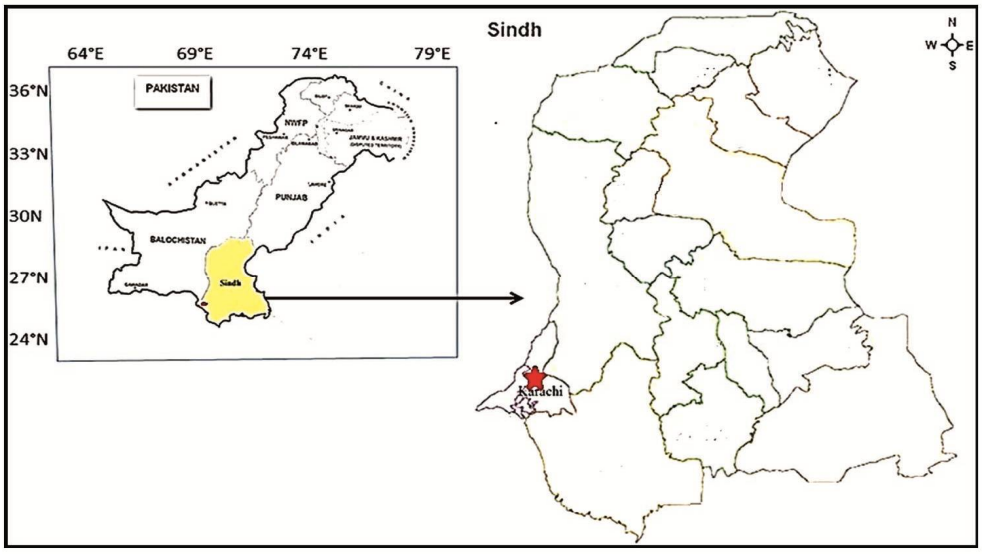

Fig. 3. Map showing current distribution of new taxa.

Results and Discussion

According to Alzahrani (2021) floral morphological features especially fruits play key role for delimitation of taxa in the genus *Abutilon*. In this work *Abutilon jafrii* F. Naseer & A. Noor although has close resemblance with *A. sepalum* especially due to calyx condition in fruit but on the basis of various morphological traits it is recognized as distinct species.

Flower is much darker yellowish in A. jafrii than A. sepalum (Fig. 2A & E). In both of the species fruits are enclosed in the calyx as shown in Fig. 2 B & F. while in each fruit, numbers of mericarps are lesser in the A. jafrii than A. sepalum. Mericarp surface and colour also vary in currently recognized species as dark brownish with dense golden hairs on apex (Fig. C & G). Leaves texture and size also vary in A. jafrii (Fig. 1A) A. sepalum leaves are slightly covered with hispid hairs as described Husssain and Baquar (1974) while leaves in A. jafrii are densely covered with soft hairs giving velvety touch. Leaves colour also differs in both of the species mentioned in Table 1. The short pedicel is the key characteristic of species with indistinct to distinct articulation both in flower and fruit, sometimes in flower sub-sessile condition of the pedicel is recorded. Calyx is densely pubescent but not leathery as in A. sepalum. Seed colour, shape and surface provide strong evidence between both of these species (Fig. 2D & H; Fig. 3), in species A. jafrii trichomes at notch can be seen clearly while not seen in A. seplaum and the number of seeds is also lesser in the newly recognized species.

Pollen surface also shows remarkable differences, details of distinguishing characters were mentioned in Table 1. Illustrated images of the type species and newly recognized species are presented in Figs. 1, 2 & 3.

