

THE PLANT FAMILY SOLANACEAE:

SEEDS IN SOLANACEAE (mostly after Hunziker Ref. 569a)

(J.A.M.van BALKEN)

INTRODUCTION

Like in all plants families the taxonomy in Solanaceae is based on a whole set of plant morphological characteristics such as, color and form of the corolla, [appearance or lack of hairs](#), hair types, calyx characteristics, androecium (anthers), gynoecium, [fruits](#) etc.. The taxonomic importance of the [embryo](#) and [cotyledons](#) in seeds of the plant family Solanaceae has been stressed by A.T. Hunziker in his preface of "The Genera of Solanaceae (A.R.G.Gantner Verlag K.G., 2001) and in his key to the subfamilies as well in his detailed descriptions of the 92 genera these features have been highlighted significantly. This page describes the seeds in the Solanaceae with a focus on seed and embryo morphology.

SEEDS IN SOLANACEAE

Seed morphology

A general structure of the seed can be found in [diagram 1](#) and [diagram 2](#).

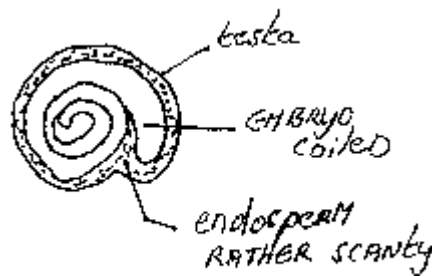


Diagram1: Seed morphology

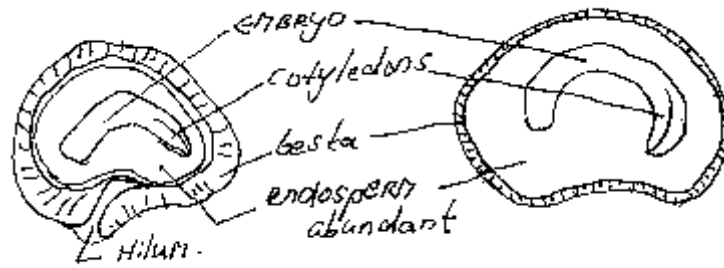


Diagram 2: Seed and embryo morphology

1. Seed form

The form of the seed in the plant family Solanaceae varies widely and ranges from:

- Compressed, flattened to depressed
- Ellipsoid, elliptical-ovate, ellipsoid-ovate, ovate, ovoid, plano-convex, globose, globose-depressed, subglobose, subglobose-depressed, nearly orbicular, suborbicular, sphaerical, subsphaerical, disc-shaped (discoidal), peltate, globose-reniform, discoidal-reniform, orbicular-reniform, subreniform, angulate-subreniform, reniform (kidney-shaped), boomerang-shaped, bacilliform, rod-shaped, lenticular, long, thin and very narrow (javelin-shaped), elongated, subcuboidal, cuboidal, cuboidal-elongated, subpolyedric, polyedric, imbricate, irregular-shaped, prismatic, polyedric to triquetrous.
- With -(angulated) or without wings.

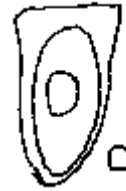
Seed form



Peltate



Sub-polyedric



Imbricate



Imbricate



Polyedric



Polyedric-triquetrous



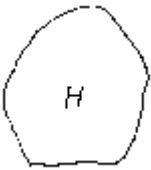


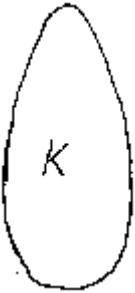


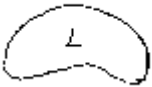

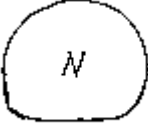
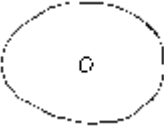





Angulate-subreniform



Reniform



***Nierembergia
hippomanica* Miers**

 <p>Cuboidal</p>	 <p>Cuboidal</p>	 <p>Cuboidal-elongated</p>	 <p>Elongated</p>
	 <p><i>Browallia demissa</i> L.</p> <p>Cuboidal</p>		 <p><i>Brunfelsia calycina</i> B.</p> <p>Elongated</p>
 <p>Boomerang-shaped</p>	 <p>Discoidal-reniform</p>	 <p>Globose depressed</p>	 <p>Discoidal</p>
	 <p><i>Solanum melongena</i> L.</p> <p>Discoidal-reniform</p>		 <p><i>Solanum acaule</i> Bit.</p> <p>Discoidal</p>
 <p>Ellips-ovate</p>	 <p>Sub-globose</p>	 <p>Sub-orbicular</p>	

2. Seed size

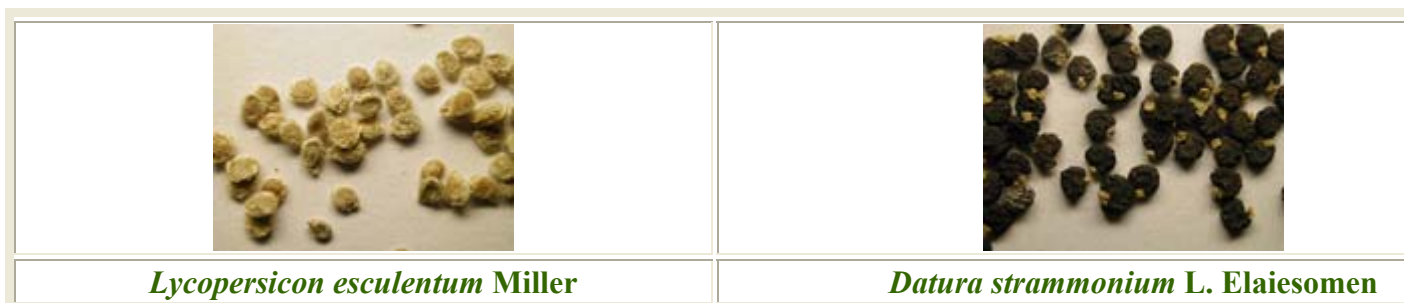
The size of the seed is mostly between 1.2-2.5 mm. long; sometimes smaller (hardly 0.75 mm. long; between 0.6-1 mm.long; the smallest being 0.3-0.4 mm. long.) or larger (between 4-6.5 mm. long) exceptionally very large: 7-8 mm.long.

3. Episperm/Testa









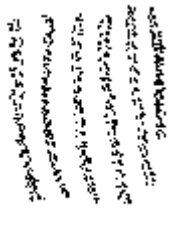


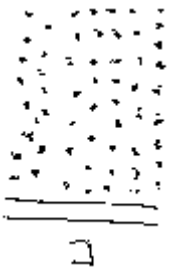



The surface of the seed (episperm (testa)) might be smooth, minutely pitted, granulate, foveolate, minutely foveolate-reticulate, foveolate-reticulate, finely reticulate, reticulate, reticulate-pitted, reticulate with straight or undulate ridges, muricate-reticulate, reticulate-tuberculate, tuberculate (warty) , tuberculate with transverse striae, rugose-tuberculate, verruucose, finely honey-combed, honey-combed, alveolate, arcuated ridges with striae between the ridges, furrowed or ridged.

