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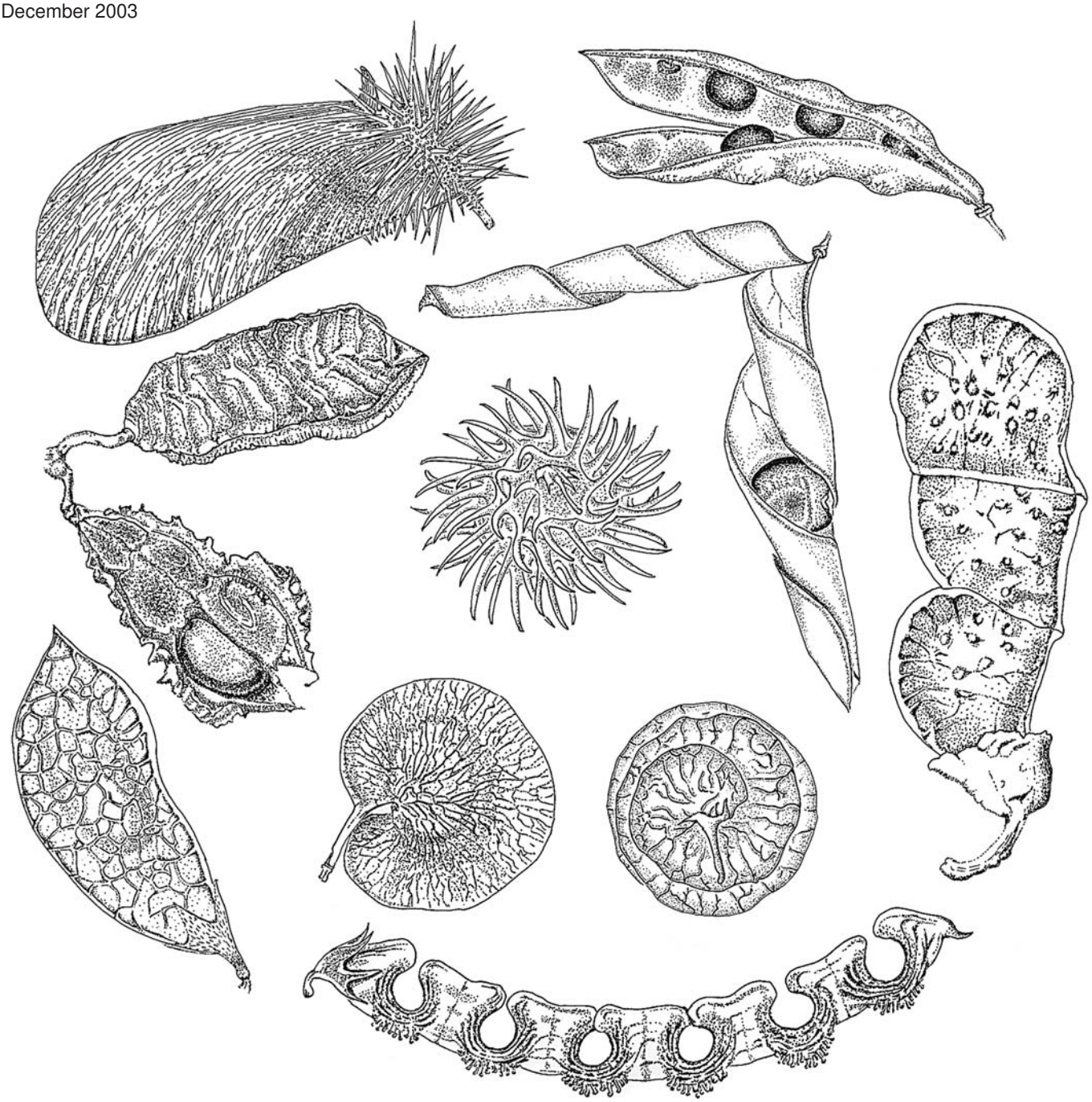
Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

Volume I



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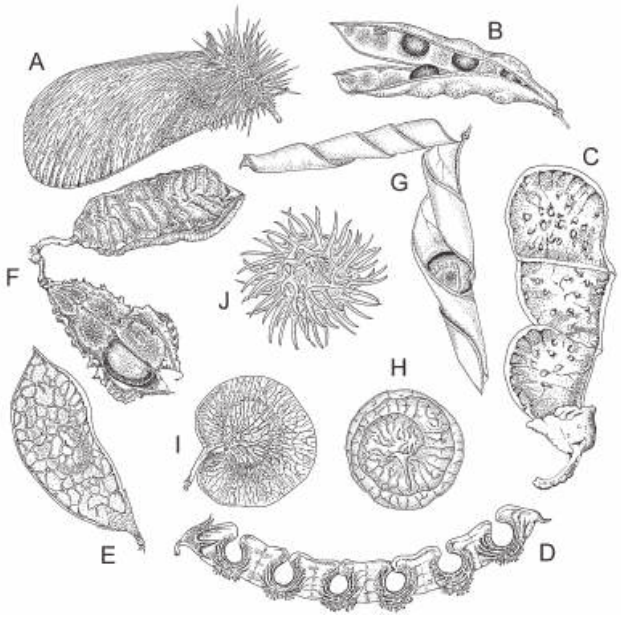
Joseph H. Kirkbride, Jr., Charles R. Gunn, and Anna L. Weitzman



Fruits of A, *Centrolobium paraense* E.L.R. Tulasne. B, *Laburnum anagyroides* F.K. Medikus. C, *Adesmia boronoides* J.D. Hooker. D, *Hippocrepis comosa,* C. Linnaeus. E, *Campylotropis macrocarpa* (A.A. von Bunge) A. Rehder. F, *Mucuna urens* (C. Linnaeus) F.K. Medikus. G, *Phaseolus polystachios* (C. Linnaeus) N.L. Britton, E.E. Stern, & F. Poggenburg. H, *Medicago orbicularis* (C. Linnaeus) B. Bartalini. I, *Riedeliella graciliflora* H.A.T. Harms. J, *Medicago arabica* (C. Linnaeus) W. Hudson.

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Weitzman is a botanist with the Smithsonian Institution, Department of Botany, Washington, DC.

Abstract

Kirkbride, Joseph H., Jr., Charles R. Gunn, and Anna L Weitzman. 2003. Fruits and seeds of genera in the subfamily Faboideae (Fabaceae). U. S. Department of Agriculture, Technical Bulletin No. 1890, 1,212 pp.

Technical identification of fruits and seeds of the economically important legume plant family (Fabaceae or Leguminosae) is often required of U.S. Department of Agriculture personnel and other agricultural scientists. This bulletin provides relevant information for identifying faboid legumes.

Data are derived from extensive sampling of the species of 435 of the 452 genera of faboid legumes. The fruits and seeds of 18 of the genera and only fruits of 7 other genera are unknown. Two keys provide for (1) the differentiation of faboid from other legume seeds and (2) the identification of faboid genera based on seed characters and rarely fruit characters.

An updated explanation and discussion of fruit and seed characters precede the generic descriptions. The information on fruit characters extends and corrects that presently in the literature. Nearly all descriptive data on fruits and seeds are new.

In general, faboid legumes have been considered to lack endosperm. The majority of faboid genera do have endosperm, although the most agriculturally important legumes lack it. Lenses—testa structures often contiguous to the hilum—occur in all three legume subfamilies, though less frequently in Caesalpinioideae, and have no diagnostic value for the subfamilies. No faboid seed has a pleurogram or pseudopleurogram, while they are common in Mimosoideae and rare in Caesalpiniodeae. Some seed characteristics are very useful for faboid generic identifications: aril presence or absence, endosperm presence or absence, radicle concealment by the cotyledons, cotyledon lobes over the radicle presence or absence and condition, overall radicle shape, radicle tip shape, and radicle length relative to that of the cotyledons.

Keywords: Abreae, Adesmieae, Aeschynomeneae, Amorpheae, androecial sheath, areola, aril, Astragaleae, Bossiaeeae, Brongniartieae, Caesalpiniaceae, Caesalpinioideae, calyx, Carmichaelieae, chalaza, Cicereae, corolla, Coronilleae, cotyledon, cotyledon lobe, cotyledon-radicle junction, Crotalarieae, cuticle, Cytiseae, Dalbergieae, Daleeae, dehiscence, DELTA, Desmodieae, Dipteryxeae, distribution, embryo, embryonic axis, endocarp, endosperm, epicarp, epicotyl, Euchresteae, Fabeae, fracture line, follicle, funiculus, Galegeae, Genisteae, gynophore, halo, Hedysareae, hilar groove, hilar groove lips, hilum, Hypocalypteae, hypocotyl, indehiscent, Indigofereae, interactive computer, legume, Leguminosae, lens, Liparieae, loment, Loteae, mesocarp, micropyle, Millettieae, Mimosaceae, Mimosoideae, Mirbelieae, nutlet, Papilionaceae, Phaseoleae, plumule, Podalyrieae, Psoraleeae, radicle, radicle lobe, raphe, replum, rim-aril, Robinieae, seed, seed coat, Sophoreae, spermoderm, stipe, suture, Swartzieae, testa, Thermopsideae, Trifolieae, valve, Vicieae, wing.

While supplies last, single copies of this publication can be obtained at no cost from Joseph H. Kirkbride, USDA/ARS Systematic Botany and Mycology Laboratory, BARC West Room 304, Building 011A, Beltsville, MD 20705–2350 or by e-mail at <joe@nt.ara-grin.gov>.

Copies of this publication may be purchased from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; telephone 703–605–6000.

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We also express our appreciation to Lynda E. Chandler, now of Temple Terrace, FL, who created the basic plate design for this series of bulletins. Karen Parker, of Bowie, MD, prepared most of the seed drawings and some of the fruit and seed photographs and assembled many of the plates. Leslie Ann Gilbert, of Mt. Airy, MD, prepared some of the seed drawings, assembled many of the plates, prepared the literature cited and scientific name index, and assisted with proofreading. James Plaskowitz, USDA, ARS, Systematic Botany and Mycology Laboratory, MD, prepared most of the fruit and seed photographs and all of the scanning electron micrographs. Michael Jeffe, now with the Peace Corps in Senegal, Africa, prepared the fruit drawings for the cover. Carole A. Ritchie, of Laurel, MD, assisted in the preparation of the character list. Doris Mason, of Beltsville, MD, entered the data into computer files and formatted the generic descriptions.

Contents

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Volume II

Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

The Fabaceae (Leguminosae of authors including Isely and Polhill *1980*, Polhill and Raven *1981*, and Polhill *1994a,b*) traditionally is divided into three subfamilies: Caesalpinioideae, Mimosoideae, and Faboideae (Papilionoideae in Polhill and Raven *1981* and Polhill *1994a,b*). Hutchinson *(1964)* and Cronquist *(1981)* recognized the subfamilies as three separate families. The Fabaceae comprises 686 genera, has more than 18,000 species (Polhill *1997*), and is the third largest flowering plant family after Asteraceae and Orchidaceae (Mabberley *1997*). However, only Poaceae rivals Fabaceae in agricultural importance, although the spectrum of legume uses is much greater. The past, present, and future value of the Fabaceae has been documented recently by Schery *(1972),* Skerman *(1977),* National Academy of Sciences *(1979),* Duke *(1981),* ILDIS and CHCD *(1994),* Simpson and Ogorzaly *(1995),* Polhill *(1997),* Vaughan and Geissler *(1997),* and Summerfield and Bunting *(1980).*

Polhill *(1981a, 1994a, 1997)* has loosely divided the Faboideae into the following four groups of tribes:

1. The basal tribes, Swartzieae (1) and Sophoreae (2), which are transitional to the subfamily Caesalpinioideae.
2. The genistoid alliance, mainly temperate tribes occurring in the northern and southern hemispheres.
3. The tropical tribes with some woody tribes, such as Dalbergieae (4), Millettieae (7), and Robinieae (8), whose limits and phylogenetic history are unclear, and with a number of predominantly herbaceous tribes such as Indigofereae (9), Desmodieae (11), Phaseoleae (10), and Aeschynomeneae (14), whose limits are better defined and which are considered to be relatively more advanced.
4. The temperate herbaceous tribes or epulvinate series, which includes, for example, Galegeae (16), Hedysareae (18), Trifolieae (21), and Fabeae (Vicieae) (19).

Above and throughout this publication, numbers in parentheses following a tribe or genus name refer to the phylogenetic number associated with that name. Phylogenetic numbers and associated names are found in the section Synopses of Fruit and Seed Characters. Phylogenetic numbers without a decimal are tribe numbers. Phylogenetic numbers having a decimal contain a tribe number before the decimal and a genus number after the decimal. For example, a phylogenetic number of 4.07 represents the fourth tribe (Dalbergieae) in Fabiodeae and the seventh genus (*Fissicalyx* G. Bentham) within the tribe Dalbergieae (see page 226). Genera in the Millettieae (7) tribe do not have phylogenetic numbers; instead, these genera are ordered alphabetically (Polhill *1994b*) rather than by phylogenetic number in the synopses.