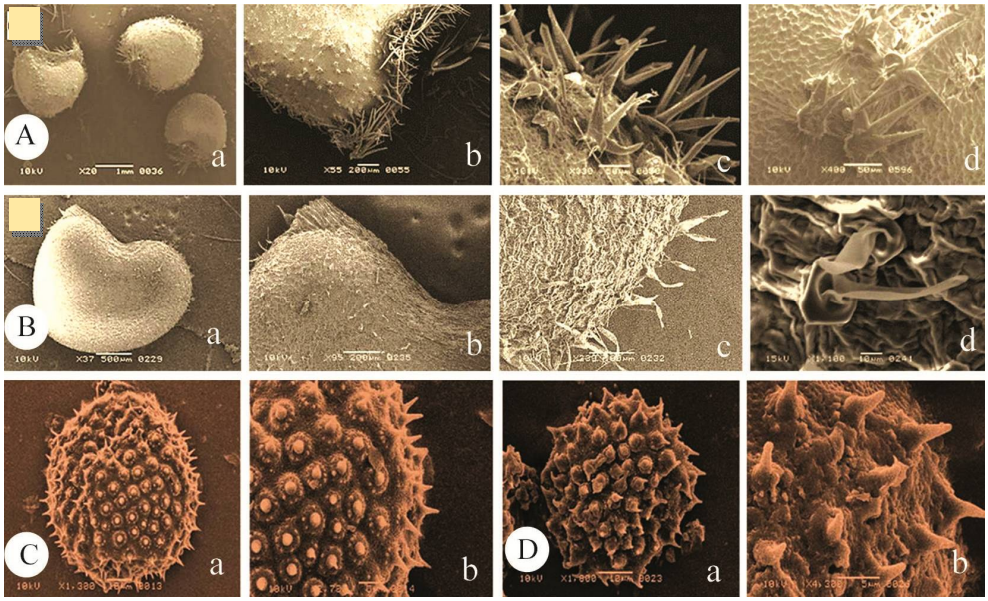

Fig. 4. (A) Scanning electron micrographs of *Abutilon jafrii* (a) Entire seeds (b) edges view of seed (c-d) Trichomes covered surface of seed (B) Scanning electron micrographs of *Abutilon sepalum* (a) Entire seed (b) edges view of seed (c-d) Trichomes covered surface of seed (C) Scanning electron micrographs of pollen grains of *Abutilon jafrii* (a) Entire pollen grain (b) edges view of pollen grain (D) Scanning electron micrographs of *Abutilon sepalum* Pollen grains (a) Entire pollen grain (b) edges view of pollen grain

Table 1. Distinguishing characters of *Abutilon jafrii* from its closely allied species *A. sepalum*.

Plant parts	*A. sepalum* S. A. Hus. & Baq. (Abedin, 1979) (characters)	*A. jafrii* F. Naseer *et al.* (characters)
Stem	Stem apparently velvety with dense tomentose hairs.	Stem covered with grayish dense and soft appressed hairs.
Leaves size	Leaves range from 4-16cm long and 3-13cm broad.	Leaves usually range from 5-6 or 7cm long and broad.
Leaves shape	Leaves are broad ovate or orbicular to ovate in shape.	Young leaves are ovate while old leaves are somewhat broad.
Leaves surface	Leaves from the upper side are somewhat scabrous.	Leaves not scabrous.
Petiole size and surface	Petioles usually range between 2 to 6cm long.	Petiole 2.5-4cm long.
Calyx surface	Calyx leathery, their size is equal to fruit length and enclosing the fruit.	Calyx not leathery, the size is more than fruit length and completely enclosing the fruit.
Pedicel length	Pedicel is 0.5 to 2cm long in fruit	Fruiting pedicel up to 0.6 long
Pollen tectum	Rugose-punctate, granulated mainly around tubercles, ± unperforated only with any occasional minute perforation.	Rugose-punctate, granulated mainly around tubercles, minutely and sparsely perforated.
Articulation	With distinct joint, usually at middle	With usually indistinct to distinct joint, usually below the middle to sometime in middle
Mericarps number	Mericarps 27-33 in each fruit	Mericarps are quite less in number per fruit 23-24
Seeds number	Seeds are usually three (sometimes 2) in each mericarp	Seeds range from 1-2 per mericarp
Pollen tectum	Rugose-punctate, granulated mainly around tubercles, ± unperforated only with any occasional minute perforation.	Rugose-punctate, granulated mainly around tubercles, minutely and sparsely perforated.

As a large genus comprising several hundred species, they produce attractive yellow to orange-yellow blooms (Naseer *et al.,* 2000), generally throughout the year. Due to their showy nature of flower and large number of flowers per plant, it is suggested to grow them as an ornamental large shrub in the gardens, particularly in eco-friendly regions. Additionally, many species in this genus are considered as fiber-yielding and medicinal plants, used to treat various diseases. Therefore, for the conservation and further exploration of newly discovered species demand a comprehensive examination of their pharmacological and phytochemical characteristics.

In their natural habitats, these plants frequently encounter a multitude of pests that inflict considerable damage upon their fruits and foliage. Within the delicate ecosystem that nurtures these remarkable species, lies an imperative to unveil the untapped potential and ensure their enduring conservation. By exploring pest management technique, we protect precious plant life, pioneer innovative pest control methods, and foster a symbiotic relationship between nature and humans.

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