Two outstanding cases are worth mentioning:

- The outermost layer of the testa is with a thick and singular episperm, enclosed in a mucilaginous envelope, when dried or after cleaning the mucilage, the seed appears covered with trichome-like filaments; these are the acutish longitudinal thickenings of radial walls of the cellulose-pectinic prismatic cells, form the outmost layer of the testa ("myxotesta" or mucilaginous epidermis), and have long been erroneously considered unicellular trichomes (Lycopersicon)
- Seeds with a well developed funicular elaiosomen (white or yellowish ones; (persistent or caducous) (Datura).



Seed surface

			
<p>Tuberculate</p>	<p>Undulate</p>	<p>Reticulate</p>	<p>Foveolate-Reticul</p>
			
		<p>Reticulate <i>Hyoscyamus niger</i> L.</p>	
			
<p>Foveolate</p>	<p>Verrucate</p>	<p>Honey-combed</p>	<p>Striate</p>
			
<p><i>Scopolia tubiflora</i> Kreyer</p>		<p><i>Petunia axillaris</i> (Lam.) E.Britton</p>	
			
<p>Punctate</p>	<p>Alveolate</p>	<p>Rugose</p>	<p>Ribbed</p>

 <p data-bbox="331 387 352 409">Z</p>			
<p data-bbox="300 448 443 477">Granulate</p>			





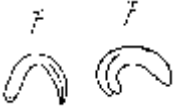

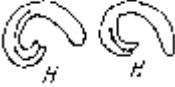

4. Endosperm

The oily endosperm in the plant family solanaceae may be scarce, but in general is rather abundant.

5. Embryo form

The solanaceous embryo may be thick or slender, straight, long or short, slightly curved, vermiform, annular, coiled or subcoiled. In Datura the embryo has a peculiar hook or curvature near the apex of the cotyledons.

Embryo form

			
<p style="text-align: center;">Straight</p>	<p style="text-align: center;">Curved</p>	<p style="text-align: center;">Strongly curved</p>	<p style="text-align: center;">Slightly bent and bent</p>
			
<p style="text-align: center;">Strongly bent</p>	<p style="text-align: center;">Annular</p>	<p style="text-align: center;">Sub-coiled</p>	<p style="text-align: center;">Coiled</p>

6. Cotyledon form

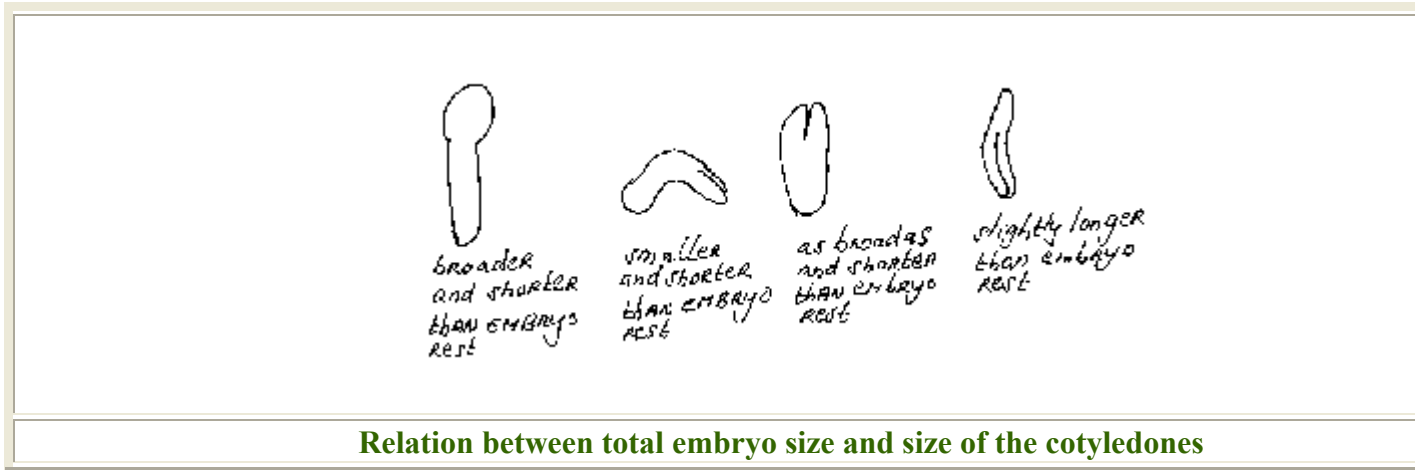
The cotyledons have broad cotyledons in the three genera of the tribe *Cestreae*, together with *Merinthopodium*, *Markea*, and *Juanulloa*. In all other taxa the width is the same as the rest of the embryo.

7. Relationship between the total embryo size and the cotyledons size.

One can distinguish two cases in the relationship between the total embryo size and the cotyledons size:

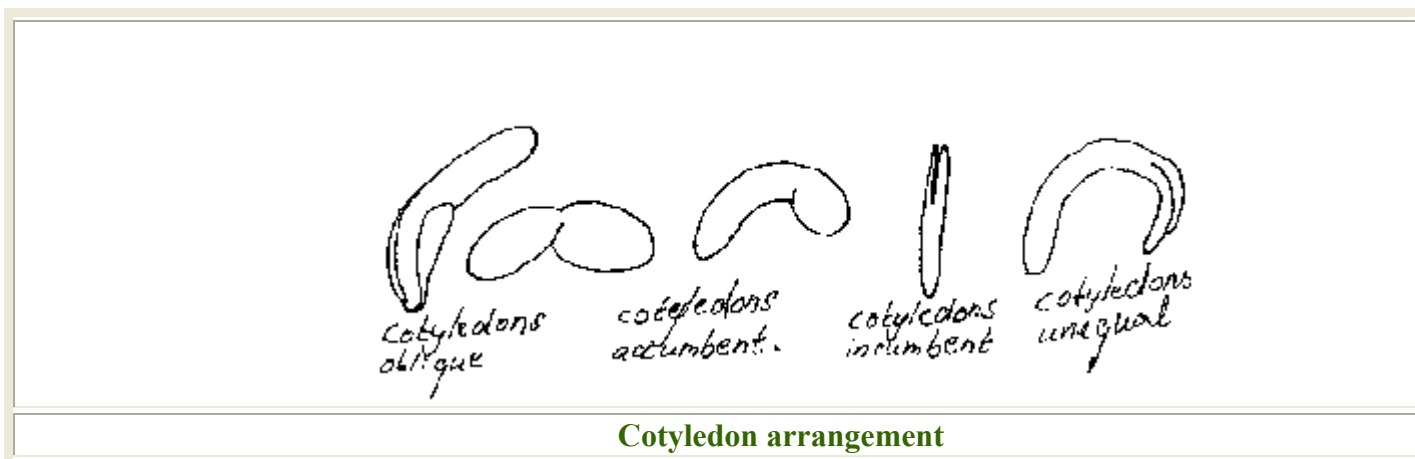
- Usual case: (all six subfamilies except Anthocercidoideae) where the cotyledons are equal, slightly longer or usually up to 2.5-3 times shorter than the rest of the curved or straight embryo.
- Exclusive case (subfamily Anthocercidoideae) where the cotyledons are very short, between 6-8 times shorter than the rest of the straight embryo.