The basal tribes are predominantly tropical and subtropical. Swartzieae has been placed in the subfamily Caesalpinioideae or even considered to be a fourth subfamily, but the general consensus of opinion among legume taxonomists is that it should be in the Faboideae (Cowan *1981a*). Recent cladistic studies (Herendeen *1995*) and *rbc*L data (Doyle et al. *1997*) indicate that Swartzieae and Sophoreae should be merged into a single tribe in the Faboideae.

The genistoid alliance was characterized (Polhill *1994a*) by progressive contraction of vegetative structures and inflorescences, progressive joining of stamens and dimorphic anthers, development on the seed of a hilar lobe from extension of the radicle, and an abundance of alkaloids as compared to other advanced tribal groupings. This alliance has three distinct regional groupings. Genisteae (30) and Thermopsideae (29) are in the northern hemisphere; Crotalarieae (27), Hypocalypteae (26), and Podalyrieae (25) are centered in southern Africa; and Bossiaeeae (23) and Mirbelieae (24) are found in Australia.

The tropical tribes are distinguished by a series of character transitions (Polhill *1994a*). These tribes have strongly papilinoid flowers, staminal fusion late in development, more distinct stigmas, and the appearance of canavanine, a nonprotein amino acid. The delimitation and separation of Millettieae from Sophoreae has remained difficult, and the generic groupings within Millettieae are unresolved. The more advanced tropical tribes centered in the Old World, Desmodieae (11), Indigofereae (9), Phaseoleae (10), and Psoraleeae (12), are differentiated from those centered in the New World, Adesmieae (15), Amorpheae (6), and Aeschynomeneae (14), by their pollen wall structure (Ferguson *1984,* Ferguson and Skvarla *1981*). The Old World tribes tend to have an increase in the thickness of the endexine and a reduction of the foot layer, and New World ones tend to have a reduction of the endexine and a thicker foot layer, usually associated with longer columellae.

The temperate herbaceous tribes are characterized by the lack of a foliar pulvinus, which correlates with a closed vascular system and loss of secondary thickening (Polhill *1981a*). This also correlates with a lack of the inverted repeat from the chloroplast DNA, stipels, ridge bundles in petioles and rhachides, anomalous secondary thickening, secretory reservoirs, and leucoanthocyanidins.

Subfamily Faboideae consists of 30 tribes (Polhill *1981a*, *1994a*,*b*; Polhill and Raven *1981*), 452 genera, and more than 12,725 species. Polhill *(1981a)* proposed merging the tribe Coronilleae into Loteae and did so in his latest classification scheme for the legumes (Polhill *1994a*,*b*), which reduced the number of tribes to 30. Faboideae are distributed throughout the world in all habitats, including aquatic ones. Three hundred and five genera have 10 or fewer species, of which 102 are monotypic. One hundred and sixteen genera have more than 10 and less than 100 species, 22 genera have 100 to 200 species, and nine genera have more than 200 species. *Astragalus* C. Linnaeus (16.15), with more than 2,000 species, is the largest genus of legumes and probably the largest genus of seed plants. The distributions, generic names, and parameters in the section on Synopses of Fruit and Seed Characters are based on Polhill and Raven *(1981)* except as noted.

Charles R. (Bob) Gunn participated in the First International Legume Conference at the Royal Botanic Gardens, Kew, in 1978. The principal objective of the conference was to arrive at a consensus on the tribal and generic classification of the legumes, and the objective was met (Polhill and Raven *1981*). Gunn recognized that this would enable sweeping family-wide studies of many aspects of legumes. As a first step in his studies, he surveyed legume seed characters (Gunn *1981a*,*b*) and then prepared a nomenclature of legume genera for use in his databases (Gunn *1983*). He soon decided that legume fruits should be included in his studies because fruits are the units of dispersal for some legumes.

Legume fruits and seeds were gathered from institutions and individuals throughout the world and incorporated into the U.S. National Seed Herbarium, BARC, Beltsville, MD. Using these resources, Gunn prepared and published treatments covering the fruits and seeds for genera of the subfamilies Caesalpinioideae (Gunn *1991*) and Mimosoideae (Gunn *1984*). This volume, on the faboid legumes, completes the studies for all legume genera. The overall objectives of this bulletin, and of the previous two, were threefold:

1. Collect complete, comparative fruit and seed data for all legume genera, illucidating their fruit and seed morphology and correcting traditional errors in legume literature.
2. Develop keys, illustrations, and descriptions for accurate and rapid identification to genus of either isolated fruits and seeds or herbarium specimens bearing only fruits or seeds.
3. Contribute to our understanding of the evolutionary history of legumes and their tribal and generic systematics by providing essential fruit and seed data for all genera.

Neither mature fruit or seed material nor published data were available for the following 19 genera: *Burkilliodendron* A.R.K.R. Sastry (Millettieae), *Carrissoa* E.G. Baker (10.79), *Clitoriopsis* R. Wilczek (10.17), *Erichsenia* W.B. Hemsley (24.05), *Exostyles* H.W. Schott (1.10), *Jansonia* R. Kippist ex J. Lindley (24.17), *Leptosema* G. Bentham (24.07), *Luzonia* A.D.E. Elmer (10.23), *Margaritolobium* H.A.T. Harms (Millettieae), *Neocollettia* W.B. Hemsley (11.26), *Neodunnia* R. Viguier (Millettieae), *Peltiera* D.J. Du Puy & J.-N. Labat (14.02A), *Petaladenium* A. Ducke (2.25), *Sartoria* P.E. Boissier & T.H.H. von Heldreich (18.05), *Sellocharis* P.H.W. Taubert (30.07), *Spongiocarpella* G.P. Yakovlev & N. Ulziykhutag (16.13), *Stirtonanthus* B.-E. Van Wyk & A.L. Schutte (25.07), *Vaughania* S. Moore (9.02), and *Weberbauerella* O.E. Ulbrich (14.18). These genera are omitted from the seed keys and from the section on Synopses of Fruit and Seed Characters. The phylogenetic number system is based on Polhill *(1994b).* The following five other genera were represented only by fruits or valves: *Arthrocarpum* I.B. Balfour (14.22), *Dahlstedtia* G.O.A. Malme (Millettieae), *Herpyza* C. Wright (10.28), *Nephrodesmus* A.K. Schindler (11.04), and *Spirotropis* E.L.R. Tulasne (2.32). These genera are omitted from the seed keys, but are included in the section Synopses of Fruit and Seed Characters. One genus, *Mildbraediodendron* H.A.T. Harms (1.07), was only represented by seeds.

Unpublished data for several tribes were supplied by the following reviewers: Aeschynomeneae, Vela E. Rudd; Amorpheae, Rupert C. Barneby; Cicereae, L.J.G. van der Maesen; Dalbergieae, R.T. Pennington, Vela E. Rudd, and K. Thothathri; Desmodieae, Shinobu Akiyama; Euchresteae, Hiroyoshi Ohashi; Fabeae, Nigel Maxted; Galegeae, Rupert C. Barneby, Aaron Liston, Dieter Podlech, and Andrey Sytin; Genisteae, Chaia Clara Heyn; Hedysareae, K. Thothathri; Loteae, Ana M. Arambarri and Chaia Clara Heyn; Millettieae, Frits Adema and K. Thothathri; Phaseoleae, Paul R. Fantz, Alfonso Delgado Salinas, and L.J.G. van der Maesen; Robinieae, Matt Lavin; Sophoreae, Patrick S. Herendeen and Velva E. Rudd; Swartzieae, Patrick S. Herendeen; Thermopsideae, B.L. Turner; and Trifolieae, Chaia Clara Heyn and Ernest Small.

Procedures

Critical materials were authenticated by an expert for each tribe and by recent annotation labels. Authenticated fruit and seed samples, selected to exhibit the range of morphological characters within a genus, were used to collect descriptive data that were transformed into keys and descriptions and to prepare illustrations. Samples were documented either by voucher herbarium specimens or by specimens deposited in the U.S. National Seed Herbarium, and a list of these specimens was filed in the herbarium. Additional fruit and seed samples, many identified by comparison, were used to augment the survey of each genus.

Fruit and seed topography was observed at magnifications of 10 to 30 using a dissecting stereoscopic microscope equipped with an ocular micrometer. Recorded observations were made at a magnification of 10 except as noted.

In preparing seeds for dissection, mature seeds of representative size and shape were drilled with a miniature electric drill. The testa was penetrated one or more times, depending on seed size, in areas removed from the embryonic axis. Drilled seeds were placed in a softening solution of 74 percent distilled water, 25 percent methyl alcohol, and 1 percent dioctyl sodium sulfosuccinate (aerosol OT). They were kept in solution for one-half to 24 hours, depending on the consistency of the testa. The testa was easily removed along with the endosperm when present. Embryos were drawn with the aid of a camera lucida fitted on a stereoscopic microscope. Illumination was provided by an above-stage fiber optic system, which split the light into one beam for the microscope and one for the camera lucida. Drawings were prepared first in pencil and then in india ink on Dupont Cronaflex U-C Tracing Film.

The light photographs were made with a Leitz copy camera that was mounted on a light stand and that used 4 × 5 Polaroid type 55 film. Mature fruits and seeds usually were photographed in face view at 1 magnification and either enlarged or printed contact size, using standard printing techniques.

For the scanning electron micrographs, seeds were cleaned by hand and attached by adhesive to aluminum specimen stubs, then stored in a desiccator for at least 24 hours before coating. Coating with gold palladium was done in a Technics Hummer V Sputter Coater. Chamber pressure was reduced to 20 millitorrs and then flushed five times with argon before the chamber was stabilized at 100 millitorrs. Coating time was 4.5 minutes at an operating potential of 700-1,200 V and a current of 15 mA. Although measurements were not made of its thickness, the gold-palladium coat was not deemed excessive for the desired magnifications of 50 and 1,000. Seeds were scanned with an AMRAY 1200b scanning electron microscope (SEM). Accelerating voltage was 15 kV, final aperture size 100 µm, and the working distance to the specimen was 15 mm. In most instances, the external surface of mature testas was photographed at magnifications of 50 and 1,000.

All data were recorded in an ASCII text file in DELTA format (Dallwitz *1980*, Dallwitz et al. *1997*) on an IBM-compatible microcomputer. DELTA format is a free-form, unlimited data-coding format that accepts multistate, numeric, and text characters and provides for linking of image files to both characters and taxa. Once recorded, the data were checked for syntax and maintained using the DELTA software system (Dallwitz *1980,* Dallwitz et al. *1997*) developed by Michael J. Dallwitz of the Division of Entomology, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia. The final character list had 303 characters (see Character List, p 1130) which included 154 fruit characters, 128 seed characters, and 5 distributional characters. When the data were completed for all available genera, generic descriptions were generated using the CONFOR program of the DELTA system. The data were moved from the DELTA system file format to that of the PANKEY software system (Pankhurst *1988*, *1991*, *1995*) developed by Richard J. Pankhurst of the Royal Botanic Gardens, Edinburgh, Scotland. The interactive key construction program, KConI, of the PANKEY system was used to prepare the keys.

Fruit Morphology

At the family and subfamily levels, much less morphological data exist for fruits than seeds. In the three most recent systematic treatments of all Fabaceae genera, fruit characters have played a minor role (Hutchinson *1964*, Polhill and Raven *1981*, Polhill *1994a*,*b*). Generalized and noncircumscribing fruit characters were used, such as "indehiscent or not," "pods various," "pericarp chaffy," "angled," "2-valved," "continuous within," and "tipped by style." Lima *(1989)* did a complete study of the fruits and seeds of tribe Dalbergieae (4) with generic descriptions and a key to genera using fruit characters.

The faboid pistil comprises a single ovary that is usually unilocular. In two faboid genera, *Swainsona*[*] (16.02) and *Astragalus* (16.15) of tribe Galegeae, the ovary is usually unilocular and rarely bilocular. In two other genera, *Biserrula* (16.15A) of Galegeae and *Chordospartium* (17.03) of Carmichaelieae, the ovary is always bilocular.

Mature dry fruits were studied, and their characters are discussed in the order given in the sections Synopses of Fruit and Seed Characters and Character List. Selected fruit characters are illustrated in figures 1-3. In the discussions that follow on fruit morphology, the number of genera exhibiting the character is usually identified in parentheses. The total number of genera for any suite of characters may exceed 435 (the number of genera studied) because a genus may be variable for the characters. For example, a genus may have stipitate, substipitate, or nonstipitate fruits. The fruit data are presented in the following order:

Fruit—type, size, persistence of flower parts, declination, twist and outline, inflation, transection, apex, base, texture, seed chamber external visibility, margin, wing, stipe, dehiscence, replum.
Loment—presence of epicarp, dehiscence, segmentation, size, shape.
Epicarp—sheen, coloration, texture, pubescence, surface, exfoliation, cracking.
Mesocarp—presence, relative thickness, venation, layering, composition, density.
Endocarp—presence, sheen, opacity, coloration, surface traits, testa adherence, septation, density, exfoliation, fusion to mesocarp and epicarp, wings, separation into segments.
Seeds—number per fruit, position, proximity, number of series.
Funiculus—length, thickness, shape.
Aril—presence, texture, shape, margin, relative size, presence and number of tongues or flaps on 2-lipped rim-aril, color.

