External morphology of some seeds of Euphorbiaceae and their taxonomic significance

Krishna Chandra Dey* & S.K. Roy

Botany Department, University of Burdwan, Burdwan - 713104, India

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Seed morphology of 16 genera and 33 species of Euphorbiaceae collected from Hooghly District, West Begal has been described. Only seed surface, shape, dimension and colour at mature stage have been considered. Taxonomic significance of the seed structure has been discussed.

Key-words - Morphology, seeds, Euphorbiaceae.

INTRODUCTION

THE family Euphorbiaceae consists of 300 genera and 5000 species (Willis, 1973), distributed in the sub-tropical, warm-temperate climatic regions of the world. Prain (1963) recorded 40 genera and 100 species of this family in "Bengal - Plants".

The developmental and morphological studies on seeds of some Indian taxa of Euphorbiaceae have been made by Baiges and Blanche (1991), Barthlott (1984), Bhatnagar and Johri (1972), Corner (1976), Joan (1967), Johri and Kapil (1953), Mangaly *et al.* (1979), Martin and Barkley (1961), Nair and Abraham (1963), Netolitzky (1926), Pal and Chopra (1987), Serwatka (1972), Singh (1954, 1970, 1971), Singh and Chopra (1971), Tomb (1974) and Wunderlich (1967, 1968). The present paper deals with the external morphology of mature seeds of the family collected from Hooghly District of West Bengal.

The morphological characters of seeds described are size, natural colour, presence or absence of caruncle, position of hilum and the surface ornamentation of the seed coat at maturity. The new information on seed morphology is of taxonomic signifcance which can be useful for identification of seeds.

MATERIAL AND METHODS

Only mature and fully dried seeds have been investigated for external morphological features. The minute seeds have been studied under SEM and the larger ones have been observed under light microscope.

For SEM study, the seeds were completely dehydrated so that electron scattering is attended satisfactorily to produce good quality electronmicrograph. This is followed by coating the seeds with thin film of gold in ions sputter coater and studied under Hitachi-s-530. SEM are photographed on ORWO 120 film.

DISCUSSION

It has been observed (Table 1) that in most of these species of herbs or shrubs possess carunculate seeds, while the seeds of trees are mostly excarunculate. The surface ornamentations of the seed coat are of various types. This is one of the characters considered for seed coat morphology. There are two types of seeds, one with a distinct longitudinal furrow in the seed surface and the other without longitudinal furrow. If the two characters are considered together, then it is possible to identify various species under a genus. The other characters which may be used for differentiating species within a genus are the position of hilum, shape and size of the seeds.

Thus, using all these characters collectively the species of various genera of this family can be identified.

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* Ghoshpur Union Netaji Bidyapith, Ghoshpur, Hooghly, India.