In an exceptional case the two cotyledons are unequal.



8. Cotyledon arrangement.

Cotyledon arrangement is incumbent and sometimes oblique or accumbent and sometimes oblique.



KEY TO THE GENERA BASED ON SEED AND EMBRYO CHARACTERISTICS

1 Cotyledons usually up to 2.5-3 times shorter, equal, slightly longer or frequently much longer than the rest of the curved or straight embryo.

2. Seeds not compressed, of various forms: prismatic, polyedric, subglobose, subreniform, or long, thin and very narrow etc. Embryo straight or slightly curved (exceptions: *Latua* with bent embryos and the three genera of *Benthamielleae* with annular embryos and seeds slightly compressed:

Subfam. CESTROIDEAE Schldl.

a Cotyledons wider than the rest of the embryo:

Seeds peltate (the hilum near the middle of the ventral face, away from the radicle), subpolyedric or compressed, adjacent or imbricate, with or without wings; Embryo straight or curved; Cotyledons elliptic or ovate in outline, incumbent, usually broader and shorter or longer than the rest of the embryo; Endosperm abundant:

Tribe CESTREAE G. Don.

b Seed slightly longer than broad, thick, subpolyedric, adjacent in the fruit (i.e. not imbricate) , without wings:

ba Cotyledons generally longer than the rest of the embryo. Seeds subpolyedric, angulated, adjacent, (1.5) 3-6x (1) 2-3 x 0.5-1.5 mm.; Embryo (.15) 2.5-4.5 (6) mm. long:

Genus *Cestrum* L.

ba' Cotyledons slightly shorter than the rest of the embryo; Seeds polyedric, angulated, 2.4-3.4 x 1.8-2.2 x 1.4-1.7 mm. , its testa tuberculate and with transverse striae; Embryo 2.3-2.6 mm. long; Endosperm fleshy:

Genus *Vestia* Willd.

b' Seeds long and thin (up to 10 times longer than broad) compressed, winged, imbricate in fruit:

b'a Cotyledons usually shorter and rather broader than the rest of the embryo; Seeds long and thin, compressed, imbricate, (4) 6-8 (13) mm. long, with a peripheric wing well developed at both ends; Embryo 2-3 mm. long:

Genus *Sessea* Ruiz. et Pav.

Embryo straight or slightly curved, 3-11 mm. long; Cotyledons incumbent, 0.5-4.5 mm. long, elliptical or ovate in outline, compressed, always broader and in general shorter or sometimes as long as the rest of the embryo; Endosperm copious:

Tribe FRANCISCEAE G. Don

Seeds, elongated, reniform, ellipsoid, ovoid or prismatic, more or less angular, occasionally flattened in one or two sides, usually 4-8 mm. long, at times larger (10-13 mm. long), testa reticulate or minutely pitted. Embryo usually 3-5 mm (cotyledons 0.5-2 mm. long), sometimes 8-11 mm. long (cotyledons 3.5-4.5 mm. long):

Genus: *Brunfelsia* L.

Seeds cuboidal or cuboidal-elongate, 0.5-1 (1.5) mm. long, embryo slightly curved, 0.6-0.7 mm. long; Cotyledons elliptic in outline, compressed, slightly wider and almost two times shorter than the rest of the embryo; Endosperm copious:

Tribe BROWALLIEAE Hunz..

Seeds cuboidal, angulate, (0.5) 1 (1.5) mm. long, its testa reticulate-foveolate or warty.or cuboidal-elongate, embryo slightly curved; Cotyledons elliptic in outline, compressed, slightly wider and almost two times shorter than the rest of the embryo; Endosperm copious:

Genus *Browallia* L.

Seeds 0.6-0.9 mm. long, cuboidal-elongated, testa reticulate.Cotyledons elliptic in outline, compressed, almost two times shorter than the rest of the embryo; Endosperm copious:

Genus *Streptosolen* Miers

a'Cotyledons and the rest of the embryo with the same breadth:

Cotyledons compressed, not wider than the slightly longer, cylindric radicle; Seeds erect, very long (30-39 x 2-3.5 mm.), thin, very narrow, with the form of a javelin, triquetrous, each angle with a narrow wing, hilum near the base of the ventral face, not far from the proximal end of the radicle.Embryo straight; Endosperm scanty:

Tribe METTERNICHIEAE Miers

Seeds 3.0-3.9 x 2-3.5 mm. the hilum at +/- 4 mm. from its proximal end; Embryo 17-19 mm. long:

Genus *Metternichia* Mik.

Cotyledons shorter than the rest of the embryo; Seeds thick, ca. 2 mm long, slightly longer than broad, its testa not thin, reticulate-pitted, dark brown to black.; Embryo bent; Endosperm abundant:

Tribe LATUEAE Hunz. et Barboza.

Genus *Latua* Phil.

Seeds reniform, subreniform or angulate-reniform, compressed, 0.5-1.7 mm. long, testa reticulate, foveolate, foveolate-reticulate or ridged-winged and striate; Embryo curved; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Tribe BENTHAMIELLEAE (Hunz.)

Seeds, reniform or subreniform, 0.5-1.75 mm. long, thick;, episperm foveolate or reticulate:

Genus *Benthamiella* Speg.

Seeds (1.5) 1.8-2.2 x 0.7-1.5 mm, angulate-subreniform, irregular its testa very peculiar, with ca. four arcuate ridges (the outermost strongly winged), striate between the ridges:

Genus *Pantacantha* Speg.

Seeds reniform, compressed, testa reticulate or foveo-reticulate, 1.3-1.5 x 1 x 0.6 mm.:

Genus *Combera* Sandw.

Seeds subsphaerical, reniform, subreniform, angulate-subreniform, globose-reniform, sphaerical-angular, polyedric or triquetar, 0.3-1.9 mm. long; testa reticulate, foveolate-reticulate or ridged-winged and striate; Embryo straight or slightly curved, on occasions (*Nicotiana*) strongly curved, its radicle longer or shorter than the equal or unequal cotyledons; Endosperm abundant.:

Tribe NICOTIANEAE G. Don.