Fruit

Type. Most fruits of faboids are legumes (true for 402 genera), that is, they have a carpel opening along two sutures and the seeds attached along the ventral suture (Spjut *1994*). There are a significant number of variations on the typical legume. The most frequent involve dehiscence. Many genera have legumes that dehisce along just one suture or are indehiscent. Some fruits are loments (50 genera), that is, they have a single carpel that disarticulates into seed-bearing segments, or nutlets (20 genera), that is, a small, hard, indehiscent, one-seeded fruit.

Almost all fruits are unilocular (400 genera). Two genera are unilocular or bilocular, and two genera have bilocular fruits. The genera are named above.

Size. Fruit size is recorded in centimeters for length, width, and thickness, frequently as a range. Length is measured from the apex to the base of the stipe, width at the widest part of the fruit, and thickness at the thickest part of the fruit. Width and thickness were measured with a caliper prior to dehiscence.

The shortest faboid fruits (less than or equal to 0.15 cm long) are found in *Marina* (6.07), *Melilotus* (21.03), and *Trifolium* (21.06). The longest recorded (more than 50 cm long) occur in *Mucuna* (10.03), but the 53-cm-long *Mucuna* fruits do not approach the 200-cm-long fruits of *Entada* M. Adanson (Mimoseae, Mimosoideae), the longest in the family. The mean fruit length is 5.6. The fruit width ranges from 0.04 to 15.5 cm with a mean of 1.5, and the thickness ranges from 0.01 to 13 cm with a mean of 0.7.

Persistence of flower parts. The androecil sheath is rarely persistent (59 genera) on the fruit and frequently is deciduous (437 genera). The corolla is rarely persistent (only 33 genera) and is frequently deciduous (407 genera). When the corolla is persistent, different petals persist on different fruits. The persisting petals are categorized as keel petals (4 genera), standard petals (10 genera), or various petals (19 genera). The calyx is approximately equally persistent (281 genera) or deciduous (251 genera). When the calyx persists, it is frequently shorter than the fruit (267 genera) and rarely the same length (15 genera) or longer (30 genera). Persistence of floral parts was a difficult character to use.

[*] For authors of studied genera and species, see Synopses of Fruit and Seed Characters.

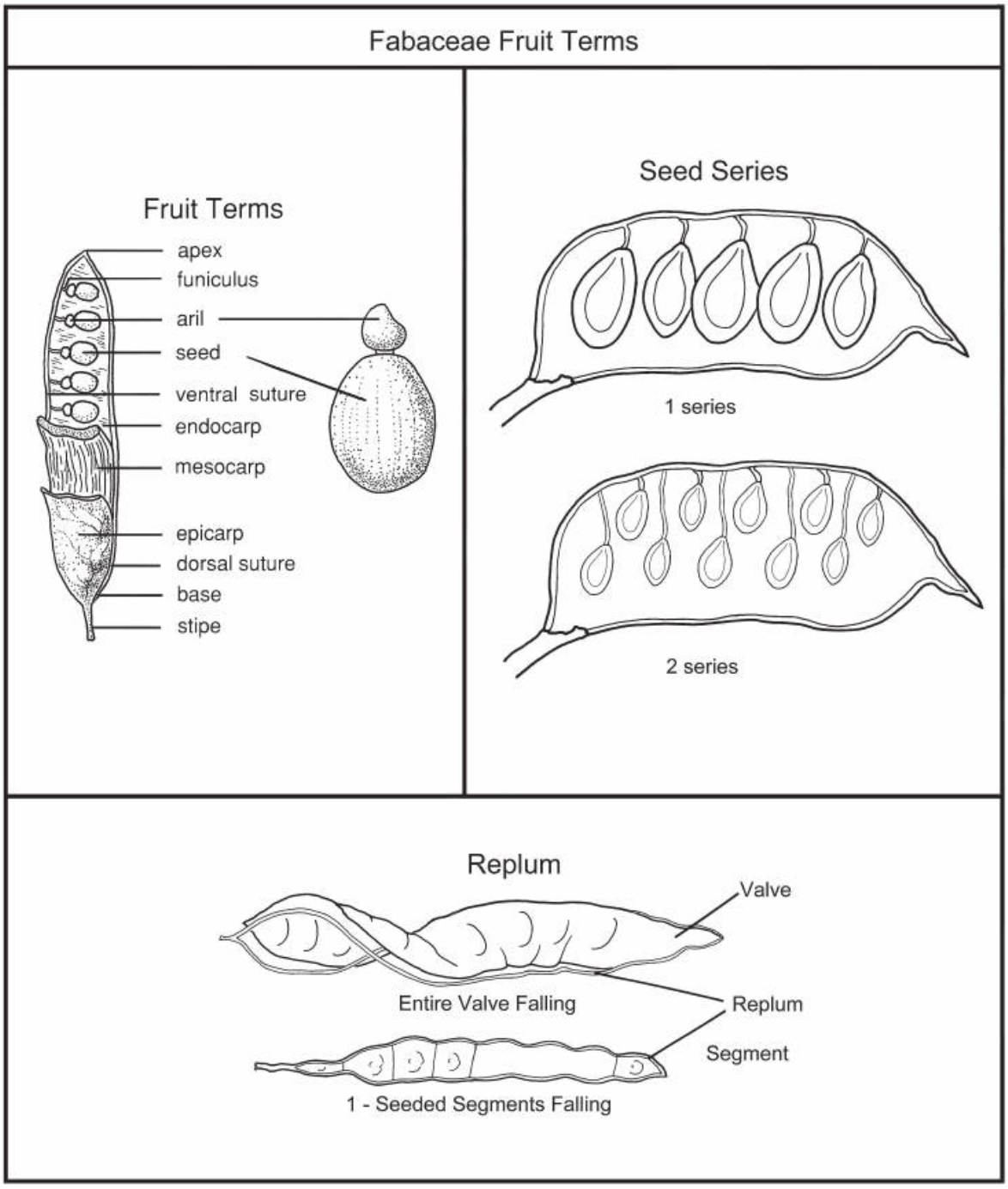


Figure 1. Selected terms for describing fruits in the subfamily Faboideae

Frequently during collection, drying, storage, or study, the floral parts were knocked off the fruits.

Declination. Fruit declination prior to dehiscence is categorized as 0.5-coiled (13 genera); 1-coiled (18 genera); 1.5-coiled (5 genera); 2-coiled (3 genera); 3-coiled (2 genera); 4-coiled (3 genera); 5- to 10-coiled (1 genus); contorted (5 genera); curved, including slightly curved (169 genera); S-curved (6 genera); or straight (397 genera). The curving or coiling creates orifices in a few fruits (16 genera), but the vast majority of fruits lack such orifices (427 genera).

Twist and outline. A few fruits are plicate (13 genera), that is, folded along their length, and several, such as *Uraria cordifolia* N. Wallich (11.16) of Desmodieae (11), were so strongly folded that they appear accordionlike. The vast majority of fruits are not plicate (431 genera). Fruit outlines occasionally are modified by a twist (11 genera) that has no role in dehiscence. The vast majority of fruits are not twisted (432 genera). More fruits are asymmetrical in outline (354 genera) than symmetrical (272 genera). Fruit outlines prior to dehiscence and disregarding declination (figure 3) are categorized as C-shaped (18 genera), circular (53 genera), coiled (9 genera), didymous (2 genera), dolabriform (3 genera), elliptic (71 genera), falcate (87 genera), fusiform (36 genera), irregularly fusiform (3 genera), harp-shaped (7 genera), irregular (36 genera), lanceolate (13 genera), linear (175 genera), moniliform (54 genera), oblanceolate (4 genera), obliquely oblanceolate (1 genus), oblong (148 genera), obovate (23 genera), obliquely obovate (16 genera), ovate (68 genera), obliquely ovate (3 genera), quadrangular (1 genus), rectangular (2 genera), reniform (11 genera), rhombic (11 genera), S-shaped (1 genus), samaroid (17 genera), or triangular (2 genera). For asymmetrical fruits, the parallelism of the sutures is recorded as one straight and one curved suture (120 genera), both sutures nearly straight (95 genera), both sutures parallelly curved (210 genera), or both sutures unequally curved (91 genera). Also for asymmetrical fruits, the position of the widest part is indicated as widest near apex (7 genera), widest near middle or D-shaped (86 genera), widest at base (1 genus), narrowing in several places, resembling *Desmodium* (9.09) fruit (21 genera), narrowest near middle, B-shaped (4 genera), or narrowing slightly once or twice on one side (2 genera).

Inflation. Some fruits are inflated (56 genera) but most are not (413 genera).

Transection. Fruit transections are categorized as compressed (266 genera); cruciform (1 genus); flattened (155 genera); quadrangular (4 genera); subtriangular (2 genera); or terete, including subterete (127 genera).

Apex. Most fruit apices do not have beaks (323 genera), but some do (230 genera). Declination of fruit apices is catagorized as straight (170 genera), declined (70 genera), hooked (32 genera), or coiled (9 genera). The vast majority of beaks are solid and the same color and texture as the rest of the fruit (221 genera) or are rarely papery fragile and rarely as long as 1 cm (9 genera).

The apex shape is categorized as abruptly long acuminate (1 genus), blunt (9 genera), cordate (1 genus), emarginate (11 genera), rounded (195 genera), long tapered (gradually attenuate) (47 genera), tapered (attenuate) (127 genera), short tapered (abruptly attenuate) (217 genera), or truncate (14 genera). Apex orientation relative to the longitudinal axis of the fruit is catagorized as aligned (339 genera), oblique (231 genera), right-angled (46 genera), bent over almost to the longitudinal axis of the fruit (5 genera), or bent over so far that they cross the longitudinal axis of the fruit (3 genera).

Base. The shape of the fruit base is categorized as cordate (1 genus), emarginate (2 genera), rounded (177 genera), long tapered (gradually attenuate) (56 genera), tapered (attenuate) (161 genera), short tapered (abruptly attenuate) (194 genera), or truncate (17 genera). Base orientation relative to the longitudinal axis of the fruit is aligned (372 genera), oblique (148 genera), or right-angled (20 genera).

Texture. The apical and basal textures are either uniform (432 genera) or rarely different (8 genera). When they differ, the differences are categorized as follows: upper 1/2 inflated and reticulate over seed cavity and lower 1/2 adnate and wrinkled to scurfy over seed cavity (1 genus); upper 3/4 barely inflated, reticulate, and pubescent and lower 1/4 not inflated, reticulate, or pubescent (3 genera); or upper 1/4-2/3 firm and/or pubescent and lower 3/4-1/3 fragile and glabrous (1 genus). The overall texture of the fruit is characterized as chartaceous (107 genera); coriaceous, including subcoriaceous (274 genera); drupaceous (8 genera); fleshy, including subfleshy (12 genera); fragile, thinner than chartaceous, like *Trifolium* (21.06) (17 genera); leathery (29 genera); ligneous, including subligneous (92 genera); or membranous (58 genera).