Table 1. Showing the range of morphological characters of seeds of Euphorbiaceae

Sl. No.	Name of plant	Colour of seeds	Shape and size	Caruncle present/absent	Position of Hilum/basal or central	Nature and surface of seed coat
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Tribe - Euphorbieae					
1.	*Euphorbia dracunculoides* Lam.	Black	Triangular, ovoid to ellipsoidal, elngth 2.5 3 mm, breadth 1.7 2.2 mm	Carun culate	Circular, short, basal	Smooth and glossy, ventral surface flat, longitudinal ridges spearated the faces, imperfect reticulation present on the dorsal surface. Tuberculate, tubercles (Pl. 1, figs 5,6) irregular in shape, below the tubercles inner wall of the outer epidermis possess fine filamentous like processes forming reticulum.
2.	*E. hypericifolia* Linn.	Deep Brown	Tetragonal or 4-ribbed, ovoid to elliptic or oblong, length 1.2 - 1.6 mm, breadth 0.7 - 0.9 mm.	Carunculate	Short basal	Smooth and glossy, ventral surface flat, longitudinaly furrowed, distinct 3-5 horizontally furrowed on the surface, Reticulate, reticulum (Pl. 1, fig 1) vertically arranged, luman present.
3.	*E. parvifolia* Mey.	Grey	Tetragonal or 4-ribbed, olbong to elliptic, length 1 1.2 mm, breadth 0.5 0.8 mm.	Carunculate	Short basal	Smooth, glossy, ventral surface flat, longitudinally furrowed, surface papillose, irregular croos ridges present on the surface. Reticulate, reticula (Pl 1, fig. 3), polygonal in shape.
4.	*E. hirta* Linn.	Brown	Tetragonal or 4-ribbed, ovate planoconves, length-0.6 - 0.9 mm, breadth - 0.5 - 0.8 mm.	Carunculate	Short basal	Smooth, glossy, ventral surface flat, longitudinally furrowed, horizontally irregular, 5-6 cross ridges present on the surface. Tuberculate, tubercles (Pl.1, fig.7) irregular in shape, forming reticulum, waxy deposition present on thesurface of seed coat.
5.	*E. thymifolia* Linn.	Orange	Tetrangonal or 4-ribbed, ovate to oblong, planoconvex or slightly elliptic, length 0.6 - 0.8 mm, breadth 0.3 - 0.4 mm.	Carunculate	Short basal	Smooth, glossy, ventral surface flat, longitudinally furrowed, undifferentiated horizontal furrows present on the surface. Tuberculate, tubercles (Pl. 1, fig. 4, 10), spherical in shape of the adjacent rows, oppositely or subopposite ly arranged.
6.	*E. prostrata* Ait.	Reddish brown	Tetragonal or 4-ribbed, ovate to oblong or ellipsoidal, length 0.9 - 1 mm, breadth 0.5 - 0.8 mm.	Carunculate	Short basal	Smooth glossy, ventral surface flat, longitudinally furrowed, prominent 6-7 horizontal furrows present on thesurface. Reticulate, wall of the reticulum (Pl 1, fig -2), thin, irregular ridges and furrows in, transverse direction of seed coat.
7.	*E. serpens* H.B.	Light reddish brown	Tetrangonal or 4-ribbed, oblong, planoconvex, length 0.9 - 1-0 mm, breadth 0.7 - 0.8 mm.	Carunculate	Short basal	Smooth, glossy, ventral surface flat, longitudinally furrowed, undifferentiated corss-ridges present on the surface. rEticulate, reticula (Pl-1, fig 9), thin walled, lumen of reticulum trigonal to polygonal in shape.
	Tribe - Phyllantheae					
8.	*Bridelia stipularis* Blume	Deep brown to blackish	Triangular, oval to elliptical or boatshaped length 9.5 10 mm, breadth 5.5 - 6.0 mm.	Excarunculate	Circular, short, central	Rough, not glossy, leathery, both ends pointed, flat woody, ventral surface longitudinally furrowed. Surface faintly reticulate. Single median ribbed on dorsal side, surface ruged, arranged with elevated and non-elevated in areas, fibers like deposits irregularly scattered over rugae (Pl. 1, fig 8).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
9.	*Breynia rhamnoides* Muell-Arg.	Light brown	Triangular or triribbed, broadly rounded length 3.0 - 4.0 mm, breadth, 2.0 2.5 mm.		Circular, short, basal	Smooth, glossy, flaty ventral surface possessing longitudinally forrowed, reticulate, reticule (Pl -2, fig 11, 12), irregularly arranged, muri unvenly thick.
10.	*Phyllanthus emblica* Linn.	Orange brown	Triangular, crescent-shaped, length 5.00 - 6.00 mm, breadth-3.5 - 4.5 mm.		Circular, central	Smooth, glossy, ventral surface flat, longitudinally furrowed, both ends pointed. Reticulate, reticula of the adjacent rows alternatively arranged (Pl-2, fig 13), muri thin.
11.	*P. reticulatus* Poir.	Deep brown to black	Triangular oval, length 1.8 - 2.0 mm, breadth 1.0 - 1.5 mm.	Excarunculate	Circular, short, central	Warty smooth, flattish, ventral side possessing longitudinally furrowed, beak like projection towards the halior end. Reticulae, reticula irregularly arranged (Pl - 2, figs 14, muri thin, lumen variously shaped.
12.	*P. simplex* Retz.	Creamy light brown	Triangular, crescent-shaped, length 1.5 2.0 mm, breadth 1.0 - 1.3 mm.	Excarunculate	Circular, short, basal	Smooth, ventral surface flat, possessing longitudianl furrows, faint straitions present on thesurfce, dorsal surface ribbed. Reticulate, reticula (Pl-2, figs 17, 19) verticaly arranged, reticulum of the adjacent rows alternate, muri thin, lumen irregular in shape.
13.	*P. amarus* Schum & Thonn	Whitish creamy to light brown	Triangular, dome-shaped, length 0.8 - 0.9 mm breadth 0.5 0.6 mm.	Excarunculate	Circular, basal	Smooth, glossy, prominent longitudinal straitions present 5-7 transverse (Pl-3, fig 24) alternative ridges present all over the seed coat, adjacent ridges and furrows interconnected with vertical rows of minor ridges and furrows.