Seeds 0.3-1.9 mm. long, subsphaerical, reniform, subreniform, globose-reniform, sphaerical-angular or polyedric, testa reticulate or foveolate-reticulate; Embryo generally straight or somewhat curved, on occasions (*Nicotiana*) strongly curved, its cotyledons shorter than the rest of the embryo:

Subtribe Nicotianeae Hunz.

Seeds 0.3-1.3 mm .long. , subsphaerical, reniform, subreniform, globose-reniform, sphaerical-angular, sometimes elongated, testa reticulate with straight or undulate ridges; Embryo straight or slightly curved (ca 80% of the species) to strongly curved (ca.

20% of the species), its cotyledons equal or unequal, usually shorter than the rest of the embryo:

Genus *Nicotiana* L.

Seeds 0.5-1.4 x 0.5-0.8 mm .long, sphaerical-angular, subreniform or globose-reniform, by exception polyedric and larger (*P. patagonica*), testa **foveolate-reticulate**; Embryo straight or slightly curved; Cotyledons shorter than the rest of the embryo:

Genus *Petunia* Jussieu

Seeds 0.6-1.6 mm .long , polyedric, angular, testa finely **honey-combed**. Embryo straight or slightly curved; Cotyledons small, much shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Fabiana* Ruiz et Pavon.

Seeds 0.7-1.9 mm. long, polyedric or **triqueter**, testa minutely reticulate-foveate; Embryo straight or slightly curved, its cotyledons lightly longer or usually shorter than the rest of the embryo:

Subtribe *Nierembergiinae* Hunz.

Seeds small, 0.9-1.9 x 0.7-0.9 mm., polyedric or triqueter ; Cotyledons slightly longer than the rest of the embryo:

Genus *Nierembergia* Ruiz. et Pavon.

Seeds 0.7-0.9 (1.2) x 0.5-0.9 x 0.4-0.8 mm. , polyedric, irregular, slightly elongated; Embryo straight or slightly curved.; Cotyledons shorter than the rest of the embryo:

Genus *Bouchetia* Dunal

Seeds reniform or polyedric, 0.3-1.6 mm. long; Embryo slightly curved:

Subtribe *Leptoglossinae* Hunz.

Seeds reniform 1.1-1.5 mm. long; episperm wrinkeld (4-7 ridges and alternating furrows), or finely honey-combed; Endosperm abundant:

Genus *Hunzikeria* D'Arcy

Embryo peculiarities of mature seeds unknown. Place of genus in present subtribe provisional; immature seeds 1.2-1.6 mm. long:

Genus *Plowmania* Hunz. et Subils.

Seeds 0.3-0.5 mm .long, polyedric, 0.3-0.5 mm. long; Episperm finely honey-combed; endosperm abundant:

Genus *Leptoglossis* Benth.

Seeds 0.5-1 (1.5) mm. long; Embryo diminutive, straight or slightly curved, testa reticulate or smooth, endosperm usually plenty, but in *Melananthus* rather scanty, cotyledons usually equal, 2-3 times shorter than the rest of the embryo:

Tribe SCHWENKIEAE Hunz.

Seeds cuboidal 0.6-0.8 (1) mm. long (in *S. micrantha* only 0.3-0.4 mm.), testa reticulate; the epispem reticulate; Embryo straight; Cotyledons 2-2.5 shorter than the rest of the embryo; Endosperm copious:

Genus *Schwenckia* L.

Seeds solitary, elongated, 1-1.5 mm. long, the base pole broad and rounded, the apical one comparatively narrow, testa smooth, hilum away from the radicle; Embryo straight or slightly curved, its cotyledons ca. two times shorter than the rest of the embryo, whose apex is slightly acutish; Endosperm rather scanty:

Genus *Melananthus* Walp.

Seeds subreniform, ca. 1 mm. long; Testa reticulate; Embryo slightly curved. Cotyledons almost three times shorter than the rest of the embryo, albumen copious:

Genus *Protoschwenckia* Soler.

Seeds cuboidal, ca. 0.5-0.6 mm. long; Epispem reticulate; Embryo straight, very small (0.25-0.35 mm. long); Cotyledons inaequal, shorter than the rest of the embryo:

Genus *Heteranthia* Nees et Mart.

2'. Seeds compressed, discoidal, reniform or boomerang-shaped. Embryo slightly or much curved:

3. Embryo almost straight or slightly curved (exception: embryo annular in *Schultesianthus*), the accumbent or oblique cotyledons usually somewhat broader than the rest of the embryo or with the same width; endosperm comparatively scanty.

Seeds reniform, boomerang-shaped, **bacilliform** or rod-shaped (the hilum side concave or straight), erect, compressed, with three sizes: small (1.9-3.8 mm. long) in *Ectozoma*, *Markea*, *Merinthopodium* and *Trianaeae*, medium-sized (2.5-5 mm. lon) in *Juanulloa* and *Hawkesiophyton*, and large (3.9-5.5 mm. long) in *Dyssochroma* and *Schultesianthus*; Epispem cells with an undulated outline, elongated or not; Embryo vermiform and thin (*Ectozoma*, *Hawkesiophyton*, *Rahowardiana*), rather slender (*Juanulloa*), or short and thick (*Merinthopodium*, *Schultesianthus*), straight or slightly curved (*Ectozoma*, *Hawkesiophyton*, *Rahowardiana*), curved (*Dyssochroma*, *Juanulloa*, *Markea*, *Merinthopodium*), or annular (*Schultesianthus*, *Juanulloa speciosa*), cotyledons accumbent (*Juanulloa*, *Merinthopodium*, *Schultesianthus*) or oblique (*Dyssochroma*, *Merinthopodium*, *Schultesianthus*) (by exception sometimes incumbent in

Hawkesiophyton), shorter than the rest of the embryo (exception: *Merinthopodium*, with cotyledons as long or somewhat shorter or longer than the rest of the embryo), usually longer than broad (exception: *Schultesianthus*, its cotyledons being almost so broad as long), slightly wider than the rest of the embryo (*Markea*, *Merinthopodium*, *Juanulloa*), or with the same width in both sectors of the embryo (*Ectozoma*, *Dyssochroma*, *Hawkesiophyton*, *Rahowardiana*, *Schultesianthus*, *Trianaea*); endosperm very scanty (*Markea*, *Juanulloa*, *Schultesianthus*), rather scarce (*Juanulloa*, *Rahowardiana*, *Merinthopodium*), or comparatively abundant (*Dyssochroma*, *Ectozoma*, *Hawkesiophyton*, *Trianaea*):

Subfam. JUANULLOIDEAE (Hunz.) Hunz.

Seeds boomerang-shaped or rod-shaped (with the cotyledonal pole somewhat thicker), 3.9-4.5 mm. long, episperm cells much elongated, its outline undulated; Embryo very slightly curved; Cotyledons oblique, somewhat curved, shorter than and more or less as wide as the rest of the embryo. Endosperm rather abundant:

Genus: *Dyssochroma* Miers.

