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Systematic Implications of Seed Coat Morphology in Malvaceae

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Abstract: Seed morphological characters and seed coat sculpture of 14 species of *Malvaceae* were examined to assess systematic implications of seed coat sculpture. These taxa are *Malva aegyptia* L., *M. parviflora* L., *M. neglecta Wallr.*, *M. nicaeensis* All., *M. sylvestris* L., *Lavatera cretica* L., *Alcea rosea* All., *Sida alba* L., *Abutilon theophrasti* Medicus, *A. pannosum* (G. Forster) Schlecht., *Abelmoschus esculentus* (L.) Moench. *Hibiscus sabdariffa* L., *H. trionum* L., *and Gossypium barbadense* (L.). Seed shape, size and colour as well as outer epidermal cell patterns as seen by SEM, anticlinal cell boundaries and periclinal cell walls sculpture allow the recognition of two distinct groups among studied taxa. Seed coat features indicated both intra-group and inter-group relationships. Recognized groupings do not correspond well with the classical treatments of the *Malvaceae*, rather they suggest restructuring of tribal and generic taxonomy in the family. One important conclusion of this study is the inclusion of *Lavatera cretica* L. in the genus *Malva* as *M. linnaei*, M. F. Ray.

Key words: Taxonomy, SEM studies, seed coat sculpture, Malvaceae, Egypt

Introduction

The *Malvaceae* is a large, mainly tropical family of herbs, shrubs and small trees with more than 1000 species (Heywood, 1979). In Egypt, *Malvaceae* is represented by 32 species belonging to eleven genera (Täckholm, 1974; El Hadidi & Fayed, 1994/95; Boulos, 1995). The classification of *Malvaceae*, particularly at the tribal and generic levels, has been a matter of considerable debate (Hutchinson, 1967; Bates, 1968; Fryxell, 1975 & 1988). Seed characters have been used successfully in taxonomic studies of different taxa such as: Cruciferae (Fayed & El Naggar, 1988 & 1996; El Naggar & El Hadidi, 1998); *Hydrophyllaceae* (Chance & Bacon, 1984); *Solanaceae* (Axelius, 1992); *Scrophulariaceae* (Chuang & Heckard, 1983). Owing to the high economic value of seeds of *Malvaceae*, several studies, from different points of view, have been carried out, the most noteworthy are those of Singh & Chauhan (1984); Krebs (1994, a & b); Ray (1998); La Duke & Doebley (1995); El Naggar (1996).

The aim of the present study is to investigate the seed coat of some taxa of *Malvaceae* growing wildly or cultivated in Egypt and to utilize their characters in classification of the family.

Materials and Methods

The study is based on mature seed samples that were collected from their natural habitats as shown in Table 1.

Table 1: A list of the studied species, their origin and collectors.

Taxon	Localities and Collectors.
Malva aegyptia	Wadi El Kuf, Gebel Akhdar, Libya, El-Naggar, 1993.
M. parviflora	Assiut, Egypt, El Naggar, 1998.
M. neglecta	Wadi Al Arbeen, S.Sinai, Egypt, El Naggar, 1997.
M. nicaeensis	El Beida, Gebel Akhdar, Libya, El Naggar, 1992.
M. sylvestris	El Beida, Gebel Akhdar, Libya, El Naggar,1992.
Lavatera cretica	El Beid, Gebel Akhdar, Libya, El Naggar, 1992.
Alcea rosea	Assiut, Egypt, El Naggar, 1999.
Sida alba	Assiut, Egypt, El Naggar, 1998.
Abutilon theophrasti	Maghagha, El Menia, Egypt, El Naggar,1998.
A. pannosum	Gebl Elba, Egypt, El Naggar, 1998.
Abelmoschus esculentus	Assiut, Egypt, El Naggar, 1998.
Hibiscus trionum	Maghagha, El Menia, Egypt, El Naggar, 1998.
H. sabdariffa	Qina, Egypt, El Naggar, 1997.
Gossypium barbadense	Assiut, Egypt, El Naggar, 1999.