14.	*P. urinaria* Linn.	Light yellow to brown	Triangular Gar-shaped or lenticular to reniform or nearly semilunar, length 1.0 - 1.5 mm breadth 0.7 - 1.0 mm	Excarunculate	Circular, basal	Smooth, glossy, horizontal furrow (10-12) present on the whole surface (Pl 3, fig. 22) alternat with fine reticulation in between the two ribbs, arranged in vertical row, furrows present.
15.	*Drypetes roxburghii* (Wall) Hurusawa.	Light brown	Triangular, spindle shaped, length 16.5 - 17.0 mm, breadth 7.0 - 8.0 mm.	Excarunculate	Short basal	Rough, not blossy, tri-ribbed slightly flat coarsely wrinkled, woody, ventral surface longitudinally furrowed. Reticulate, reticule (Pl-2), fig. 20), polygonal in shape, muri thick.
16.	*Antidesma ghesaembilla* Gaertn.	Deep brown to black	Triangular, compressed or circular to disk shaped, diametre 3.0 - 4.0 mm.	Excarunculate	Circular, short basal	Rough, not glossy, flat, tri-ribbed, ventral surface longitudinally furrowed, coarsely wrinkled forming narrow grooves. Surface undulated, undulate (Pl.2,figs 15, 18), forming troughs and crests, crests and troughs shows subsidary minor projection and depression.
	Tribe - Crotoneae					
17.	*Jatropha curcas* Linn.	Straw colour	Triangular, compressed to ellipsoidal, length 16.0 - 17.0 mm., breadth 9.0 - 10.0 mm.	Carunculate	Short basal	Rough, not glossy, flat, woody, ventral portion longitudinally furrowed, surface uneven or coarsely reticulate forming a narrow grooves, dorsal surface ribbed, a narrow grooves, dorsal surface ribbed, Rugose irregular filamentous thickenignss and depression present on the seed coat surface (Pl. 3, fig. 25).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
18.	*J. gossypifolia* Linn.	Light brown	Triangular, long, oblong, length 7.0 - 9.0 mm, breadth r.0 - 5.0 mm.	Carunculate	Circular, short, basal	Smooth, glossy, flat, ventral surface longitudinally furrowed, microreticulate, a short ridge present on the dorsal surface, caruncale covered by a black line. Surface rougose, irregularly arranged, filamentous (Pl-3, fig. 26) and non-filamentous thickenings present on theseed coat surface.
19.	*J. panduraefolia* Andr.	Brown black patches	Triangular, long, oblong to rod-shaped, length 9.0 - 10.0 mm., breadth 5.0 - 6.0 mm.	Carunculate	Circular, Short, basal	Smooth, glossy, flat longitudinally furrowed on the ventral surface, whole surface covered by black dots. Rugose, reticulate, reticula (Pl-2, fig-21) compactly arranged, muri thick irregular, lumen variously-shaped.
20.	*Croton bonplandianus* Baill.	Grey	Triangular, oblong to elliptic, length 4.5 - 5.0 mm, breadth 2.0 - 2.5 mm	Carunculate	Circular, Short, basal	Smooth, glossy, ventral surface flat posessing longitudinal furrows, flat portion consists of two gently sloping faces and the junction is marked by a narrow line from one end to other, cellular reticulation forming narrow grooves, reticula (Pl-3, fig-3), hexagonal in shape, muri straight, lumen, smooth.
21.	*C. caudatus* Geisel.	Deep brown to black	Triangular, ellipsoidal, length 10.0 - 11.0 mm, breadth 8.0 - 9.0 mm	Carunculate	Circular, Short, basal	Rough, flat, ventral side longitudinally furrowed, uneven or coarsely reticulate forming narrow grooves, 1-2 rows of longitudinal furrows on the central of the dorsal surface, Rugose, stellae type (Pl-3, figs 31, 32), hairs present on the seed coat surface, rugate irregularly arranged with flakes-like thickenings.
22.	*Chrozophora plicata* A. Juss.	Light brown	Triangular, broadly rounded to ovoid, diametre 3.0 mm to 4.0 mm	Excarunculate	Circular, Short, basal	Rough, slightly flat mottled, coarse or uneven surface forming reticulation, longitudinally furrowed on theventral surface. Rugose, reticulum irregular (Pl-3, figs-27, 28, 30), muri of reticulum thick, lumen polygonal.
23.	*C. prostrata* Dalz.	Grey	Triangular, broadly rounded to ovoid, diametre 2.0 - 2.5 mm	Excarunculate	Circular, short, basal	Rough, slightly flat, longitudinally furrowed on the ventral surface, uneven or coarsely reticulate forming narrow grooves on the surface. Tuberculate, tubercles (Pl-3, fig-29), irregularly arranged forming ridges and depressed areas.
24.	*Acalypha fallax* Muell-Arg.	Grey	Triangular, pitcher-shaped, length 1.5 - 2.0 mm, breadth 1.2 - 2.0 mm	Carunculate	Circular, short	Smooth glossy, ventral side flat, longitudinally furrowed, prominent, reticulation forming narrow grooves on the surface, reticula (Pl-4, fig-35) thickwalled.
25.	*A. indica* Linn.	Brown to light grey	Triangular, conical, length 1 - 1.5 mm breadth 0.5 - 1.0 mm	Carunculate	Circular, short, central	Warty smooth, flat, ventral surface longitudinally furrowed, faintly cellular reticulate. Upper surface leathery, inner epidermis with distinct irregular reticulum (Pl-4, figs-33, 34), muri irregur, broken, lumen, with small tubercles.
26.	*Trewia nudiflora* Linn.	Deep brown	Triangular, ovoid to rounded, diametre 7.0 - 9.0 mm	Excarunculate	Short & basal	Smooth, a woody, tubercle at one end. Reticulate, reticula (Pl-4, fig-42) pentagonal, muri straight and thick.
27.	*Mallotus philipinensis* Muell-Arg.	Black	Triangular, ovoid plano-convex or more or less rounded, diametre 4.0 - 5.0 mm	Excarunculate	Short & basal	Rough, flat, woody, ventral surface flat possessing short longitudinal furrows nerve-like fibers present on the surface, mottled, microreticulate. Surface rugolose, rugae irregularly arranged (Pl-4, fig-36) often wavy