Seeds 2-2.8 mm. long, almost boomerang-shaped, but the hilum side straight instead of concave; Embryo thick and short, curved; Cotyledons accumbent, as long (or somewhat shorter or longer) but wider than the rest of the embryo Endosperm rather scarce:

Genus *Merinthopodium* J. Don. Sm.

Seeds reniform, elongated, thin, (2) 2.5-2.8 (3) x 1.2 x 0.5 mm., on occasion strongly curved near the hilum, episperm cells not elongated, its outline much undulated; Embryo curved, vermiform; Cotyledons oblique in a transverse section, longer than broad, shorter but not wider than the rest of the embryo; Endosperm rather abundant:

Genus *Trianaea* Planch. et Linden

Seeds large, 5-5.5 mm. x 4-4.5 mm., kidney-shaped; embryo thick, strongly annular, its accumbent cotyledons almost so broad as long, a little shorter and not wider than the rest of the embryo; endosperm reduced to a thin sheet:

Genus *Schultesianthus* Hunz.

Seeds 2.2-2.5 mm. long, boomerang-shaped but with the hilum side straight instead of concave, episperm cells with an undulated outline; embryo vermiform scarcely curved; Cotyledons longer than broad, 2-3 times shorter than the rest of the embryo, oblique in a transverse section; endosperm rather abundant:

Genus *Ectozoma* Miers

Seeds shortly subreniform or boomerang-shaped. 2.5-5 x 1.5-3 x 1-1.2 mm.; episperm finely reticulate; embryo usually curved (annular in *J. speciosa*); Cotyledons oblong, accumbent, shorter but wider than the rest of the embryo (both areas separated by a clear constriction), Endosperm usually somewhat scarce (exception in *Hawkesiophyton* rather abundant):

Genus *Juanulloa* Ruiz. et Pav.

Seeds reniform, boomerang-shaped or bacilliform, 1.9-3.8 mm. long, slightly curved or almost straight; Embryo 1.6-3.2 mm. long, slightly curved; Cotyledons oblique, longer than broad, shorter but wider than the rest of the embryo; Endosperm very scanty:

Genus *Markea* Rich.

Seeds rod-shaped or boomerang-shaped with the hilum side straight and somewhat curved towards the cotyledonal pole, (2.8) 3.1-4 mm. long; Episperm reticulate, the cells much elongated; Embryo vermiform, straight, excepting the slightly curved cotyledons; Cotyledons oblong, accumbent or oblique (by exception incumbent), shorter and as wide as the rest of the embryo, with a constriction at their point of their union; Endosperm rather abundant:

Genus *Hawkesiophyton* Hunz.

Seeds (2.1) 2.5-2.8 mm. long, boomerang-shaped, but the hilum side straight instead of concave; Embryo vermiform very slightly curved; Cotyledons oblong, shorter and as wide as the rest of the embryo; Endosperm scanty:

Genus *Rahowardiana* D' Arcy

3' Embryo annular, coiled or subcoiled, the incumbent cotyledons never broader than the rest of the embryo; endosperm usually abundant.

Seeds compressed, discoidal or reniform. small (ca. 0.75 mm. long) or large (up to 8-12 mm. long in *Brugmansia*). Embryo annular, subcoiled or coiled, its cotyledons never broader than the rest of the embryo, usually incumbent, exceptionally slightly oblique, endosperm abundant or rather abundant, by exception scanty.

Subfam. SOLANOIDEAE Schltldl.

Seeds discoidal reniform; Embryo coiled; Cotyledons shorter than the rest of the embryo.; Endosperm abundant:

Tribe NICANDREAE Wettst.

Seeds brown-yellowish, finely foveolate, 1.5-2 mm. long:

Genus *Nicandra* Adans.

Cotyledons longer than the rest of the embryo.

Seeds reniform, compressed, big (2.5-6 mm. long); Embryo coiled; Cotyledons unequal, longer than the rest of the embryo.; Endosperm scanty:

Tribe MANDRAGOREAE (Wettst.) Hunz. et Barboza.

Seed size according to the species, ca. 2.5 x 2.2 mm., or ca. 4-6 x 5-7 mm.:

Genus *Nicandra* L.

Cotyledons shorter than the rest of the embryo (exception *Grabowskia*). Embryo coiled

Embryo annular, cotyledons shorter than the rest of the embryo, with (*Datura*) or without (*Brugmansia*) a hook or curvature near the apex of the cotyledons; Endosperm rather abundant, cells with thick hard walls, lacking starch, rich in protein:

Tribe DATUREAE G. Don.

Seeds (2.5) 4-5 (6) mm. long, discoidal or reniform, with a well developed funicular elaiosome (white or yellowish ones; (persistent or caducous) or lacking it ; Testa usually black, yellow or brown, reticulate-foveolate, verrucose, finely pitted, furrowed or ridged; Embryo with a peculiar hook or curvature near the apex of the cotyledons; Endosperm "ab initio" cellular, afterwards, its cells show very thick and hard cell walls, lacking starch, but with lipid vesicles and rich in protein bodies (containing one protein crystalloid and one or more globoid crystals:

Genus *Datura* L.

Seeds large (8-12 mm. long) , wedged, subreniform or irregularly shaped, usually with a thick , corky seed coat, lacking an elaiosome; Testa verruculose or smooth, usually thick, sometimes suberose. Embryo without a curvature in the cotyledons. Endosperm abundant:

Genus *Brugmansia* Persoon

Cotyledons shorter than the rest of the embryo (exception *Grabowskia*). Embryo usually annular, by exception subcoiled. Seeds discoidal and depressed or ovoid and plano-convex; Endosperm copious:

Tribe LYCIEAE Hunz.

Seeds discoidal-compressed, kidney-shaped or polyedric (1) 1.5-2.5 (3.5) mm. long, or ovoid and plano-convex 2.5-4.5 mm. long (only in section *Sclerocarpellum*); Cotyledons shorter than the rest of the embryo; Endosperm rather abundant, "ab initio" cellular:

Genus *Lycium* L.

Seeds kidney-shaped, compressed, 2-3 mm. long; Episperm almost smooth or slightly reticulate; Embryo subcoiled.; Cotyledons somewhat shorter than the rest of the embryo:

Genus *Phrodus* Miers.

Seeds elongated, very much depressed (the bigger ones ca. 4 mm. long, the smaller ones ca. 2 mm. long). its tegument perforated or open at the hilar pole; Embryo annular; The cotyledons longer than the rest of the embryo; Endosperm rather copious:

Genus *Grabowskia* Schtdl.

Cotyledons shorter than the rest of the embryo. Embryo arcuate, annular, subcoiled or coiled.

Tribe SOLANEAE G. Don.

Subtribe: *Witheringinae* (Miers) Hunz.