Seed chamber external visibility. Approximately half of the fruits have externally visible seed chambers (260 genera) and half do not (244 genera). Of those fruits with externally visible seed chambers, some are torulose (33 genera), that is, somewhat cylindrical with alternate

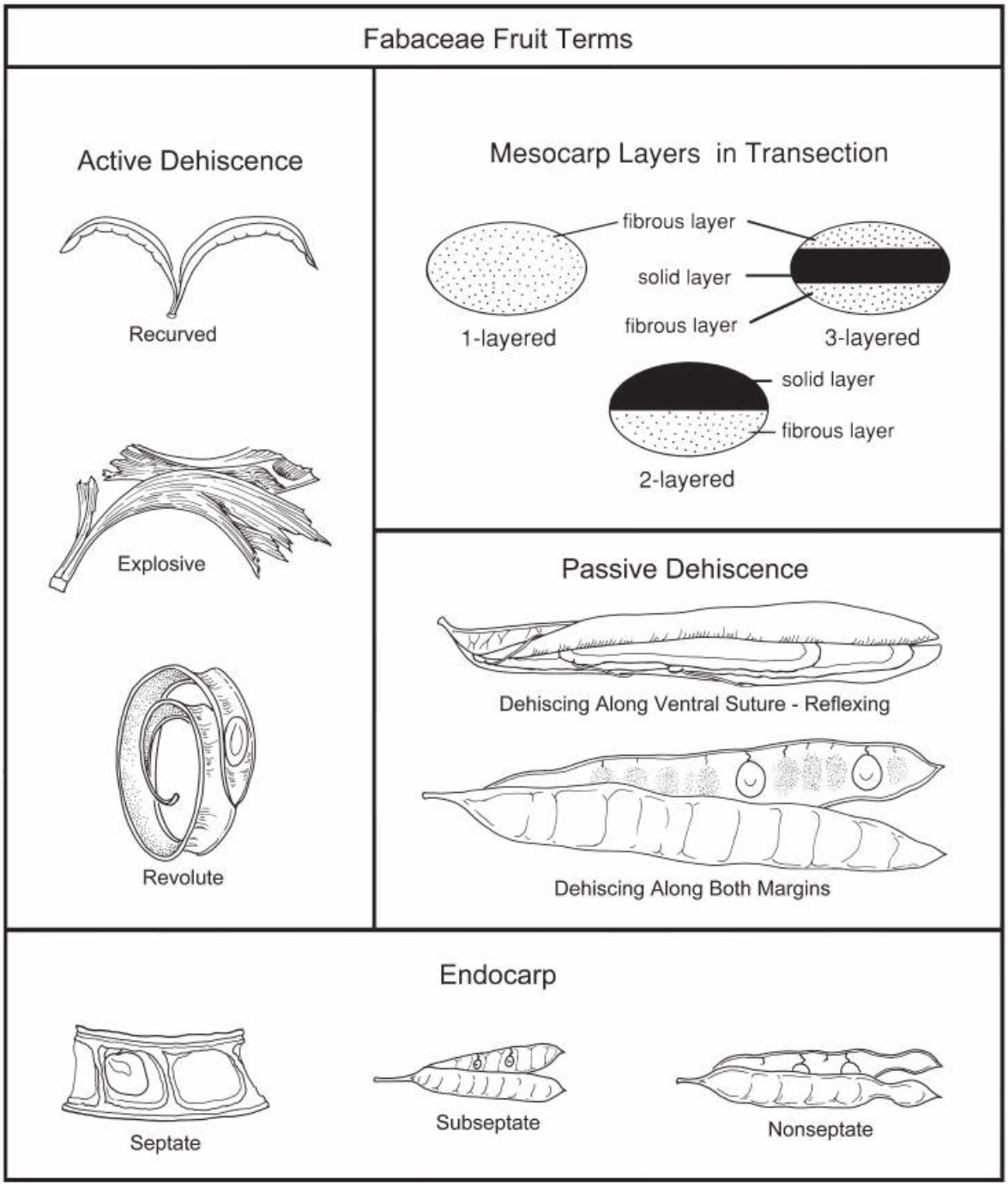


Figure 2. Selected terms for describing fruits in the subfamily Faboideae

swellings and contractions (Harris and Harris *1994*), while most are not (181 genera).

Margins. Some fruits have constricted margins (143 genera), but most do not (379 genera). The constrictions are catagorized as constricted along both margins (63 genera), slightly constricted along both margins (65 genera), constricted only on one margin (16 genera), slightly constricted only on one margin (12 genera), or constricted on one margin and slightly constricted on the other (8 genera). A few fruits have a sulcus, or groove, running along the margin (22 genera), but the overwhelming majority do not (421 genera). Some fruits have one or more types of embellishments on the margin (173 genera), while most do not (358 genera). The embellishments are characterized as flanges (2 genera), fringe (8 genera), prickles (12 genera), ridges (21 genera), spines (6 genera), thickened sutural areas (78 genera), or wings (86 genera).

Wing. Some fruits have wings (88 genera), while most do not (370 genera). The number of wings per fruit varies from one on most fruits up to a maximum of 30 on a few individuals of *Machaerium* (4.06). The wing width ranges from 0.1 to 130 mm and averages 11 mm. The largest wing is found on *Centrolobium* (4.12) of Dalbergieae (4) and ranges from 76 to 130 mm wide. Fruit wings are categorized as samaroid (26 genera); valvular, on the face of the valve (13 genera); sutural, on the suture (47 genera); or continuous around the fruit (9 genera). Wings in the first three categories are located in different positions on the fruit. The samaras are either apical (5 genera) or basal (9 genera), the valvular wings are on one valve (2 genera) or on both (16 genera), and the sutural wings are on one suture (44 genera) or on both (30 genera).

Stipe. Approximately half of the fruits do not have a stipe (281 genera). Of those with a stipe, the majority are substipitate (192 genera), that is, the stipe is only 0.1–5 mm long, and the remainder clearly are stipitate (107 genera), that is, the stipe is 5 mm or longer. The length of 5 mm was chosen as an arbitrary division between substipitate and stipitate so that the large number of fruits with very short stipes could be more easily identified. The stipes range from 0.1 to 70 mm long and average 8.5 mm.

Dehiscence. The majority of fruits exhibit complete, typical legume dehiscence (276 genera). Two genera, *Endosamara* of the Millettieae (7) and *Glottidium* (8.01A) of the Robinieae (8), have a dehiscent epicarp and mesocarp and an indehiscent endocarp. Two other genera, *Piptanthus* (29.02) of the Thermopsideae (29) and rarely *Sophora* (2.45) of the Sophoreae (2), have epicarp and mesocarp that break near the center of the valve and an endocarp that dehisces along the suture. The remainder of the fruits are indehiscent (188 genera), a condition normally not associated with legumes.

Five genera have unique types of fruit dehiscence. *Cyclocarpa* (14.16) of Aeschynomeneae (14) have fruits that separate from the suture and along loment segment margins. *Antopetita* (13.16) of Loteae (13) have fenestrating fruits that open via a coiling strip of tissue. *Anthyllis* (13.02) of Loteae has fruits that open following deterioration of a delicate strip of tissue along the inner suture or both sutures. *Endosamara* of Millettieae (7) has fruits in which the epicarp and mesocarp dehisce along the suture and the endocarp lomented forming an indehiscent, winged segment around each seed. *Glottidium* (8.10A) of Robineae has fruits in which the epicarp and mesocarp dehisce along the suture and the endocarp is indehiscent and entire with flat winglike areas.

Of those fruits with complete sutural dehiscence, most dehisce along both sutures (239 genera), while some dehisce only along one suture (43 genera) (figure 2). Those dehiscing along just one suture should be called follicles (Spjut *1994*), but we have chosen to describe them as legumes because most previous authors have done so.

The vast majority of valvular dehiscence starts at the apex and progresses toward the base (241 genera). On a few fruits, however, it starts in the middle and progresses both up and down (11 genera) or starts at the base and progresses upward (5 genera). Valvular dehiscence is mainly active (193 genera) but is sometimes passive (95 genera). The condition of the valves after valvular dehiscence is described as breaking (2 genera), coiling (1 genus), enrolling (16 genera), reflexing (8 genera), revolute (6 genera), or twisting (166 genera) (figure 2).

Replum. In a few dehisced fruits, a replum is visible (9 genera), but in the vast majority no replum is visible (399 genera). The replum consists of the intact sutures with their veins from which the valves have separated or dehisced (figure 1). The replum can only be observed in dehisced fruits.

Loment

Presence of epicarp. When the epicarp is present, the article is intact or complete (7 genera).

Dehiscence. A few loments dehisce along one suture (4 genera), but most were indehiscent (47 genera).

Segmentation. Few loments have conspicuous segments, or articles, with distinct lines of cleavage (7 genera), but most have inconspicuous segments (41 genera).

Size. The loment segments range from 1 to 35 mm in length and average 7.3 mm. All of the loments are widest across the seed area (48 genera) except for those of *Coronilla* (13.11) of Loteae (13) which varies—some are widest across the seed area and some widest across the ends.

Shape. Most of the time the loment segments of a single fruit have essentially the same shape (31 genera). Sometimes, however, the segments differ and are catagorized as upper one different from the middle ones (16 genera), lower one different from the middle ones (14 genera), or upper one different from the lower one (1 genus). The overall shape of the loment segments is categorized as circular (10 genera), curved (3 genera), D-shaped (25 genera), elliptic (2 genera), hippocrepiform (horseshoe or ring-shaped) (1 genus), linear (1 genus), oblong (16 genera), ovate (1 genus), quadrangular (9 genera), rectangular (7 genera), trapezoid (1 genus), or triangular (3 genera).

Epicarp

Sheen. Most epicarps are dull (413 genera) but a few are glaucous (2 genera), glossy (27 genera), or semiglossy (13 genera).

Coloration. Most epicarps are monochrome (398 genera), but some are multicolored (115 genera). Of the multicolored ones, some are bichrome (17 genera), most are mottled (99 genera), and some are streaked (12 genera). The basic background color of the epicarp is categorized as black (53 genera), brown (359 genera), gray (15 genera), green (36 genera), orange (5 genera), purple (8 genera), red (6 genera), tan (151 genera), or yellow (19 genera). The predominant epicarp color is brown.

For multicolored epicarps, the overlaying colors are categorized as black (11 genera), brown (85 genera), gray (3 genera), green (5 genera), purple (8 genera), red (6 genera), tan (4 genera), or yellow (1 genus). The majority of mottling color combinations are variable (56 genera), but some are constant (34 genera). Some of the mottled epicarps also have mottled seed chambers (24 genera)

Texture. The vast majority of epicarps have a uniform surface texture (448 genera). For the few that are not uniform, the variation is not confined to the base or apex (8 genera).

Pubescence. Presence or absence of hairs is categorized as glabrous, that is, completely without hairs (246 genera); glabrate, with just a few scattered hairs (40 genera); pubescent and indurate, with abundant, persistent hairs (282 genera); or pubescent and soon deciduous, with abundant hairs that are expected to fall off soon (64 genera). The hairs are frequently erect (273 genera) but are often appressed against the epicarp surface (105 genera). The majority of the time the hairs are all of the same type (296 genera), but sometimes the hairs were of two types (34 genera) or rarely three (3 genera). The hair types are characterized as hirsute (1 genus), peltate (densely micropuberulous) (2 genera), pilose (58 genera), puberulent (128 genera), sericeous (57 genera), strigose (12 genera), tomentose (57 genera), velutinous (42 genera), or villous (70 genera). When the hairs are all the same color, they are described as black (3 genera), brown (58 genera), golden (158 genera), gray, including silver (136 genera), gray-brown (7 genera), red (5 genera), tan (9 genera), white (41 genera), or yellow (4 genera).

A few epicarps have variable, often-unique color patterns in hairs on a single epicarp. The variable hair color patterns are categorized as longitudinal bands of lighter and darker brown (1 genus); appressed dark-brown hairs and scattered, erect gray hairs intermixed (1 genus); long, appressed brown hairs and short and shorter white hairs intermixed (1 genus); golden glandular hairs and short-pilose reddish-brown hairs intermixed (1 genus); erect, golden hairs and white hooked or not hooked hairs (1 genus); golden hooked hairs and gray plain hairs (3 genera); gray and black hairs intermixed (2 genera); long and short gray plain-tipped hairs (2 genera); gray hairs on valves and golden hairs on sutures (1 genus); long and short white hairs intermixed (1 genus); long and short yellow hairs intermixed (1 genus); long and short golden-to-brown hairs intermixed (1 genus); long, white and short, golden hairs intermixed (1 genus); or contiguous areas of golden and white hairs (1 genus).

The vast majority of epicarps have hairs uniformly distributed over them (283 genera). A few epicarps have unevenly distributed hairs and are described as having apical pubescence differing from basal pubescence (9 genera) or pubescence denser near the sutures and sparser centrally (4 genera). A few epicarps have distinct or unique patterns of pubescence that are described as apical 1/4 tomentose and basal 3/4 glabrous (3 genera), apical 3/4 tomentose and basal 1/4 glabrous (2 genera), apical 1/2 crinkly tomentose and basal 1/2 densely villose with straight hairs (1 genus), apical 1/3–1/2 pubescent and basal 1/2–2/3 glabrous (3 genera), apical 3/4 glabrous and basal 1/4 pilose (1 genus),