(1)	(2)	(3)	(4)	(5)	(6)	(7)
18.	*J. gossypifolia* Linn.	Light brown	Triangular, long, oblong, length 7.0 - 9.0 mm, breadth r.0 - 5.0 mm.	Carunculate	Circular, short, basal	Smooth, glossy, flat, ventral surface longitudinally furrowed, microreticulate, a short ridge present on the dorsal surface, caruncale covered by a black line. Surface rougose, irregularly arranged, filamentous (Pl-3, fig. 26) and non-filamentous thickenings present on theseed coat surface.
19.	*J. panduraefolia* Andr.	Brown black patches	Triangular, long, oblong to rod-shaped, length 9.0 - 10.0 mm., breadth 5.0 - 6.0 mm.	Carunculate	Circular, Short, basal	Smooth, glossy, flat longitudinally furrowed on the ventral surface, whole surface covered by black dots. Rugose, reticulate, reticula (Pl-2, fig-21) compactly arranged, muri thick irregular, lumen variously-shaped.
20.	*Croton bonplandianus* Baill.	Grey	Triangular, oblong to elliptic, length 4.5 - 5.0 mm, breadth 2.0 - 2.5 mm	Carunculate	Circular, Short, basal	Smooth, glossy, ventral surface flat posessing longitudinal furrows, flat portion consists of two gently sloping faces and the junction is marked by a narrow line from one end to other, cellular reticulation forming narrow grooves, reticula (Pl-3, fig-3), hexagonal in shape, muri straight, lumen, smooth.
21.	*C. caudatus* Geisel.	Deep brown to black	Triangular, ellipsoidal, length 10.0 - 11.0 mm, breadth 8.0 - 9.0 mm	Carunculate	Circular, Short, basal	Rough, flat, ventral side longitudinally furrowed, uneven or coarsely reticulate forming narrow grooves, 1-2 rows of longitudinal furrows on the central of the dorsal surface, Rugose, stellae type (Pl-3, figs 31, 32), hairs present on the seed coat surface, rugate irregularly arranged with flakes-like thickenings.
22.	*Chrozophora plicata* A. Juss.	Light brown	Triangular, broadly rounded to ovoid, diametre 3.0 mm to 4.0 mm	Excarunculate	Circular, Short, basal	Rough, slightly flat mottled, coarse or uneven surface forming reticulation, longitudinally furrowed on theventral surface. Rugose, reticulum irregular (Pl-3, figs-27, 28, 30), muri of reticulum thick, lumen polygonal.
23.	*C. prostrata* Dalz.	Grey	Triangular, broadly rounded to ovoid, diametre 2.0 - 2.5 mm	Excarunculate	Circular, short, basal	Rough, slightly flat, longitudinally furrowed on the ventral surface, uneven or coarsely reticulate forming narrow grooves on the surface. Tuberculate, tubercles (Pl-3, fig-29), irregularly arranged forming ridges and depressed areas.
24.	*Acalypha fallax* Muell-Arg.	Grey	Triangular, pitcher-shaped, length 1.5 - 2.0 mm, breadth 1.2 - 2.0 mm	Carunculate	Circular, short	Smooth glossy, ventral side flat, longitudinally furrowed, prominent, reticulation forming narrow grooves on the surface, reticula (Pl-4, fig-35) thickwalled.
25.	*A. indica* Linn.	Brown to light grey	Triangular, conical, length 1 - 1.5 mm breadth 0.5 - 1.0 mm	Carunculate	Circular, short, central	Warty smooth, flat, ventral surface longitudinally furrowed, faintly cellular reticulate. Upper surface leathery, inner epidermis with distinct irregular reticulum (Pl-4, figs-33, 34), muri irregur, broken, lumen, with small tubercles.
26.	*Trewia nudiflora* Linn.	Deep brown	Triangular, ovoid to rounded, diametre 7.0 - 9.0 mm	Excarunculate	Short & basal	Smooth, a woody, tubercle at one end. Reticulate, reticula (Pl-4, fig-42) pentagonal, muri straight and thick.
27.	*Mallotus philipinensis* Muell-Arg.	Black	Triangular, ovoid plano-convex or more or less rounded, diametre 4.0 - 5.0 mm	Excarunculate	Short & basal	Rough, flat, woody, ventral surface flat possessing short longitudinal furrows nerve-like fibers present on the surface, mottled, microreticulate. Surface rugolose, rugae irregularly arranged (Pl-4, fig-36) often wavy

