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Seed morphology and seed coat anatomy of some species of Apocynaceae and Asclepiadaceae

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SEM

Abstract Seed shape, dimensions, surface texture and sculpture, hilum shape and position were recorded for seven species of each of the Apocynaceae and Asclepiadaceae by using light microscope (LM) and scanning electron microscope (SEM). Seven patterns were recognized based on surface sculpturing pattern: reticulate (with five subtypes), striate, ruminate, papillate, colliculate, aculeate and rugose.

Anatomical investigation using light microscope showed that the hypodermis is present in the outer integument of two species and absent in the rest. The inner integument is recorded two types. The data proved useful in the construction of a bracketed key to the species. The potential taxonomic value of the recorded characters is indicated by the richness of variation recorded in the limited sample of genera and species.

Introduction

The Apocynaceae and Asclepiadaceae are relatively large families comprising a total of approximately 5000 species of mainly tropical or subtropical plants with abundant latex. The seed features of the two families include wings, comas, and arils.

The morphology of seed coat is usually stable and is little influenced by external environmental conditions while the seeds develop and ripen within the fruit (Heywood, 1971; Cole and Behnke, 1975; Barthlott, 1981). Therefore seed characters can provide useful data in the delimitation and identification of species. The morphologic features of different seed structures provide a wide range of characters which can play an important role on the identification of taxa (Vaughan, 1968) and have traditionally been used to solve systematic and phylogenetic problems. Micromorphology and ultra-structural data have contributed useful information for evolution and classification of seed plants and play an important role in the modern synthetic systems of angiosperms (Dahlgren, 1980). Several studies focused on intragenic seed coat variation (Juan et al., 2000; Segarra and Mateu, 2001) or on variation among several closely related genera (Zainhasan and Lester, 1990; Karam, 1997; Kanak Sahai et al., 1997; Koul et al., 2000; Abdel Khalik and Vander Maesen, 2002; Al-Gohary and Mohamed, 2007; Abdel Khalik, 2013). Scanning electron microscopy (SEM) provides deeper insight where gross morphology proves insufficient to analysis seed coat structure and surface sculpture. These two aspects are of a great taxonomic value at generic and infra-generic status (Brisson and Peterson, 1976, 1977).

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Very little research has been undertaken on the seed coat surface of the species of Apocynaceae and Asclepiadaceae as (Pichon, 1948, 1949; Leeuwenberg, 1994; Omlor, 1998; Dlcdm et al., 2010 and Kumar et al., 2011). In Egypt only a few Egyptian species have been worked out for seed coat surface as; Al Nawaihi et al., 2006 and the anatomy are not yet correctly projected. The present work examined the morphological and micro-morphological characteristics of the seeds for 14 species in Egypt, in a search for taxonomic characters useful in distinguishing of the species.

Materials and methods

The present study included seeds of seven species of Apocynaceae and seven species of Asclepiadaceae collected fresh from different localities in Egypt (Table 1). The materials studied were identified by means of comparison with specimens kept in the herbarium of the Agricultural Museum (CAIM). In addition, keys of Bailey (1916), Lindley (1932), Metcalfe and Chalk (1979), Hutchinson and Dalziel (1963), Täckholm (1974), Davis (1975), Pandey (1997), Endress and Bruyns (2000) and Boulos (2000). Reference herbarium specimens of studied species were prepared and kept in the herbarium of Botany and Microbiology Department, Faculty of Science (Girls Branch) Al-Azhar University. For seed morphology, five to seven seeds were investigated to record their dimensions, shape, color and surface texture. Details of seed sculpture were examined by a JEOL JSM – 5500 scanning electron microscope operated at an accelerated voltage of 20 kV and photographed. The terminology of Barthlott (1981, 1990) and Stearn (1992) was adopted to describe the SEM aspects of the seed coat.

Table 1 Collection data of the species included in the present study; all localities are in Egypt.

Family	Species	Locality and date
Apocynaceae	*Acokanthera spectabilis* Hook.	El-Orman Garden, 3/2009
	Carissa spinarum L.	The Zoo, 3/2009
	Thevetia peruviana (Pers.) K. Schum.	Agriculture Museum Garden, 3/2009
	Vinca rosea L.	The Zoo, 3/2009
	Alstonia scholaris (L.) R. Br.	The Zoo, 3/2009
	Nerium oleander L.	El-Kobba Palace, 3/2009
	Mascarenhasia elastica K. Schum.	Asswan Botanical Garden, 4/2009
Asclepiadaceae	*Leptadenia arborea* (Forssk.) Schweinf.	Asswan, 4/2010
	Leptadenia pyrotechnica (Forssk.) Decne.	Wadi Hagol, 3/2010
	Calotropis procera (Aiton) W. T. Aiton.	Al–Azhar University, 6/2009
	Cynanchum acutum L.	El-Fayoum, 3/2009
	Solenostemma argel (Delile) Hayne.	Asswan, 4/2010
	Asclepias curassavica L.	Asswan Botanical Garden, 4/2009
	Cryptostegia grandiflora R.Br.	Agriculture Museum Garden, 3/2009

For seed anatomy matured seed was soaked in boiling water, then hand section at 20–30 μm in thickness take place. The sections were stained according to Dilcher (1974) in safranin (1% solution in 50% ethanol) and light green (1% solution in 96% ethanol) then photographed.

Results and discussion

Examination of available specimens yielded a wealth of information concerning seed morphology, sculpture of seed surface and anatomy of seed coat. Variation in these three aspects among the species is listed in Table 2 and recorded comparatively for individual species in Table 3. Although the characters and their states are self explanatory, they are illustrated in Plates 1–3 for further clarification. Most of the characters and their states as defined in Table 2 are recorded for the first time for the species included in the present study.

The data recorded in Table 3 were used to construct the following bracketed key to the 14 species of Apocynaceae and Asclepiadaceae that it might help in the confirmation of their identification.

1. Seeds folded	2
1. Seeds flat	
2. Seed elliptic and seed coat reticulate-undulate	*Carissa spinarum*
2. Seeds flask-shaped; seed coat irregular reticulate…	*Solenostemma argel*
3. Seed winged	4
3. Seed wingless	
4. Seed texture hairy with papillate coat	*Calotropis procera*
4. Seed texture not hairy; coat not papillate	
5. Seed texture smooth and seed coat reticulate	*Leptadenia pyrotechnica*
5. Seed texture tuberculate and seed coat not so	
6. Seed coat ruminate	*Leptadenia arborea*
6. Seed coat colliculate	*Cynanchum acutum*
Seed globose	3
7. Seed flattened	5
Seed color off white and seed coat striate	*Thevetia peruviana*
8. Seed color otherwise and seed coat reticulate	
9. Seed color brown and seed size more than 10 mm	*Acokanthera spectabilis*
9. Seed color black and seed size 1–2 mm	*Vinca rosea*
10. Seed texture hairy or warty	
10. Seed texture tuberculated	
11. Seed texture hairy and seed coat reticulate–rugose…	*Nerium oleander*
11. Seed texture warty and seed aculeate	*Asclepias curassavica*
12. Seed oblong and coma persistent	*Alstonia scholaris*
12. Seed elliptic or long ovate and coma deciduous	
13. Seed elliptic and seed coat reticulate–verruculate	*Mascarenhasia elastica*
13. Seed long ovate; seed coat rugose	*Cryptostegia grandiflora*