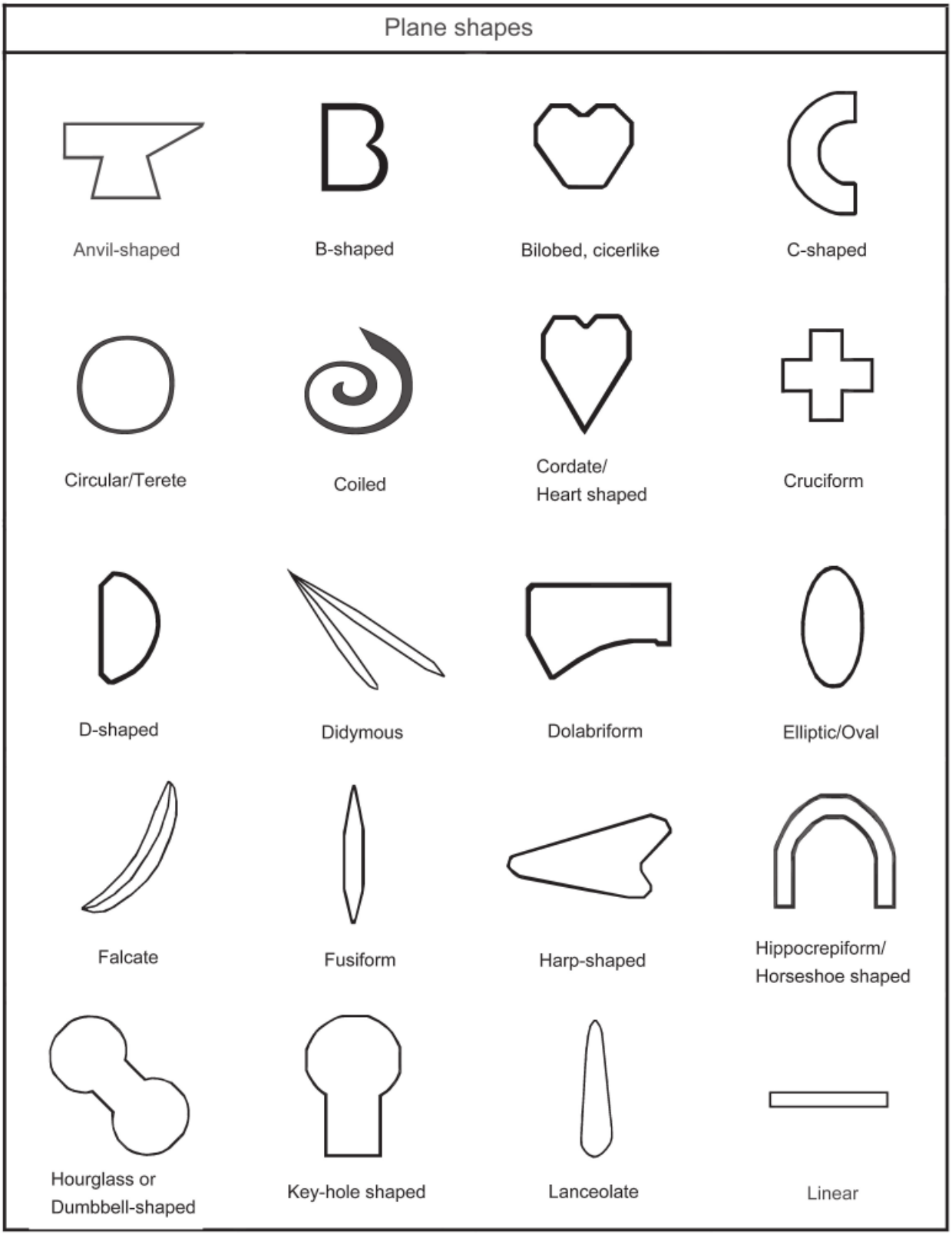


Figure 3. Plane shapes

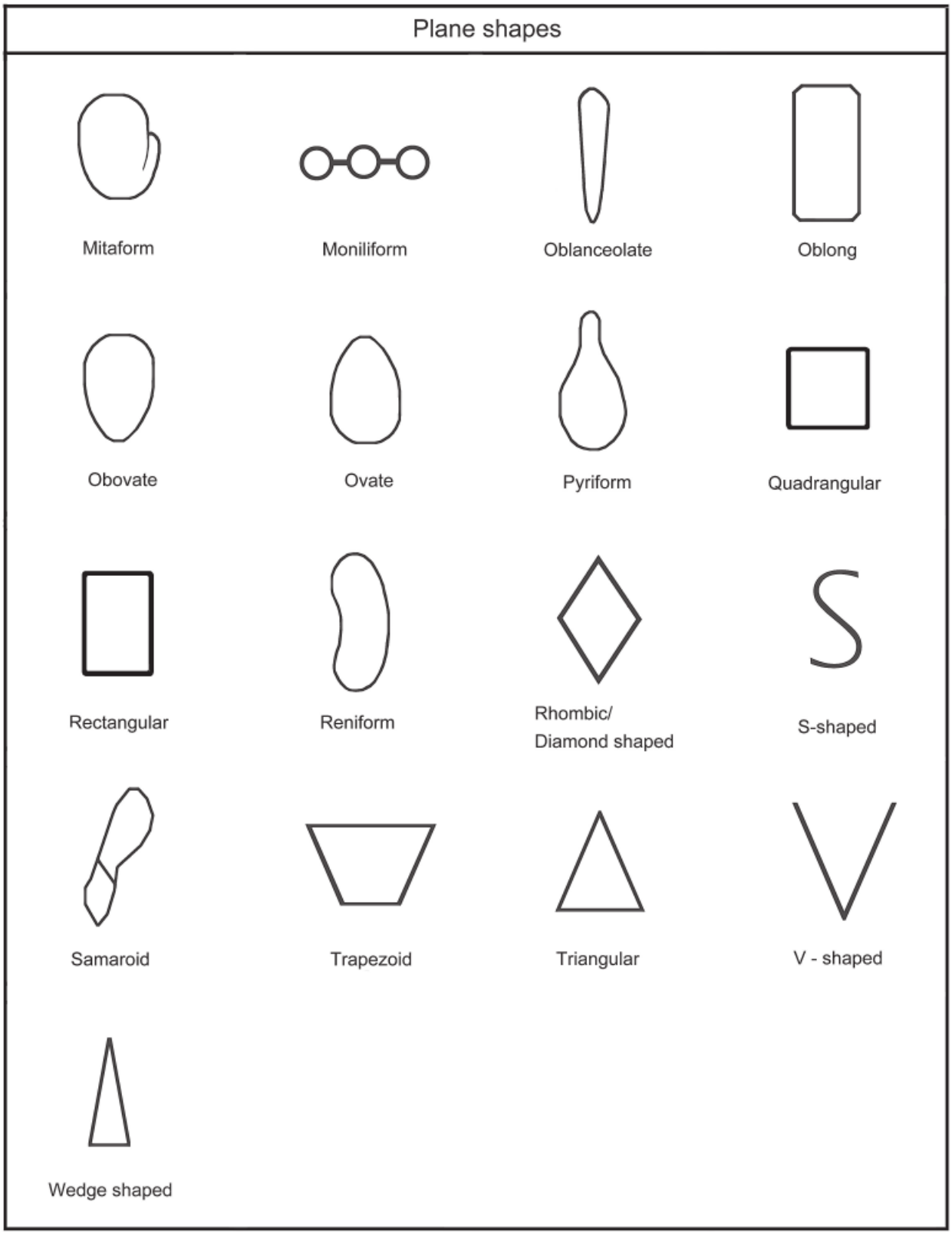


Figure 3 (continued). Plane shapes

or stipe (only) sericeous, [*Styphnolobium* (2.44), in literature] (1 genus).

The vast majority of epicarp hairs are simple in structure (301 genera), but a few are more complicated and are labeled as glandular (18 genera) or complex (9 genera). The complex hairs are categorized as bristlelike (6 genera), plumose (2 genera), setae (1 genus), or T-shaped (3 genera).

Most of the epicarp hairs are pliable (273 genera), but some are stiff (50 genera). Most of the epicarp hairs also have plain bases (299 genera), but some have swollen, or enlarged, bases (34 genera). When the hairs are bristlelike, some are erect (10 genera), while others are bent and either pointed toward the apex (antrorse) (7 genera) or the base (retrorse) (4 genera). The apices of the bristlelike hairs are characterized as straight (14 genera), coiled (1 genus), curved (1 genus), or hooked (3 genera).

Surface. Some epicarp surfaces are glandular (66 genera), but most are not (378 genera). The glandular structures are categorized as disks (1 genus), dots (38 genera), hairs (28 genera), papillae (1 genus), or setae (4 genera). The glands are limited to a portion of the fruit (6 genera) or are uniformly distributed over the entire fruit (1 genus). When the glands are limited to a portion of the fruit, their distribution is described as upper 1/4-2/3 glandular and lower 3/4-1/3 eglandular (1 genus), upper 1/2 glandular and lower 1/2 eglandular (1 genus), upper 2/3 glandular and lower 1/3 eglandular (1 genus), or upper 3/4 glandular and lower 1/4 eglandular (3 genera).

The vast majority of epicarps are spineless (421 genera), but a few have spines (18 genera). The spines mainly are persistent (10 genera), and on some epicarps the spines are broken off but their bases are evident (5 genera). Usually the spines are the same color as the rest of the fruit (10 genera), but in two cases the spines or their basal remnants are a different color from the rest of the fruit.

The epicarp surface is usually not smooth (389 genera) but sometimes is smooth (99 genera). The nonsmooth nature of the epicarp surface mostly is caused by elevated or raised features (369 genera), and rarely by recessed or depressed features (35 genera).

Veins are usually elevated (or raised), and more than half of the epicarps are veined (274 genera). Slightly less than half of the epicarps have no apparent veins (221 genera). Venation patterns vary and are categorized as longitudinally veined relative to fruit length (25 genera), obliquely veined relative to fruit length (12 genera), transversely veined relative to fruit length (34 genera), reticulately veined (net-like veins) (223 genera), or irregularly veined (17 genera).

The vast majority of epicarps do not have tubercules (428 genera), but a few do (16 genera). All of the tubercules are solid (11 genera).

The elevated features of nonsmooth epicarp surfaces are categorized as blistered (2 genera); concentric whorls like a fingerprint (1 genus); dotted (18 genera); faveolate (1 genus); glandular dotted, including resinous globular (10 genera); knobbed (1 genus); lenticular (11 genera); muricate (5 genera); papillose (25 genera); pusticulate (4 genera); raised reticulate (2 genera); ribbed (6 genera); rugose (35 genera); scaly (2 genera); scurfy (3 genera); shagreen (13 genera); striate (5 genera); subvesicular (2 genera); tessellate (2 genera); tuberculate (16 genera); verrucose-rugose (10 genera); warty (17 genera); or wrinkled (111 genera). The recessed features of nonsmooth epicarp surfaces are characterized as glandularly punctate (3 genera), grooved (7 genera), pitted (11 genera), punctate (5 genera), or slitted obliquely (9 genera).

Exfoliation. Most epicarps do not exfoliate (404 genera). Rarely do epicarps exhibit exfoliation or checking. Exfoliation is categorized as exfoliating (11 genera), exfoliating in part (31 genera), or checking (3 genera).

Cracking. Most epicarps do not crack (406 genera), but some do (67 genera). The patterns of cracking on the surface of the epicarp are described as oblique to fruit length (46 genera), transverse to fruit length (12 genera), or irregular (11 genera).

Mesocarp

Presence. The majority of fruits have a mesocarp (361 genera), but some do not (89 genera). Those valves that twist during dehiscence always have a mesocarp.

Relative thickness. Mesocarp thickness is subjectively described as thick (95 genera), thin (267 genera), or trace (22 genera).

Venation. Most mesocarps are not veined (294 genera). A few are uniformly veined (24 genera), and one [*Pterodon* (3.03) of Dipteryxeae] is veined over the seed chamber and inconspicuously veined on the wing.

Layering. Most mesocarps consist of a single layer of material (306 genera). Some, however, are either two-layered (67 genera) or three-layered (12 genera) (figure 2).

Composition. Most mesocarps lack balsamic vesicles (344 genera), but a few have them (15 genera). Most mesocarps also lack fibers (311 genera), while a few have them (13 genera). Only fruits of one genus, *Bobgunnia* (1.01A) of Swartzieae (1), have large reniform canals running through the mesocarp from the base to the apex.

The composition of single-layered mesocarps is categorized as firm-walled cells that are open and empty (6 genera); fibrous throughout (shreds) (5 genera); fleshy, including pulpy (7 genera); glassy beads (2 genera); mealy (soft) (7 genera); spongy (soft) (11 genera); vitreous* (glasslike, as in lava rock obsidian) (7 genera); or solid, of uniform texture but not having the above traits (273 genera).

The composition of two-layered types is sorted out according to whether or not they include fibers. The fibrous, two-layered types are characterized as fibers over solid layer (7 genera), fibers embedded in mealy tissue over solid layer (1 genus), or fibers below solid or compacted fibrous layer (1 genus). The nonfibrous, two-layered types are categorized as empty space (with or without spongy tissue) within solid layer (2 genera), honeycomb layer over solid layer (1 genus), solid layer over solid layer (26 genera), solid layer over spongy layer (5 genera), solid layer over vitreous layer (1 genus), spongy layer over solid layer (18 genera), veins over solid layer (1 genus), or vitreous layer over solid layer (14 genera).

The composition of three-layered types is categorized as solid layer over spongy layer over solid layer (2 genera), solid layer over two distinct spongy layers (1 genus), solid layer over two distinct solid layers (3 genera), solid layer over vitreous layer over solid layer (3 genera), spongy layer over vitreous layer over solid layer (2 genera), or vitreous layer over two distinct solid layers (4 genera).

Density. The overall mesocarp density is characterized as chartaceous (100 genera), coriaceous (226 genera), fleshy (4 genera), or ligneous, including subligneous (85 genera).