Seeds reniform or subreniform, commonly 1.3-1.6 mm. long, a few species with larger seeds (1.8-3.3 mm. long); Epsiperm honey-combed, its cells flat or deep , usually thin-walled [exception *W. mexicana* (Robison) Hunz.with thick walls], theri periclinal wall disappearing by autolysis in mature seeds; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus: *Witheringia* L'Heritier.

Seeds subglobose-depressed, compressed, (0.9) 1-1.4 mm. long; Episperm honey-combed with flat cells; Embryo annular; Cotyledons shorter than the rest of the embryo; Endosperm fairly abundant:

Genus *Brachistus* Miers

Seeds reniform, discoidal, flat, 2.3-2.7 mm. long; Embryo strongly curved; Cotyledons shorter than the rest of the embryo; Endosperm very abundant:

Genus *Cuatresia* Hunz.

Seeds subreniform, compressed, 1.75-2 mm long or 3.2-4 mm. long (according to the species); testa honey combed; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Deprea* Raf.

Seeds subreniform, much compressed, ca. 3 mm. long; Embryo annular; Cotyledons shorter than th erest of the embryo:

Genus *Discopodium* Hochst.

Seeds more or less reniform or subreniform (1) 1.2-1.6 mm. long; Testa cells small or somewhat large, deep, the anticlinal walls moderately or very much undulated and thick; Embryo bent; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Exodeconus* Raf.

Seeds reniform to suborbicular (0.8) 1.4-2 mm. long; Episperm verrucose or alveolate, testa cells either deep with undulated rather thick anticlinal walls or they are open, with much undulated anticlinal walls, and lacking thickenings almost completely, both types with minute pores at the inner periclinal wall; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus *Jaltomata* Schldl.

Seeds subreniform, compressed, 2-2.5 mm. long.; Embryo annular; Cotyledons as long as or slightly shorter than the rest of the embryo; Endosperm rather scanty:

Genus *Nothoestrum* A. Gray

Seeds subreniform, ca. 1.5-1.8 mm. long.; Episperm slightly honeycombed, testa cells deep, the anticlinal walls undulated with sturdy thickenings and the inner periclinal wall lacking holes; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm copious:

Genus *Acnistus* Schott.

Subtribe PHYSALINAE (Miers) Hunz.

Seeds reniform, compressed, 1.5-2.4 (2.8) mm. long, envelopped by parenchymatic cells of placentarian and pericarpic origin; Episperm reticulate, honeycombed or rugose-tuberculate, the testa cells shallow with undulate anticlinal walls and very peculiar holes at the inner periclinal wall; Embryo subcoiled or coiled; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant;

Genus *Physalis* L.

Seeds reniform, compressed, 1.8-4 mm. long, the margin opposed to the one of the hilum clearly irregular or soemwaht crenate; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus *Quincula* Raf.

Seeds kidney-shaped, discoidal, depressed, black, 1.3-1.7 mm. long (excepting *L.nana* with larger seeds: 2-2.3 mm.long.); Episperm honey-combed; Embryo subcoiled or annular; Cotyledons shorter than the rest of the embryo; Endosperm rather plenty:

Genus *Leucophysalis* Rydberg.

Seeds kidney-shaped (0.95) 1.2-2 (2.5) mm. long; Episperm foveolate, alveolate or tuberculate, the anticlinal walls of the cells with unequal height; Embryo subcoiled; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus *Chamaesaracha* (A. Gray) Benth. et Hook.

Seed coat foveolate-alveolate:

Sect. *Chamaesaracha*

Seed coat tuberculate:

Sect. *Capsicophysalis*

Subtribe IOCHROMINAE (Miers) Hunz.

Seeds reniform, (1) 1.5-2 mm. long; Embryo subcoiled or almost hippocrepiform ; Cotyledons slightly shorter than the rest of the embryo; Endosperm abundant:

Genus *Iochroma* Benth.

Seeds reniform, compressed, (2.5) 3.7-5 mm. long, testa reticulate, brownish with straight walls; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Saracha* Ruiz. et Pav.

Seeds nearly orbicular, much compressed, 2.2-3.5 mm. long; Episperm honey-combed (its cells very shallow, lacking holes at the bottom), excepting the hyaline peripheric wing with radially elongated cells. Embryo coiled; Cotyledons incumbent, shorter than the rest of the embryo; Endosperm rather scanty:

Genus *Oryctes* S. Watson

Seeds orbicular-reniform (1.5) 1.9-2.1 mm. long, somewhat translucent; Episperm foveolate-reticulate; Embryo annular; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Tubocapsicum* (Wetts.) Makino

Subtribe CAPSICINAE Yamazaki

Seeds reniform or subreniform, 2.4-3.5 (4.2) mm. long, usually slightly rugose and yellow or tan (exception: black seeds in *C. pubescens*, etc.) testa varied, usually thick, its epidermic cells wavy or straight, deep or flat, smooth, reticulate, or spiny (on account of the different height of the radial walls), etc. Embryo annular, cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus *Capsicum* L.

Seeds reniform, discoidal, compressed (2.3) 2.8-4.2 (4.7) mm. long; Episperm honey-combed, epidermic cells straight; Embryo subcoiled; Cotyledons shorter than the rest of the embryo; Endosperm fairly abundant:

Genus *Aureliana* Sendtn.

Seeds subreniform, discoidal, compressed, (2.4)2.7-3.8 (4.2) mm. long; testa honey-combed, its cells deep with moderately undulated anticlinal walls, whose well developed thickenings grow into pillars of different heights (at the corners, one from each adjacent cell); Embryo arcuate, cotyledons much shorter than the rest of the embryo; Endosperm abundant:

Genus *Athenaea* Sendtn.

Seeds small, ca. 0.75 mm. long, episperm honey-combed; Embryo annular; Cotyledons shorter than the rest of the embryo; Endosperm not scarce:

Genus *Darcyanthus* Hunz.

Seeds reniform, much depressed, ca. 2 mm. long; Embryo arcuate or annular; The Cotyledons almost as long as the rest of the embryo; Endosperm rather abundant:

Genus *Eriolarynx* (Hunz.) Hunz.

Seeds dicoidal, depressed, 1.8-2.1 mm. long; Cotyledons shorter than the rest of the annular embryo; Endosperm rather abundant:

Genus *Vassobia* Rusby

Seeds reniform, usually (1.6) 2-2.8 (3.2) mm. long, by exception larger (3.5-4 mm. long); Embryo strongly bent, small; Cotyledons sometimes remarkable short, endosperm scanty or abundant:

Genus *Larnax* Miers

Seeds reniform, compressed, 2.1-2.5 (2.8) mm. long; Episperm smooth, somewhat alveolate; Embryo annular; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Dunalia* Kunth.

Seeds reniform, or disc-shaped, compressed, (1.5) 2-2.5 (3.5) mm. long; Episperm honey-combed with deep pits and very thin tangential walls, or almost smooth with sinuose thick-walled cells; Embryo strongly bent; Cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Withania* Pauq.