(1)	(2)	(3)	(4)	(5)	(6)	(7)
28.	*M. repandus* Muell-Arg.	Deep brown	Triangular, globose rounded, diametre 5.0 - 6.0 mm	Excarunculate	Short, basal & circular	Rough, woody, ventral surface possessing longitudinal canal, uneven or coarsely reticulate, forming narrow grooves, prominent median ribbed on the dorsal surface. Rugose, rugae (Pl-4, fig-45) irregularly arranged, rod-like and filamentous processes present all over the seed coat surface.
29.	*Ricinus communis* Linn.	Irregular, deep brown to black patches	Triangular, ellipsoidal, length 8.0 - 10.0 mm, breadth 5.0 - 7.0 mm	Carunculate	Circular, short & basal	Smoth, gloosy, flat, ventral side longitudinally furrowed, forsal surface slightly convex projecting ridge formed in the centre by the remains of raphae or raphial bundle. Rugose, occasionally tuberculate (Pl-4, fig-38), irregular rod-like processes present on the seed coat surface.
30.	*Gelonium multiflorum* A. Juss.	Light brown	Triangular, bi-planoconvex, subglobose or cup-shaped, diametre 8.0 - 9.0 mm	Excarunculate	Circular, short & basal	Smooth not glossy, slightly flattish, ventral surface longitudinally furrowed, woody, uneven surface forming narrow grooves, tubercals present at the base. Rugate with irregulary arranged (pl-4, fig-39).
31.	*Tragia hispida* Willd.	Mixture of brown-grey patches	Triangular, globose rounded, diametre 3.00 0 - 4.0 mm	Carunculate	Cricular, centrally placed	Smooth, not glossy, not flattish, ventral surface longitudinally furrowed, raphe line is on the surface forming uneven pathces, caruncle, canal shaped. Tuberculata, tubercles (Pl-4, fig-37, 44) irregularly arranged, intertubercular areas smooth.
32.	*T. involucrata* Linn.	Mixture of brown black patches	Triangular, globose rounded, diametre 4.5 - 5.0 mm	Carunculate	Circular, centrally placed	Smooth, not glossy, not flattish, ventral surface longitudinally furrowed, short raphae line is on the surface forming uneven patches, caruncle black bi-forked. Surface rugate with irregularly arrange with flakes like thickenings and with troughs (Pl-4, fig-44).
33.	*Sebastiania chamaelea* Muell -Arg.	Creamy-light brown	Triangular, oblong to cylindric or subglobose, length 3.0 - 3.5 mm, breadth 2.0 2.5 mm.	Carunculate	Short, circular, basal	Smooth, warty, flattish, ventral surface longitudinally furrowed, microreticularte, dorsal surface slightly ribbed. Reticulate, reticula irregular in shape, (Pl-4, fig-40, 43), tuberculate, tubercles irregularly arranged.