Endocarp

Presence. The vast majority of fruits have an endocarp (420 genera). However, two genera, *Cullen* (12.01) of Psoraleeae (12) and *Sutherlandia* (16.03) of Galegeae (16), have no endocarp. In one genus, *Amphicarpaea* (10.44) of Phaseoleae (10), some fruits have an endocarp and others do not. Three genera, *Aldina* (1.04) of Swartzieae (1) and *Myrocarpus* (2.05) and *Uribea* (2.04) of Sophoreae (2), have endocarps, but in the first two genera the endocarp is concealed by an adnate seed testa and in the last genus by a fleshy mesocarp.

Sheen. Most endocarps appear dull (353 genera), but some are glossy (86 genera).

Opacity. The vast majority of endocarps are opaque (412 genera), but a few are translucent (17 genera).

Coloration. Most endocarps are monochrome (371 genera), but some are multicolored. The multicolored endocarps are bichrome (9 genera), mottled (72 genera), or streaked (14 genera). The basic background colors of the endocarp are black (6 genera), brown (159 genera), gray (8 genera), green (3 genera), purple (3 genera), orange (2 genera), red (2 genera), tan (268 genera), white (52 genera), or yellow (23 genera). The predominant endocarp color is brown, of which many shades exist.

Some endocarps are generally mottled (44 genera), a few are mottled over the seed chambers (21 genera), and very few (5 genera) genera are mottled above and below the seed chambers. Two genera have generalized streaking on their endocarps, one genus has endocarps with streaking over the seed chambers, and three genera have endocarps with streaking above and below the seed chambers. The overlaying colors are categorized as black overlay (6 genera), brown overlay (71 genera), gray overlay (3 genera), green overlay (1 genus), purple overlay (1 genus), red overlay (1 genus), tan overlay (6 genera), or yellow overlay (2 genera).

Surface. The appearance of the endocarp inner surface is categorized as cobwebby (25 genera), cracked (11 genera), fibrous (21 genera), floury-filamentous (20 genera), hairy (10 genera), pithy (5 genera), pulpy (1 genus), reticulate (3 genera), rugose (5 genera), scurfy (63 genera), smooth (341 genera), spongy (25 genera), veined (3 genera), vitreous* (1 genus), or transversely wrinkled (4 genera). Most endocarps are smooth on the inner surface. Hairs on the endocarp are restricted to sutures (2 genera), are found in longitudinal rows (2 genera), are scattered over the endocarp (10 genera), or surround the seed chambers (2 genera).

Testa adherence. For the vast majority of endocarps, the seed testa do not adhere to the endocarp (419 genera). Two genera, however, *Myroxylon* (2.07) of Sophoreae (2) and *Ostryocarpus* of Millettieae (7), have some endocarps that have adhering pieces of seed testa and some endocarps that

* "Vitreous" replaces "vitriol," used in the previous two volumes of this series (Gunn *1984, 1981*).

do not. One genus, *Kunstleria* of Millettieae, has endocarps that have adhering seed testa.

Septation. Most endocarps are nonseptate (290 genera). The remainder are either septate (134 genera) or subseptate, that is, weakly or partially septate (67 genera) (figure 2). The septa textures are catagorized as thin (tissue paper-like), flexible (99 genera); thicker than paper, firm (90 genera); or composed of a minute fringe of hairs (1 genus). This last characteristic is found only in *Cytisus* (30.15) of Genisteae (30).

Only one genus, *Indigofera* (9.07) of Indigofereae (9), has septa with and without glands. All the other genera only had septa without glands (169 genera).

Density. Endocarp density is characterized as chartaceous (376 genera); coriaceous (42 genera); ligneous, including subligneous (5 genera); osseous (2 genera); or pulpy (6 genera).

Exfoliation. Most endocarps do not exfoliate (379 genera). Some endocarps do exfoliate, either almost entirely (10 genera) or partially (52 genera).

Fusion to mesocarp and epicarp. When the mesocarp is present, most endocarps remain fused to the epicarp and mesocarp (402 genera). In some cases, the endocarps separate from the mesocarp (19 genera), and in three genera the endocarps together with the mesocarp separate from the epicarp. When there is no mesocarp, the vast majority of endocarps remain fused to the epicarp (80 genera) and rarely separate (4 genera).

Wings. Most endocarps have no wings (368 genera). When present, the wings either extend into the epicarp (83 genera) or do not (2 genera). The wings of *Endosamara* of Millettieae (7) and *Glottidium* (8.01A) of Robinieae (8) do not extend into the epicarp.

Separation into segments. The vast majority of endocarps remain entire (401 genera). Three genera—*Endosamara* of Millettieae (7), *Oxytropis* (16.17) of Galegeae (16), and *Piptanthus* (29.02) of Thermopsideae (29)—have endocarps that are separated into one-seeded, winged segments.

Seeds

Number per fruit. The number of seeds per fruit ranges from 1 to 80 and averages 4.6. Frequently the number of seeds per fruit is less than the number of ovules per locule. Seed set can be affected by many external factors, both biotic and abiotic, such as lack of pollinators or unfavorable macroclimatic or microclimatic conditions.

Position. Most seeds are oriented in the fruit paralleling the length of the fruit (328 genera). Some seeds are obliquely oriented to the length of the fruit (87 genera), and others are transversely oriented (100 genera).

Proximity. Most of the seeds in fruits are separated from each other; that is, they are neither overlapping nor touching (353 genera). Sometimes the seeds overlap (23 genera) or touch (44 genera). Frequently the seeds that overlap also touch, and vice versa. But, sometimes seeds touch at their edges without overlapping, or overlap without touching. When seeds touch, the pressure of adjacent seeds sometimes modifies their shape.

Number of series. The vast majority of fruits have the seeds in a single series (361 genera). In a few genera, the seeds are arranged in two series in the fruit (16 genera) (figure 1). Fruits with their seeds in two series have their seeds aligned in two distinct rows within the fruit. The funiculi of the two rows are distinctly different in length and alternate short and long. This arrangement packs more seeds in the fruit. A few species of *Astragalus* (16.15) in Galegeae (16) have two-series fruits.

Funiculus

Length. Slightly less than half of the funiculi are less than 0.5 mm long (201 genera), and the remainder are 0.5 mm or more long (238 genera). The length of the funiculi ranges from 0.1 to 70 mm and averages 2.4 mm. The vast majority of fruits have funiculi that were approximately the same length (358 genera). Three genera—*Candolleodendron* (1.03) of Swartzieae (1), *Myriocarpus* (2.05) of Sophoreae (2), and *Lotononis* (27.09) of Crotalarieae (27)—have funiculi of two distinctly different lengths in their individual fruits.

Thickness. Funiculus thickness is characterized as filiform (90 genera), flattened (143 genera), partially filiform and partially thick (5 genera), thick (156 genera), or triangular (31 genera).

Shape. Funiculus shape is categorized as anvil-shaped (2 genera), contorted (12 genera), convoluted (5 genera), curved (68 genera), S-curved (13 genera), hooked (15 genera), plicate (1 genus), straight (289 genera), or triangular (80 genera). Most funiculi are straight.

Aril

Presence. More than half of the seeds have arils (267 genera), and less than half do not (202 genera). The presence or absence of a seed aril is one of the most useful characters for generic identifications.

Texture. Arils are either fleshy (74 genera) or dry (210 genera).

Shape. Fleshy arils exhibit a greater diversity of shapes than dry ones. The shapes of fleshy arils are categorized as annular (11 genera), caplike (3 genera), cupshaped (21 genera), expanded funiculus (1 genus), flat from apex to near base (2 genera), hippocrepiform rim-aril (11 genera), hooked (4 genera), horseshoe-shaped (1 genus), knotty (1 genus), leaflike and attached to marginal hilum (2 genera), two-lipped rim-aril (12 genera), marginal around seed (1 genus), marginal hilar (9 genera), or topknot-like (13 genera). The shapes of the dry arils are characterized as cupshaped (2 genera), hippocrepiform rim-aril (10 genera), hooded (1 genus), two-lipped rim-aril (36 genera), rim-aril (162 genera), partial rim-aril (8 genera), or tongue-aril (68 genera). Several aril shapes are shown in figure 5.

Margin. Fleshy and dry arils have the same types of margin shapes. Entire margins are typical of both types (fleshy, 61 genera; dry, 197 genera). Dissected margins are characterized as crenate (fleshy, 11 genera; dry, 5 genera), fimbriate (fleshy, 7 genera; dry, 14 genera), or lacinate (fleshy, 2 genera; dry, 1 genus).

Relative size. No aril completely covers its seed. The vast majority of fleshy arils cover less than half of their seed (70 genera), and only four genera have arils that cover half to nearly all of their seed. Only a small fraction of dry arils have their relative size indicated, and they all cover less than half of their seed (38 genera).

Presence and number of tongues or flaps on two-lipped rim-aril. The majority of the two-lipped rim-arils had tongues or flaps on their lips (42 genera), and less than half of them do not (25 genera). Of the two-lipped rim-arils with tongues or flaps on their lip, most have a single tongue or flap on one lip (38 genera) (figure 5), and a few have two tongues or flaps, one on each lip of the two-lipped rim-aril (18 genera).

Color. Aril color is categorized as black (5 genera), brown (76 genera), cream (75 genera), gray (2 genera), green (2 genera), ivory (11 genera), olive (2 genera), orange (3 genera), red (4 genera), tan (118 genera), white (45 genera), or yellow (12 genera). The predominant aril color is brown, followed by white, and various shades of each color exist.

Seed Morphology

Seed characters support the concept of all legumes being in one family, Fabaceae, as advocated by Candolle *(1825a,b).* He divided this large family into two unequal groups, the much larger Curvembriae, which has a curved embryonic axis, and the smaller Rectembriae, which has a straight embryonic axis. The Curvembriae approximately encompassed the Faboideae, and the Rectembriae included the Caesalpinioideae and Mimosoideae. Although curvature of the embryonic axis is no longer regarded as the best character for primary division of the legumes, it is an indicator of better protection for the radicle and may be part of a suite of seed characters, which especially include hilar characters, separating Faboideae from Caesalpinioideae and Mimosoideae. Another characteristic supporting this bipartite division is the presence of a tracheid bar in the subhilar tissue in Faboideae (figure 6) or the absence of a tracheid bar in Caesalpinioideae and Mimosoideae (Corner *1951*, *1976*; Lersten *1982*; Manning and Staden *1987b;* Lersten et al. *1992*). Presence or absence of a visible lens has also been proposed as a trait supporting this bipartite division. Detailed anatomical studies (Lersten et al. *1992*) proved that lenses occur throughout all three subfamilies. Selected seed characters for the three subfamilies are enumerated in the section Seed Key to Three Subfamilies of Fabaceae and are shown in figure 4.

Bentham *(1865)* used floral characters to divide the legumes into three suborders corresponding to Faboideae, Caesalpinioideae, and Mimosoideae. Taubert *(1894)* maintained the tripartite division of the family, treating the suborders as subfamilies, and moved the tribe Swartzieae (2), most of whose genera have a straight embryonic axis, to Caesalpinioideae as the last tribe before Faboideae. Corner *(1951, 1976)* recognized four subfamilies using seed characteristics, the fourth being Swartzioideae with the single tribe Swartzieae. Cowan *(1981a)* and Polhill and Raven *(1981)* returned Swartzieae (and Swartzioideae) to Faboideae as its first tribe. The tripartite division has been universally accepted (Cronquist *1981*; Hutchinson *1964*; Mabberley *1997*; Polhill *1994a*,*b*; Polhill and Raven *1981*). Recently, only El-Gazzar and El-Fiki *(1976)* have insisted that Candolle's bipartite division of legumes is superior to the tripartite division used by other authors.

In the 20th century, interest in legume seed morphology was renewed. Capitaine *(1912)* studied the seed morphology of the entire family. He concluded that legume seed morphology was useful in legume classification and identification at the tribal, generic, and specific levels. In the 40 years following Capitaine, Jensen *(1998)* documented just 27 publications dealing principally with legume seed morphology. In the last 30 years there has been a resurgence of interest in seed morphology, and Jensen has recorded 225 publications on the subject. Most of the studies have dealt with seeds of tribes, genera, or species, many of which are cited in Synopses of Fruit and Seed Characters, and some have dealt with particular geographic regions, especially countries, or classes of plants, such as noxious weeds.

The multifamily studies of Martin *(1946)* and Isely *(1947)* laid the basis for the overview by Gunn *(1972).* Although Corner *(1951, 1976)* primarily dealt with seed anatomy, he also discussed and illustrated several morphological characters of legumes. Isely *(1955),* without citing the foregoing literature, restated the similarities and differences among the seeds of the three subfamilies. One of his students (Kopooshian *1963,* Kopooshian and Isely *1966*) confirmed Isely's findings, using a much larger sample of genera. The reports of Kopooshian and Isely laid the foundations for Gunn's studies (Gunn *1981a*,*b*, *1984, 1991*) as well as for this bulletin. Gunn *(1981a)* summarized the seed characteristics for 510 legume genera, including 347 genera of Faboideae.