Subtribe SOLANINAE Hunz.

Seeds discoidal or reniform, much compressed, 1.2-4 (7-8) mm. long, usually somewhat foveolate; Embryo much coiled; Cotyledons shorter than the rest of the embryo; Endosperm abundant:

Genus *Solanum* L.

Subgenus *Solanum*

Sect. 6 *Solanum* Sect. *Maurella* Dunal

Sect 7 *Episarcophyllum*

Sect. 8 *Delitescens*

Sect. 9 *Campanulisolanum* Bitter

Sect. 10 *Geminata*

Sect. 11 *Pseudocapsicum*

Episperm blackish, tuberculate:

Sect. 12 *Chamaesarachidium*

Subgenus *Potatoe* (G.Don) D'Arcy

Sect. 1 *Petota*

Sect. 2 *Neolycopersicon*

Sect. 3 *Dulcamara*

Seeds reniform, large, 3-3.5 (4) mm. long:

Sect. 4 *Glaucophyllum*

Sect. 5 *Basarthrum*

Seeds usually 2.5-3.5 mm. long or by exception 7-8 mm. long:

Sect. *Jasminosolanum*

Sect. *Rhynchantherum*

Seeds reniform, +/- 3 mm. long:

Subgenus *Lyciosolanum*

Seeds plump rather than flattened, almost round or ovoid-reniform:

Subgenus *Bassovia*

Subgenus *Archaeosolanum*

Subgenus *Brevantherum*

Seeds 1.2-1.5 mm. long or 3.4-3.8 mm. long;

Sect. *Brevantherum*

Sect. *Holophylla*

Seeds lenticular to reniform, (1.5)2-4 (5) mm. long; Episperm honey-combed, foveolate or slightly reticulate, on occasions broadly winged (wing 1-1.2 mm. wide), pale yellow, light or dark brown, black or straw-coloured:

Subgenus *Leptostemonum*

Seeds reniform, (2) 4-6 (9) mm. long,; Episperm glabrous or usually covered with trichome-like filaments, being remnants of lateral wall thickenings of the outermost layer of the testa, similar to *Lycopersicon*; Embryo coiled, cotyledons shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Cyphomandra* Sendtn.

Seeds ellipsoid-ovate, much flattened, with a thick and singular episperm, enclosed in a mucilaginous envelope, when dried or after cleaning the mucilage, the seed appears covered with trichome-like filaments; these are the acutish longitudinal thickenings of radial walls of the cellulose-pectinic prismatic cells, form the outmost layer of the testa ("myxotesta" or mucilaginous epidermis), and have long been erroneously considered unicellular trichomes; Embryo coiled; Cotyledons shorter than the rest of the embryo; Endosperm rather scanty:

Genus *Lycopersicon* Miller

Seeds generally discoidal or subreniform (0.8) 1.5-3.5 (5) mm. long, slightly or much depressed, on occasions rather thick, testa reticulate minutely pitted; Embryo coiled; Cotyledons almost as long as the rest of the embryo; Endosperm abundant:

Genus *Lycianthus* (Dunal) Hassler

Seeds reniform to subglobose, large 5-5.5 x 4.5 x 2-4 mm.; Episperm honeycombed, cells very deep; Embryo coiled; Cotyledons slightly shorter than the rest of the embryo; Endosperm rather abundant:

Genus *Triguera* Cav.

Seeds adhering to the pericarp, kidney-shaped, 3.2-4 x 3-3.2 x 1.3-1.5 mm.; Episperm rugose, brownish, testa honey-combed, with very deep cells; Embryo coiled; Cotyledons shorter than the rest of the embryo; Endosperm thick:

Genus *Normania* Lowe

Cotyledons almost as long as the rest of the embryo. Embryo annular almost subcoiled
.Seeds reniform, compressed; Endosperm rather abundant:

Tribe ATROPEAE Miers

Genus *Atropa* L.

Cotyledons shorter than the rest of the embryo. Embryo annular. Seeds dicoidal, testa thick; Embryo annular (*Jaborosa*) or coiled; The cotyledons clearly shorter than the rest of the embryo. Endosperm copious (*Jaborosa*) or rather scanty:

Tribe JABOROSEAE Miers

Seeds reniform, subreniform, subsphaeric or irregular (2) 3-4 (5.5) mm. long; Episperm honey-combed, its cells very deep; Embryo annular; Endosperm copious:

Genus *Jaborosa* Juss.

Seeds reniform, compressed, episperm apparently hairy (the cellulosic radial walls of the episperm cells elongated) or not, (1.5)2-2.5 (4) mm. long; Embryo subcoiled; Cotyledons much shorter than the rest of the embryo; Endosperm rather scanty:

Genus *Salpichroa* Miers.

Seeds reniform-discoidal, compressed, glabrous, 1.8-2.5 mm. long; Embryo coiled; Cotyledons slightly shorter than the rest of the embryo. Endosperm rather scanty:

Genus *Nextouxia* Kunth.

Seeds discoidal or reniform, compressed; Cotyledons incumbent or slightly oblique, shorter than the rest of the embryo. Embryo subcoiled; Endosperm rather abundant:

Tribe SOLANDREAE Miers

Seeds 4-6.5 x 2.5-4 mm:

Genus *Solandra* Swartz.

Seeds reniform, subreniform or discoidal, compressed, episperm foveolate, reticulate-foveolate, or reticulate-tuberculate. Cotyledons shorter than the rest of the embryo. Embryo strongly curved, annular or subcoiled. Endosperm rather abundant:

Tribe HYOSCYAMEAE Endl.

Seeds, usually (0.8) 1.1-1.5 (1.8) mm. long (in *H. turcomanicus* Pojark: 2.4-2.9 mm. long). Episperm opaque or shining, reticulate-foveolate, foveolate, or reticulate-tuberculate; Embryo strongly curved; Cotyledons unequal; Endosperm cellular:

Genus *Hyoscyamus* L.

Seeds 3-4 mm. long, episperm foveolate:

Genus *Anisodus* Link.

Seeds ca. 2.8-3.2 x 2.5-2.9 x 2.-2.5 mm; Testa thick, foveolate. Embryo subcoiled; Endosperm abundant:

Genus *Atropanthe* Pascher

Seeds (2) 2.5-3.8 mm long; Embryo subcoiled; Endosperm abundant:

Genus *Physochlaina* G. Don

Seeds reniform, ca. 3 mm. long:

Genus *Przewalskia* Maxim.

Seeds (2) 2.6-3 (4) mm. long; Episperm foveolate; Endosperm abundant:

Genus *Scopolia* Jacq.