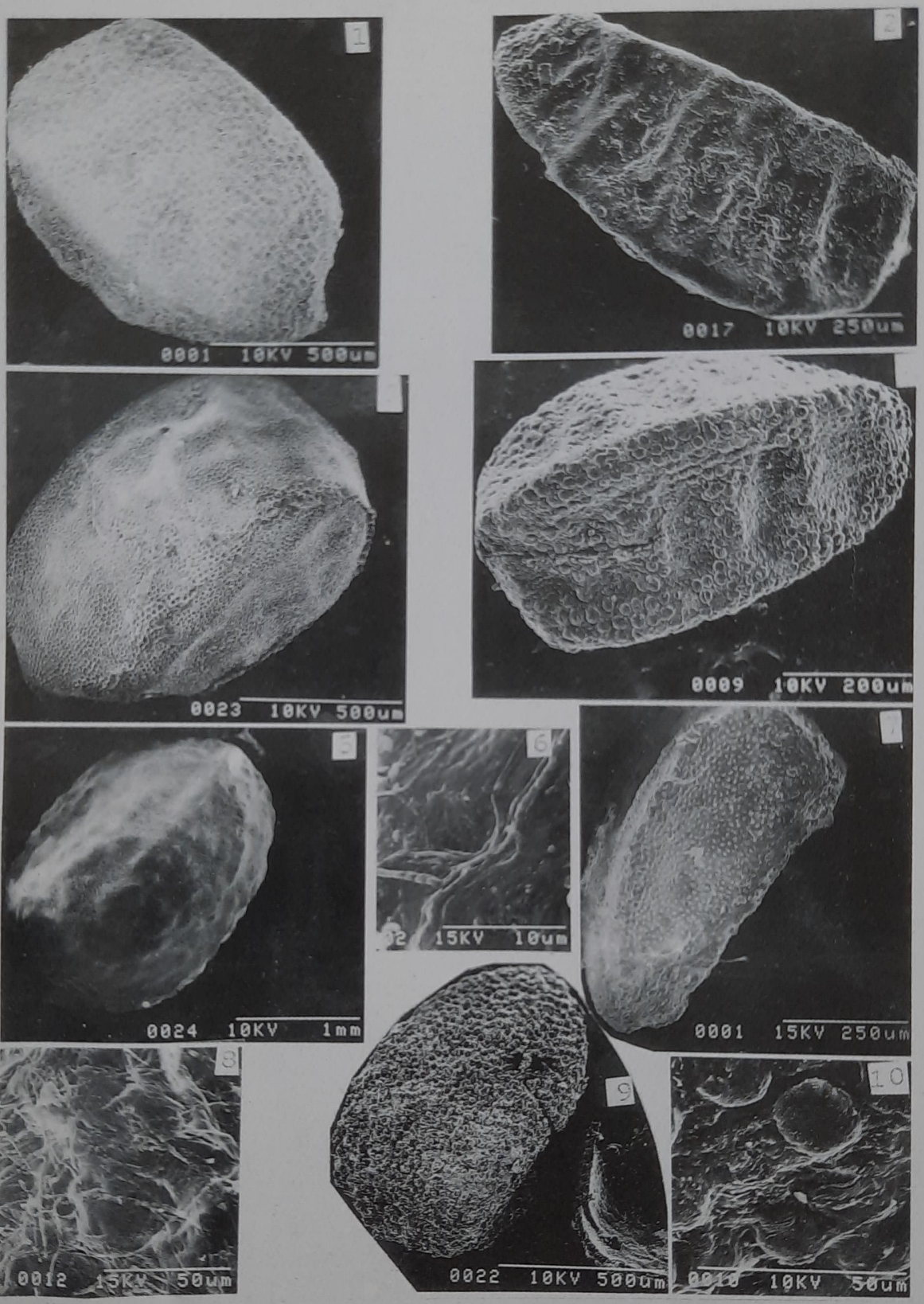

Plate 1

1. *Euphorbia hypericifolia*. Complete seed showing the surface ornamentation pattern.
2. *E. prostrata*. Complete seed showing the surface ornamentation pattern.
3. *E. parvifolia*. Complete seed showing the surface ornamentation pattern.
4. *E. thymifolia*. Complete seed showing the surface ornamentation pattern.
5. *E. dracunculoides*. Complete seed showing the surface ornamentation pattern.
6. *E. dracunculoides*. Part of the seed coat surface enlarged to show the details of ornamentation pattern.
7. *E. hirta*. Complete seed showing the surface ornamentation pattern.
8. *Birdelia stipularis*. Part of the seed coat surface enlarged to show the details of ornamentation pattern.
9. *Euphorbia serpens*. Complete seed showing the surface ornamentation pattern.
10. *E. thymifolia* Part of the seed coat surface enlarged to show the details of ornamentation pattern.