This section of this bulletin reports information from studies on mature, dry seeds. Seed characters are discussed in the order given in the sections Synopses of Fruit and Seed Characters and Character List. Selected seed characters are illustrated in figures 3–52. In the discussions that follow on seed morphology, the number of genera exhibiting the character is usually identified in parentheses. The total number of genera for any suite of characters may exceed 428 (the number of genera studied) because a genus may be variable for the characters. For example, a genus may have terete, compressed, or flattened seeds. The seed data are presented in the following order:

Seed—size, overgrown vs. not overgrown, shape, transection, surface.
Cuticle—exfoliation, inflation, wrinkling.
Testa—presence, epicarp adherence, endocarp adherence, sheen, bloom, coloration, surface traits, thickness, pleurogram, fracture lines, rim, wings.
Raphe—visibility, position, bifurcation, coloration, elevation.
Hilum—concealment, faboid split, size, shape, position, elevation, encirling structures.
Lens—visibility, size, shape, position, elevation, coloration, encirling structures.
Endosperm—presence, thickness, pluglike vs. not pluglike, covering of embryo, adnation.

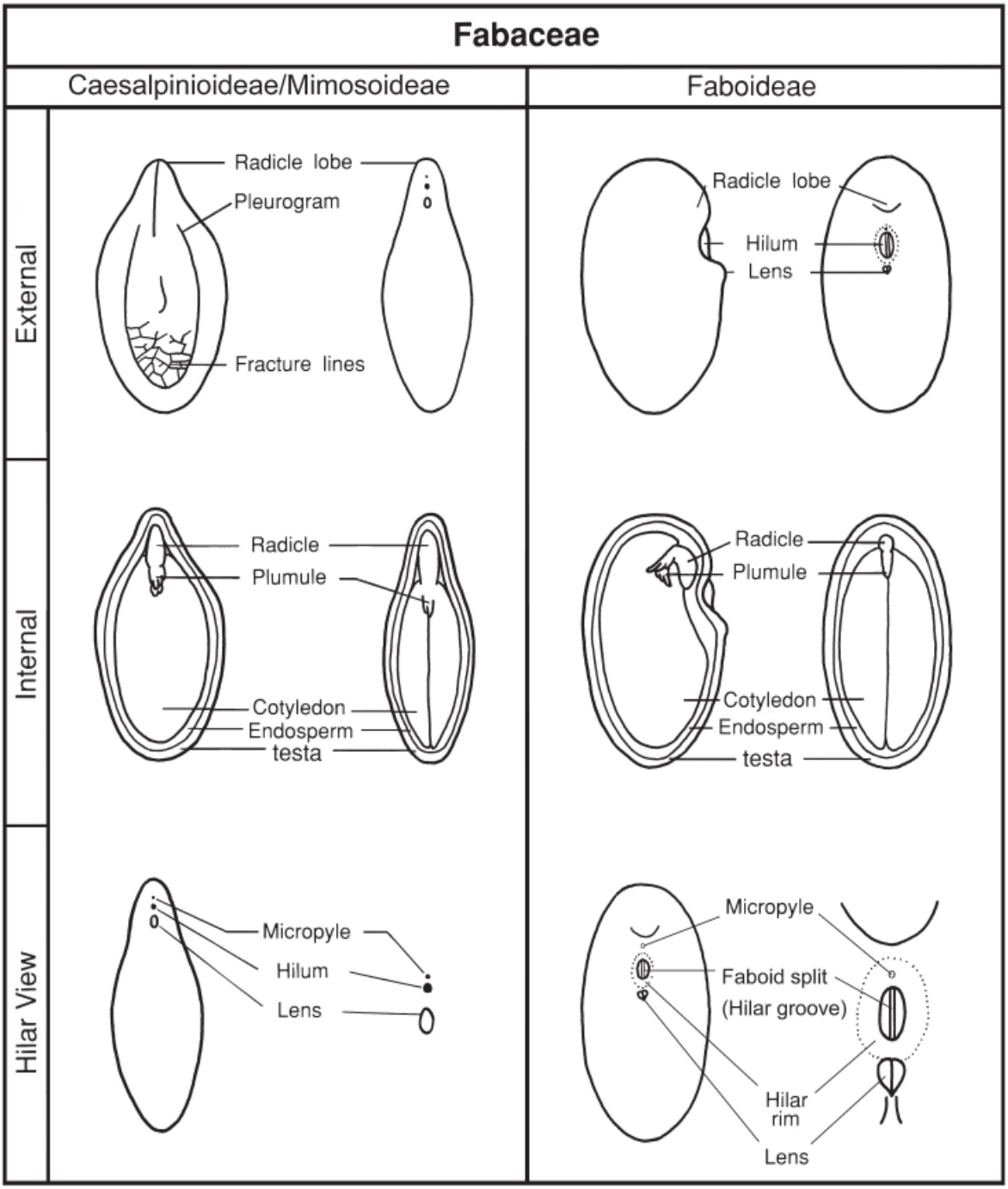


Figure 4. Terms used to describe seeds of subfamilies Caesalpinioideae, Mimosoideae, and Faboideae

Cotyledons—surface, topography, relative thickness and length, folding, margin, coloration, inner face topography, pubescence.
Embryonic axis—alignment of cotyledons and radicle, joint location.
Radicle—differentiation, shape, alignment with cotyledons, relative length.
Plumule—development, pubescence.

Seed

Size. Seed size is recorded in millimeters and mostly as a range. Length is measured along the long axis of the seed without regard to hilum position. Width is measured at a right angle to and in the same plane as the long axis and at the widest point of the seed. Thickness, or short axis of the seed, is measured through the thickest part.

The seed length ranges from 0.5 to 80 mm and averages 9.1 mm, width ranges from 0.4 to 60 mm and averages 6.1 mm, and thickness ranges from 0.1 to 60 mm and averages 3.5 mm. The four genera with the largest seeds are *Andira* (4.04) of Dalbergieae (4), 20–80 mm long; *Clathrotropis* (2.26) of Sophoreae (2), 17–70 mm long; *Mildbraediodendron* (1.07) of Swartzieae (1), 42–72 mm long; and *Swartzia* (1.01) of Swartzieae, 2–70 mm long. There are seven genera with seeds less than one millimeter long, and the smallest are of *Ononis* (21.01) of Trifolieae (21) at 0.5–5.5 mm long.

Statements that caesalpinioid and mimosoid seeds generally are larger than faboid ones are confirmed by this study and studies by Gunn *(1981a,b, 19843, 1991).* Caesalpinioid seed ranges are 1.2–180 × 0.7–120 × 0.2–70 mm and average 14, 11, and 6.5 mm, respectively, and mimosoid seed ranges are 2.3–130 × 1.5–70 × 0.1–40 mm and average 18, 10, and 3.5 mm, respectively. The mean seed length for caesalpinioids and mimosoids are 135–200 percent greater than for faboids, and the mean seed width for caesalpinioids and mimosoids is 139–145 percent greater than for faboids.

Overgrown. The term "overgrown seeds" was coined by Corner *(1951)* and defined as follows:

> "The Leguminous seed has normally a specific size set by differentiation of the palisade at a certain stage of development of the fruit and seed. As a result the pod conforms with the seeds. In some cases, in contrast, the seed enlarges and fills the seed-cavity of the pod without differentiation of the features of the Leguminous testa. Such seeds, conforming with the pod, are exalbuminous and have the nature of tumours, the growth of which is limited by the size of the pod: hence I refer to them as *overgrown seeds*. Their main character is the lack of differentiation of the testa, which remains embryonic."

Corner established two criteria for determining whether a seed is overgrown: (1) unlimited growth of seeds which is restrained only by the size of the fruit cavity and (2) a lack of differentiation or development of the seed coat. The determination of unlimited seed growth is difficult or impossible from preserved specimens. When overgrown seeds are in physical contact in the fruit, their shapes are distorted, and these seeds can be identified as overgrown. When seed shapes are not distorted, the determination of overgrowth is very difficult or impossible. Anatomical examination of the testa is the certain way to determine overgrowth. The testas of overgrown seeds are always poorly differentiated and lack some of the typical structures of the legume testa (Maumont *1993*), such as Malpighian cells with the light line or hourglass cells.

Most faboid seeds are not overgrown (414 genera), but a few are (25 genera). Overgrown seeds are found in genera of 12 tribes: 5 genera of Swartzieae (1), 2 genera of Sophoreae (2), 1 genus of Dipteryxeae (3), 3 genera of Dalbergieae (4), 2 genera of Millettieae (7), 3 genera of Indigofereae (9), 1 genus of Phaseoleae (10), 2 genera of Aeschynomeneae (14), 1 genus of Adesmieae (15), 2 genera of Galegeae (16), 1 genus of Carmichaelieae (17), 1 genus of Cicereae (20), and 1 genus of Mirbelieae (24). In our opinion, the occurrence of overgrown seeds in Faboideae has no relationship to its tribal classification and frequently is not a good indicator of generic relationships. Maumont *(1993)* studied the testa anatomy of overgrown seeds in the tribe Ingeae of Mimosoideae and concluded "that overgrown seeds evolved in parallel at least three times in the Ingeae."

Shape. The vast majority of seeds have nonangular shapes (417 genera), but many have angular shapes (128 genera). Obviously, most of the genera with nonangular seeds also have angular seeds (114 genera). Most seeds are asymmetrical in shape (333 genera), but many are symmetrical (171 genera). Seed shape in outline (figure 3) is categorized as bilobed, cicerlike (bilobular to subglobular and beaked) (5 genera); C-shaped (10 genera); circular (100 genera); cordate (8 genera); D-shaped (37 genera); elliptic (103 genera); falcate (1 genus); hippocrepiform (1 genus); irregular (63 genera); linear (13 genera); mitaform (mitten shaped) (50 genera); oblong (154 genera); obovate (6

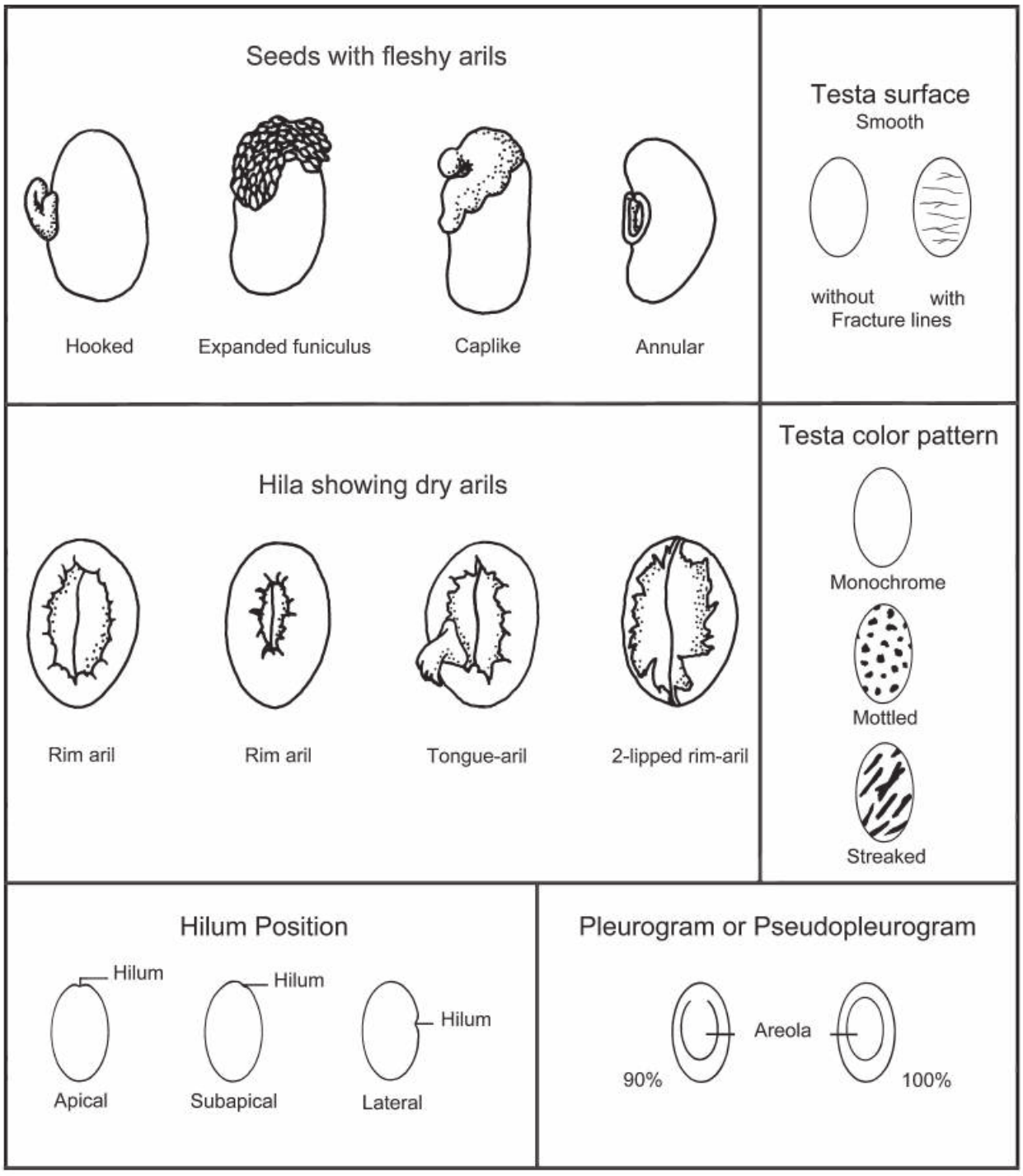


Figure 5. Selected terms for describing seeds of the subfamily Faboideae

genera); ovate (117 genera); pyriform (2 genera); quadrangular (30 genera); rectangular (40 genera); reniform (206 genera); rhombic (20 genera); samaroid (2 genera); trapezoid (2 genera); or triangular, including cuneate (26 genera). The most common shape is reniform; the next most common shapes are circular, elliptic, oblong, and ovate. These observations indirectly confirm the historic observation that faboid embryos are curved.