Seeds were examined by light and scanning electron microscopy. Seven to ten seeds of each sample were selected to cover the range of variation. Voucher specimens of studied taxa are deposited in CAI (Holmgren *et al.*, 1990) and AST (Herbarium of botany department, faculty of science, Assiut university, proposed abbreviation). Material for SEM was prepared by mounting dry seeds onto clean stubs using double-sided adhesive tape. These seeds were coated with gold in a JEOL JFC 1100E ion-sputtering device. They were then examined in a JEOL JSM 5400LV scanning electron microscopy, which operated at accelerated voltage of 15 kV at the Scanning Electron Microscopy Unit, Assiut University. The terminology used here is that proposed by Cutler (1979) and Bartthlott (1981, 1984).

Results and Discussion

Seeds of studied species of *Malvaceae* are morphologically diverse. Ranging from 1.0- 4.5 mm in length and 0.9- 3 mm in width. Seeds are black or brown in colour and discoid-reniform or ellipsoid-ovoid in shape. However, as noted in other groups (El Naggar & El Hadidi, 1998; Canne, 1980; Clark & Jernstedt, 1978; Chance & Bacon, 1984) the shape and size of mature seeds may vary in some studied taxa. Variation appears to be primarily related to the number and position of ovules developing within the ovary (Canne, 1979). Nevertheless for each studied specie of *Malvaceae* there is a typical shape and size (Figs. 1-30).

Utilizing seed morphology and seed coat features, seeds of examined taxa may be divided into two distinct groups. Within each group seed shape, size and epidermal cell patterns, anticlinal cell boundaries and periclinal cell walls sculpture, as seen by SEM, may further characterize each specie.

Group (1): Seeds of this group are discoid to reniform, brown, ranging from 1 mm to 1.5 mm in diameter. Epidermal cell patterns are tetra- pentagonal and elongated in one direction. Anticlinal cell boundaries raised and thick with definite extra longitudinal ridges. Periclinal cell walls flat. These features characterize six species namely: *Malva aegyptia* L., *M. parviflora L.*, *M. neglecta Wallr.*, *M. nicaeensis* All., *M. sylvestris* L. and *Lavatera cretica L.*. (Figs. 1-12). All these species belong to one tribe: *Malveae*. The present results indicate that *Lavatera cretica* is more closely allied to the studied species of *Malva*. The results from seed coat sculpture, therefore, confirm the conclusion of Ray (1998), who transferred this taxon, on account of the analysis of rDNA

Figs. 1-6 : SEM photomicrographs of seeds and seed coat sculpture.

1-	*Malva aegyptia*	X50	2-	*Malva aegyptia*	X750
3-	*Malva sylvestris*	X35	4-	*Malva sylvestris*	X500
5-	*Malva nicaeensis*	X35	6-	*Malva nicaeensis*	X500

Figs. 7- 12 : SEM photomicrographs of seeds and seed coat sculpture.

7-	*Malva parviflora*	X 35	8-	*Malva parviflora*	X 500
9-	*Malva neglecta*	X 50	10-	*Malva neglecta*	X 500
11-	*Lavatera cretica*	X 35	12-	*Lavatera cretica*	X 750

Figs. 13- 18 : SEM photomicrographs of seeds and seed coat sculpture.

13-	*Alcea rosea*	X 15	14-	*Alcea rosea*	X 500
15-	*Sida alba*	X 35	16-	*Sida alba*	X 1000
17-	*Abutilon theophrasti*	X 15	18-	*Abutilon theophrasti*	X 350

Figs. 19- 24 : SEM photomicrographs of seeds and seed coat sculpture.

19-	*Abutilon pannosum*	X 35	20-	*Abutilon pannosum*	X 150
21-	*Abutilon pannosum*	X 750	22-	*Abutilon pannosum*	X 2000
23-	*Hibiscus trionum*	X 15	24-	*Hibiscus trionum*	X 150

Figs. 25- 30 : SEM photomicrographs of seeds and seed coat sculpture.