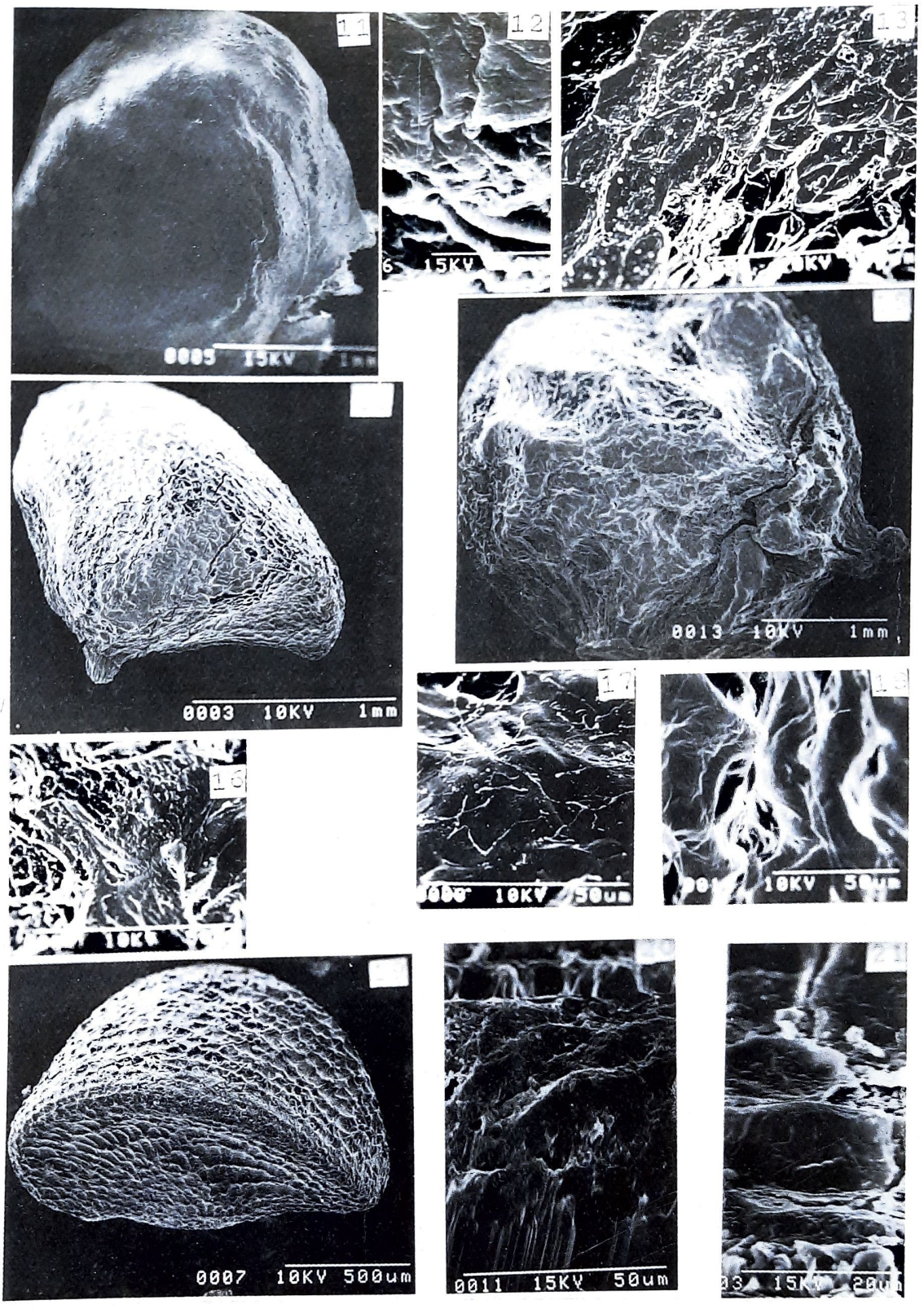

Plate 2

11. *Breynia rhamnoides.* - Complete seed showing the surface ornamentation pattern..
12. *B.rhamnoides.* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
13. *Phyllanthus emblica.* - Part of the seed coat surface enlarged to show the details reticulation pattern.
14. *P. reticulatus.* - Complete seed showing the surface ornamentation pattern.
15. *Antidesma ghesaembilla.* - Complete seed showing the surface ornamentation pattern.
16. *Phyllanthus reticulatus.*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.
17. *P. simplex.* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
18. *Antidesma ghesaembilla*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.
19. *Phyllanthus simplex* - Complete seed showing the ornamentation pattern.
20. *Drypetes roxburghii*- Part of the seed surface enlarged to show the details of ornamentation pattern.
21. *Jatropha pandurae folia*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.

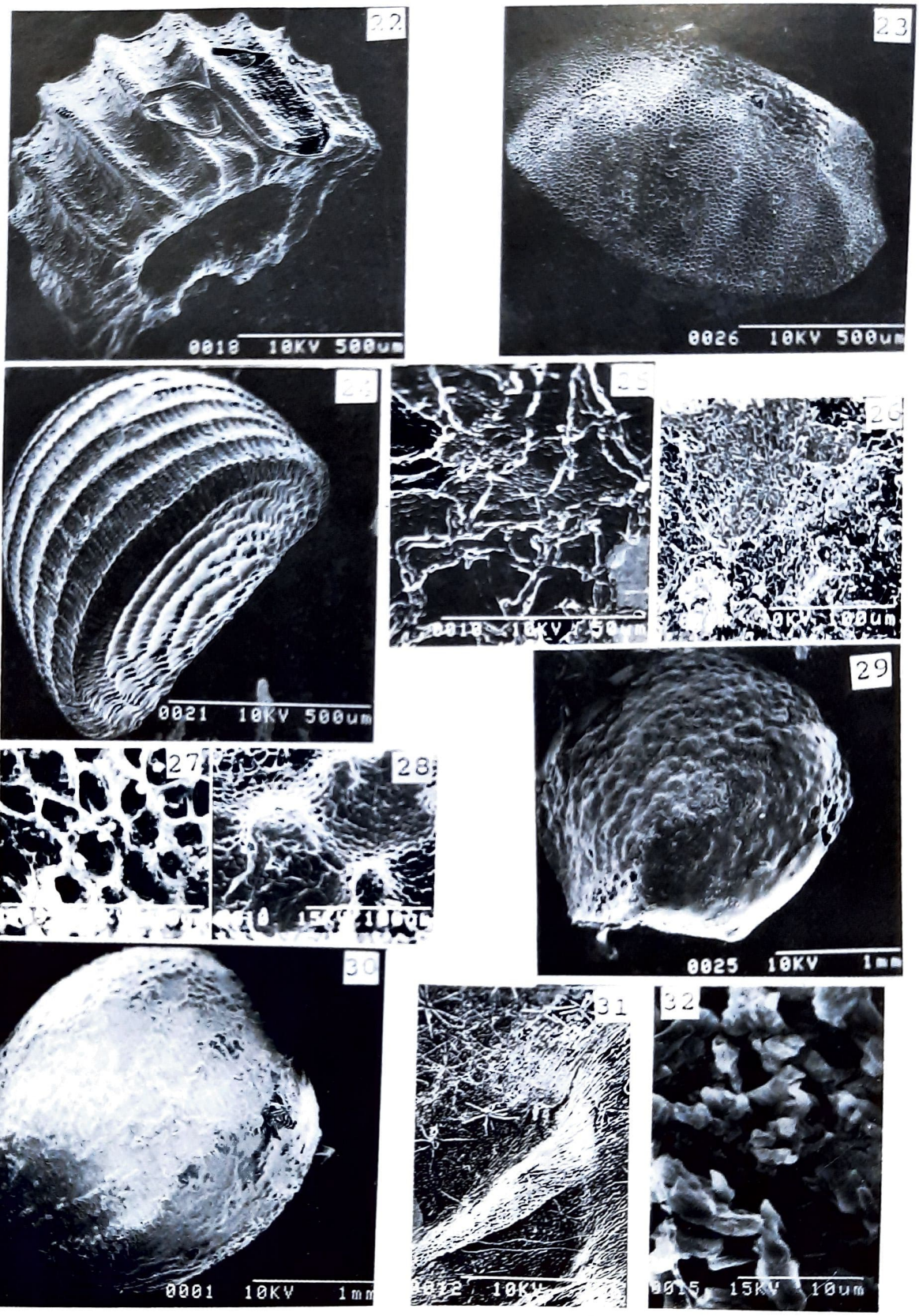

Plate 3

22. *Phyllanthus urinaria*. Complete seed showing the ornamentation pattern.
23. *Croton bonplandianus*- Complete seed showing the ornamentation pattern.
24. *Phyllanthus amarus*. - Complete seed showing the ornamentation pattern.
25. *Jatropha curcas*.- Part of the seed coat surface enlarged to show the details of ornamentation pattern.
26. *J. gossypifolia*. - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
27, 28. *C. plicata*.- Part of the seed coat surface showing reticulation pattern.
29. *C. prostrata*- Complete seed showing the reticulation pattern.
30. *C. plicata* - Complete seed showing the ornamentation pattern.
31. *Croton caudatus*. Part of the seed coat surface showing stellate type of hairs.
32. *C. caudatus*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.