Seeds compressed, 0.8-1.1 mm. long; Its testa reticulate of granulate; Embryo coiled or subcoiled; Cotyledons incumbent, shorter than the rest or the embryo (up to 3 times); Endosperm cellular, copious:

Subfam. SALPIGLOSSOIDEAE (Benth.) Hunz. (Endosperm cellular [at least in *Salpiglossis*])

Episperm reticulate:

Genus *Salpiglossis* Ruiz et Pavon

Episperm reticulate or granulate; Embryo coiled:

Genus *Reyesia* Gay

Seeds compressed, testa somewhat wrinkled, muricate-reticulate, with straight or slightly undulate thick walls. Embryo arcuate; Cotyledons incumbent and clearly shorter than the rest of the embryo; Endosperm copious:

Subfam. SCHIZANTOIDEAE (Miers) Hunz. (Endosperm cellular).

Seeds sometimes almost subsphaeric (0.4-1 mm in diam.), usually oval or reniform (1-2.1 mm long):

Genus *Schizanthus* Ruiz. et Pavon.

1' Cotyledons very short , circa 6-8 times shorter than the rest of the straight embryo:

Seeds reniform or subreniform, elongated, somewhat depressed, (1.4) 2-3 (3.5) mm. long; Testa reticulate-honeycombed; Embryo terete, straight or slightly curved; Cotyledons short.; Endosperm copious, including a small oil sector (excepting *Duboisia*):

Subfamily ANTHOCERCIDOIDEAE (G. Don)Tétényi

Seeds (1.4) 1.6-2.3 mm. long; Embryo almost straight, long and thin:

Genus *Anthocercis* Labill.

Seeds ca. 2 mm. long; Embryo slightly arcuate:

Genus *Symonanthus* Haegi

Genus *Crenidium* Haegi

Seeds 2.5-3.5 mm .long; Embryo slightly curved; Cotyledons very short:

Genus *Grammosolen* Haegi

Seeds 2.3-3.3 mm long; Embryo straight, short and thick:

Genus *Anthotroche* Endl.

Seeds (1.6) 2.1-3.5 mm. long; Embryo almost straight:

Genus *Cyphanthera* Miers

Seeds 2.2-3.2 mm .long; Embryo slightly curved:

Genus *Duboisia* R.Br



GLOSSARY (Ref. 946a)

Accumbent: Cotyledon arrangement: Lying along or against another body, e.g. the cotyledons having their edges against the radicle.

Alveolate:(Seed surface) Pitted, covered with small cavities.

Annular: (Embryo form) Ring-shaped.

Angulate-subreniform:(Seed form). The form is somewhat reniform and the seed is winged.

Bacilliform: (Seed form) Rod-shaped, rod-like.

Boomerang-shaped: (Seed form) In the shape of a boomerang.

Coiled: (Embryo form) Turned, like a spiral.

Compressed: (Seed form) Flattened lengthwise, usually lateral

Cotyledons: The embryo leaf or leaves of seed plants that usually store or absorb food in a young seedling; in angiosperms (flowering plants) the following distinction is made with respect to the cotyledons: dicots have two cotyledons and monocots have one cotyledon.

Cuboidal: (Seed form) Cubic.

Cuboidal-elongated:(Seed form) The form is cubic but lengthened

Curved:(Embryo form) Bent but smoothly, not abruptly.

Depressed: (Seed form) Flattened from above (vertically), somewhat sunken at the centre

Discoidal: (Seed form) Discoid, with a rounded blade and thickened margin.

Discoidal-reniform:(Seed form) Between discoidal and reniform.

Elaiosomes: Fruits and seeds (diaspores) of ant-dispersed plants possess elaiosomes - appendages of various shapes - which are attractive for ants. It is known that elaiosomes contain lipids, proteins, sugars and vitamins and thus constitute a valuable nutritional source for ants.

Ellipsoid-ovate(Seed form) Elliptic figure-egg-formed

Elongated: (Seed form) Ellipsoid but lengthened.

Embryo: Young sporophyte, diploid (2n), result of fertilization. The mature embryo consists of cotyledons (seed leaves), hypocotyl (stem-like embryonic axis below the cotyledons), radicle (embryonic root).

Endosperm: Food storage tissue, triploid (3n), result of fertilization. During seed maturation the endosperm will develop into a storage tissue that will provide nutrients to the seedling as it emerges (in monocots) or that will be digested and stored by the cotyledons before germination (in dicots)

Episperm: The skin or coat of a seed, especially the outer coat; protective outer layer of seeds of flowering plants

Foveolate: (Seed surface) Minutely pitted.

Foveolate-reticulate:(Seed surface) Between minutely pitted and netted.

Globose-depressed: (Seed form) Globose but on one side slightly flattened.

Globose-reniform: (Seed form) Intermediate form between globose and reniform.

Honey-combed: (Favosus)(Seed surface) Excavated in the manner of a section of honeycomb.

Incumbent: Cotyledon arrangement: Folded inwards and lying upon, used of cotyledons having the radicle resting on one side of a cotyledon instead of along the edge.

Imbricate:Seed form Overlapping in regular order, as the scales on a snake.

Javelin-shaped: (Seed form) Long, thin and very narrow, like a spear..

Lenticular: (Seed form) Lens-shaped, resembling a double convex lens.

Myxotesta: Slimy testa

Oblique: Cotyledons with a slight degree of inequality of the two sides.

Ovoid: (Seed form) Ovate form resembling an egg.

Peltate: (Seed form) Shield-shaped.

Peripheric: Pertaining to the boundary or outer surface.

Polyedric: (Seed form) Many surfaces and many margins

Prismatic: (Prism-shaped) (Seed form) Having several longitudinal angles and intermediate flat faces.

Proximale pole: Nearest to the axis

Reniform: (Seed form) Kidney-shaped, resembling the figure of a kidney, that is to say crescent-shaped, with the ends rounded.

Reticulate: (Seed surface). Netted, like a network

Reticulate-foveolate:(Seed surface) Between reticulate (like a network, netted.) and foveolate (minutely pitted).

Sclerified: Hardened

Sphaerical-angular: (Seed form) Forming nearly a true sphere and winged

Straight:(Embryo form) Not curved but erect

Striae:(Seed surface) Fine linear markings, lines, fine grooves.

Subcoiled: (Embryo form) Somewhat coiled.

Subglobose:(Seed form) Somewhat globose

Suborbicular:(Seed form) Somewhat circular.

Subpolyedric: (Seed form) Somewhat like polyedric.

Subsphaerical: (Seed form) Somewhat globose. Almost forming nearly a true sphere.

Testa: (seed coat): Outer protective layer of the seed, developed from the integuments of the ovule, maternal diploid tissue.

Triqueter: (three-edged) (Seed form) Having three acute angles with concave faces (genraaly used as synonym of trigonus (trhee-cornered)).

Tuberculate: (Seed surface) Covered with wart-like projections.

Undulate: (Seed surface) Wavy structure.

Vermiform: (Embryo form) Worm-shaped.

Verrucose:(Seed surface). Warty

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