25-	*Hibiscus sabdariffa*	X 15	26-	*Hibiscus sabdariffa*	X 350
27-	*Abelmoschus esculentus*	X 15	28-	*Abelmoschus esculentus*	X 500
29-	*Hibiscus trionum*	X 750	30-	*Gossypium barbadense*	X 500

ITS sequence, from *Lavatera* to *Malva* under the name *M. linnaei* M. F. Ray. On the other hand this group seems to be a natural group since all including taxa belong to one tribe *Malveae*. *Alcea rosea* usually classified within tribe *Malveae*. The circumscription of the tribe *Malveae* is usually based on the morphological and cytological features (La Duke & Doebley, 1995; Bates & Blanchard, 1970). This circumscription has been subjected to considerable debate (Fryxell, 1968 & 1988). On account of seed coat sculpture, in this study, *Alcea rosea* could be excluded from this tribe and may be housed in other tribe. Among this group the features of the extra longitudinal anticlinal ridges may be used to distinguish between studied taxa. These ridges are clearly obvious in seeds of *M. aegyptia, M. parviflora, M. nicaeensis, M. sylvestris* and *Lavatera cretica*, (Figs.2,4,6,8&12) but are faint or ill definite in *M. neglecta* (Fig. 10). The sculpture of the anticlinal cell boundaries may be distinguished between the species within this group. These are striated folded in *M. parviflora and M. sylvestris* (Figs. 4&8), and smooth in the rest of taxa included in this group.

Group (2): Seeds of this group are ellipsoid to ovoid or reniform, black to gray, ranging from 1.5-3.5 mm in length to 0.9-2.5 mm in width. Epidermal cell patterns tetra-polygonal, isodiametric, usually with hair bases. Anticlinal cell boundaries raised and thick. Periclinal cell walls flat or concave. This group comprises eight species namely: *Alcea rosea* All., *Sida alba* L., *Abutilon theophrasti* Medicus, *A. pannosum* (G. Forster) Schlecht., *Abelmoschus esculentus* (L.) Moench. *Hibiscus sabdariffa* L., *H. trionum* L. and *Gossypium barbadense* L. It seems to be an unnatural assemblage which include taxa, which belong to three different tribes: *Alcea rosea (Malveae)*, *Sida alba, Abutilon theophrasti* and *A. pannosum (Abutileae)*, *Abelmoschus esculentus, Hibiscus sabdariffa, H. trionum* and *Gossypium barbadense* (*Hibisceae*). Among this group the hair bases may be useful in distinguishing the studied taxa. Hair bases are absent or ill-defined as in *Sida alba, Abelmoschus esculentus* and *Gossypium barbadense* (Figs.16, 28 & 30) or well defined as in *Alcea rosea, Abutilon theophrasti, A. pannosum, Hibiscus sabdarffia* and *H. trionum* (Figs.14, 18, 20, 21, 24 & 26). The shape of these bases is also taxonomically useful. It is domated shaped with truncate apex in *Abutilon pannosum* (Fig. 21) or globular as in the rest of the species (Figs. 14 & 20).

Epidermal cell patterns in this group can be used to recognize the taxa. These are isodiametric and rhombic shaped in *Hibiscus trionum* (Fig. 29), but have different shape in the remaining taxa of this group. Epidermal cell patterns are not well defined in *Hibiscus sabdariffa* and *Gossypium barbadense (Hibisceae)*. The sculpture of anticlinal cell boundaries distinguishes between the studied taxa. These are striate folded as in *Abutilon pannosum* and *Hibiscus trionum*, (Fig. 22 & 29) or smooth in other taxa. Periclinal cell walls are flat in *Alcea rosea, Abutilon theophrasti, Abelmoschus esculentus Hibiscus trionum, H. sabdariffa* and *Gossypium barbadense* and concave in *Sida alba* and *Abutilon pannosum* (Figs. 16 & 22) the striate folded periclinal cell walls of *Hibiscus trionum* and *Abutilon pannosum* distinguish these two species from the rest of the studied species, which have smooth periclinal cell walls.

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