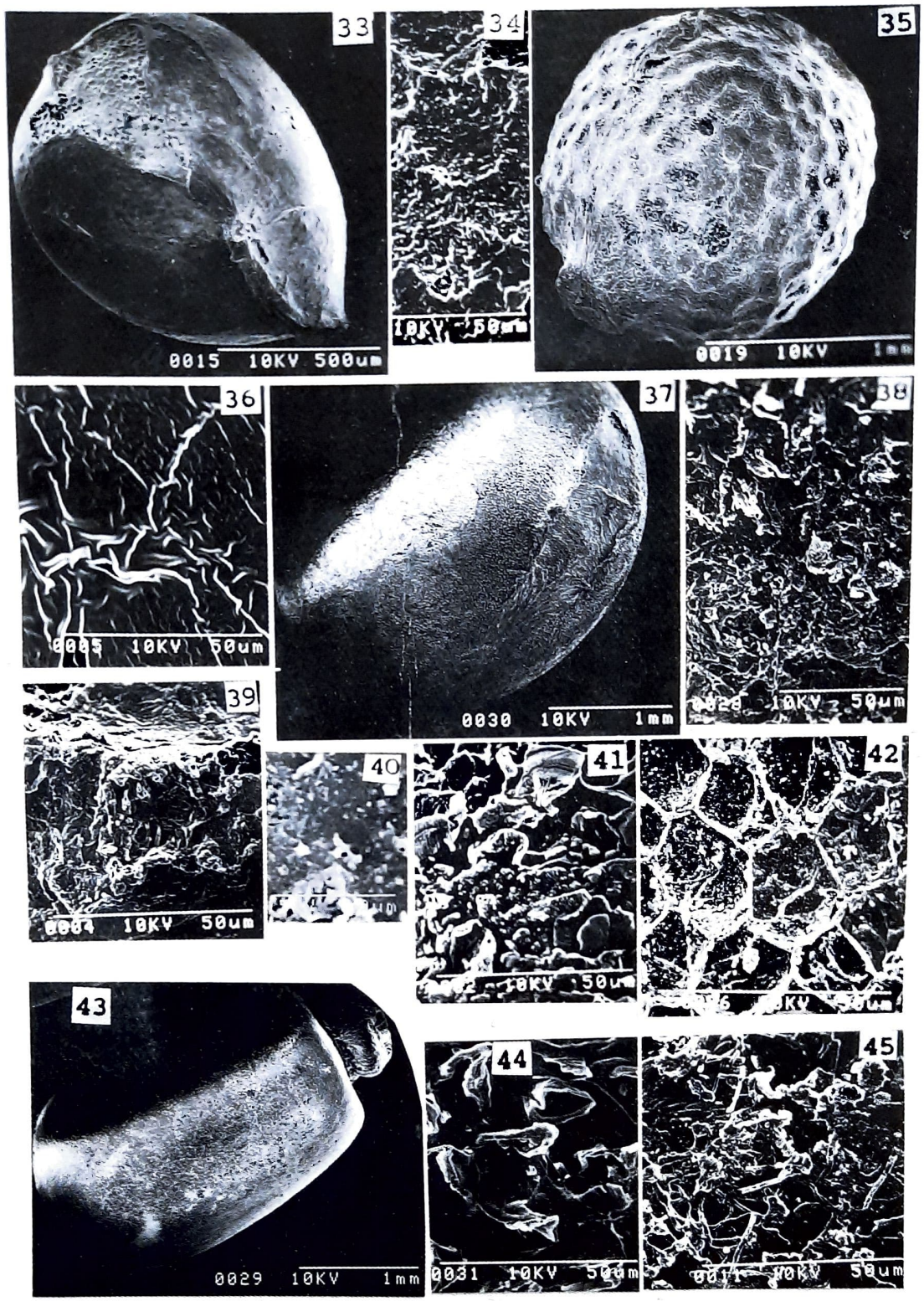

Plate 4

33. *Acalypha indica* - Complete seed showing the ornamentation pattern.
34. *A. indica* - Part of the seed coat surface enlarged to show the details of reticulation pattern.
35. *A. fallax* - Complete seed showing the reticulation pattern.
36. *Mallotus philipinensis* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
37. *Tragia hispida.* - Complete seed showing the ornamentation pattern.
38. *Ricinus communis* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
39. *Gelonium multiflorum.*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.
40. *Sebastiania chamaelea.*- Part of the seed coat surface enlarged to show the details of ornamentation pattern.
41. *Tragia involucrata.* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
42. *Trewia nudiflora.* - Part of the seed coat surface enlarged to show the reticulation pattern.
43. *Sabastiania chamaelea.*- Complete seed showing the ornamentation pattern.
44. *Tragia hispida* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.
45. *Mallotus repandus.* - Part of the seed coat surface enlarged to show the details of ornamentation pattern.

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