Transection. Seed transections are characterized as terete with a 1:1 ratio, including subterete (126 genera); quadrangular with a 1:1 ratio (10 genera); compressed with a more-or-less 2:1 ratio (337 genera); flattened with a greater than 4:1 ratio (62 genera); or mounded on one side and straight on the other side (5 genera). The separation between compressed and terete is arbitrary because there was no distinct break between the 2:1 and 1:1 ratios. On the other hand, flattened seeds clearly are flat.

Surface. The seed surface is categorized as grooved (10 genera), ridged (7 genera), smooth (306 genera), or wrinkled (15 genera). Grooves are described as longitudinal (5 genera), oblique (3 genera), reticulate (1 genus), or transverse (3 genera). On some seeds the raised outline of the radicle and cotyledon lobes is visible (181 genera), but on most it is not visible (305 genera). When the radicle and cotyledon lobes are evident, most seeds have a groove between them (160 genera), but some do not (35 genera). The color of the groove is either the same color as the testa (34 genera) or is lighter [1 genus, *Astracantha* (16.16) of Galegeae (16)].

Most seeds have no hilar sinus (369 genera). Of those with a hilar sinus, some have a shallow one (27 genera), and the rest have a deep one (14 genera). The vast majority of seeds are not umbonate, that is, they lack an umbo on the seed faces (411 genera), but a few are umbonate (23 genera) (figure 7). Of those that are umbonate, six genera have an umbo on both faces and one genus, *Tadehagi* (11.13) in Desmodieae (11), has an umbo on only one face. Only one genus, *Craibia* in Millettieae (7), has a medial ridge on each face of the seed.

Cuticle. None of the faboid seeds have an exfoliating cuticle (417 genera), unlike those in Caesalpinioideae and Mimosoideae. Two genera, *Gompholobium* (24.01) and *Phyllota* (24.19), both in Mirbelieae (24), have an inflated cuticle; the rest do not (416 genera). The cuticle of *Phyllota* is inflated around the hilum. Three genera, *Chamaecytisus* (30.15A) and *Echinospartum* (30.23) in Genisteae and *Jacksonia* (24.08) in Mirbelieae (24), have a wrinkled cuticle, and the rest have a nonwrinkled cuticle (415 genera).

Testa

Presence. The vast majority of seeds have a testa or seed coat (424 genera). Seven genera, *Aldina* (1.04) in Swartzieae (1), *Angylocalyx* (2.13) in Sophoreae (2), *Bituminaria* (12.02) in Psoraleeae (12), *Cordyla* (1.06) in Swartzieae, *Mildbraediodendron* (1.07) in Swartzieae, *Monopteryx* (2.31) in Sophoreae, and *Vatairea* (4.02) in Dalbergieae (4), do not have a testa when mature. In four genera, *Andira* (4.04) in Dalbergieae, *Carmichaelia* (17.05) in Carmichaelieae (17), *Geoffroea* (4.15) in Dalbergieae, and *Myroxylon* (2.07) in Sophoreae, some seeds have a testa and others do not. Therefore, when the testa is absent, its associated structures, raphe, hilum, and lens, are also absent, and their characteristics are not recorded.

Epicarp adherence. The vast majority of seeds do not have pieces of adhering epicarp (420 genera), but a few do (10 genera).

Endocarp adherence. The vast majority of seeds do not have the testa adhering to the endocarp (417 genera). Some seeds have the testa partially adhering to the endocarp (39 genera), and the seeds of just one genus, *Ostryocarpus* in Millettieae (7), have the entire testa adhering to the endocarp. The vast majority of seeds have the testa free from the endocarp (419 genera), and four genera, *Kunstleria* and *Ostryocarpus* in Millettieae and *Myrocarpus* (2.05) and *Myroxylon* (2.07) in Sophoreae (2), have seeds with their testa fused to the endocarp.

Sheen. Most seeds appear dull (344 genera), but many appear glossy (164 genera). Four genera, *Centrosema* (10.14), *Dumasia* (10.42), and *Teramnus* (10.36) in Phaseoleae (10) and *Pericopsis* (2.17) in Sophoreae (2), have seeds with a glaucous testa, and one genus, *Vicia* (19.01) in Fabeae (19), has some seeds with a velvet testa.

Bloom. The vast majority of seeds do not have a bloom (409 genera), but a few do (19 genera).

Coloration. The vast majority of testas are opaque (418 genera), and therefore have a coloration. A few are transparent, that is, they lack pigment in the testa (13 genera). The opaque testas are either monochrome (384 genera), mottled (179 genera), streaked (84 genera), or bichrome, with two different colored areas (18 genera) (figure 5). Those with mottles are recorded as frequently mottled (137 genera), meaning they have more than three marks per seed face, or

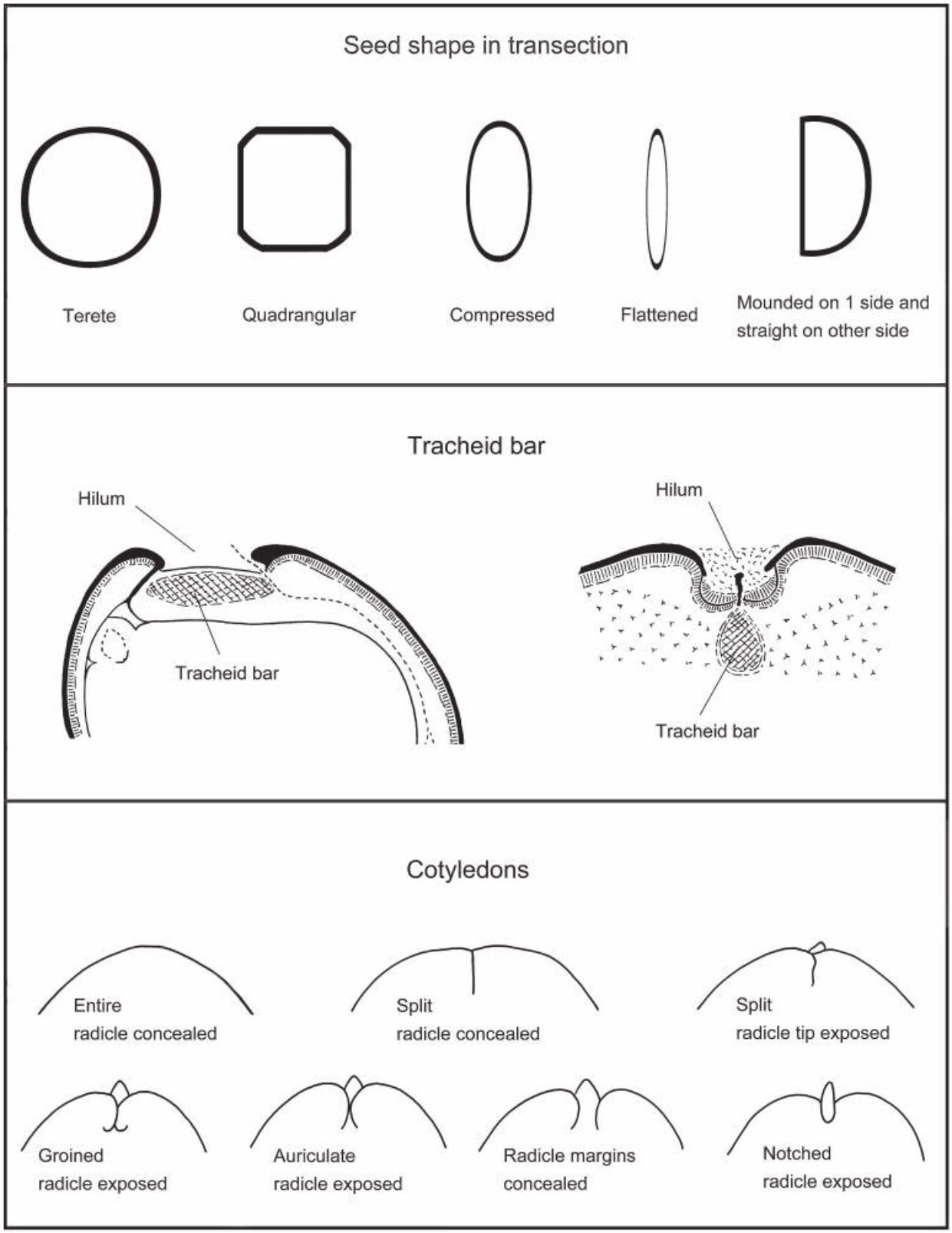


Figure 6. Selected terms for describing seeds of the subfamily Faboideae. Tracheid bar illustrations are adapted from Corner *(1976).*

infrequently mottled (42 genera), meaning they have one to three marks per seed face. Those with streaks are also recorded as frequently streaked (69 genera), meaning they have more than three marks per seed face, or infrequently streaked (11 genera), meaning they have one to three marks per seed face. The basic background colors of the testa are black (99 genera), blue (5 genera), brown (377 genera), cream (15 genera), gray (9 genera), green (51 genera), ivory (4 genera), olive (19 genera), orange (34 genera), pink (3 genera), purple (16 genera), red (33 genera), scarlet (1 genus), tan (120 genera), white (12 genera), or yellow (41 genera). The most common testa color is brown (397 genera), and many shades of brown exist. For multicolored testas, the overlaying colors were characterized as black (83 genera), brown (106 genera), gray (4 genera), green (3 genera), orange (2 genera), pink (1 genus), purple (26 genera), red (7 genera), tan (11 genera), or yellow (2 genera).

Surface. The vast majority of testas are glabrous, that is, hairless (415 genera). Two genera, *Callerya* of Millettieae (7) and *Myrospermum* (2.06) of Sophoreae (2), have only very short hairs on their testas, while two other genera, *Harpalyce* (22.02) of Brongniartieae (22) and *Psophocarpus* (10.51) of Phaseoleae (10), have pubescent testas and glabrous testas.

Most testas are smooth (346 genera), but many are not (178 genera). The nonsmooth testas have either elevated (154 genera) or recessed features (52 genera). The elevated features are categorized as bearing endocarp remnants (3 genera), having a blistered cuticle (2 genera), echinate (1 genus), papillate (5 genera), powdery and not rubbing off (2 genera), reticulate (20 genera), with one longitudinal ridge on each face (2 genera), ridged longitudinally more than once (1 genus), transversely ridged (3 genera), rugose (24 genera), shagreen (22 genera), tessoroid (1 genus), tuberculate (21 genera), veined (5 genera), verrucose (1 genus), warty (11 genera), or wrinkled (91 genera). The recessed features are characterized as concaved (3 genera), cracked (1 genus), large depressions on each face (2 genera), grooved (4 genera), pitted with large concatenated pits (1 genus), pitted with small separate pits (31 genera), pitted with stomata in the bottom of the pits (1 genus), punctate (7 genera), or striate (6 genera). Lersten *(1981)* conducted a survey of faboid testa topography at high magnification using the scanning electron microscope (SEM), and Bridges and Bragg *(1983)* added three genera and five species to the survey.

If faboid seeds are viewed at relatively high magnifications of 50 and 1,000 magnifications, few would have a testa that could be described as smooth. The illustrations in the section Synopsis of Fruit and Seed Characters usually contain two SEM micrographs of a selected testa at 50 and 1,000 magnifications for those genera for which sufficient seeds were available. Representative testa surfaces are illustrated in figures 8–52.

Thickness. Testa thickness is described as chartaceous (152 genera); coriaceous, including subcoriaceous (277 genera); or osseous, including subosseous (13 genera).

Pleurogram. No faboid seeds or testas have pleurograms or pseudopleurograms (figure 5). Thirty-nine mimosoid genera (Gunn *1984*), and only four caesalpinioid genera (Gunn *1991*)—*Burkea* W.J. Hooker, *Dimorphandra* H.W. Schott, *Pachyelasma* H.A.T. Harms, and *Senna* P. Miller—have pleurograms.

Fracture lines. Most testas lack fracture lines (419 genera), but a few have them (21 genera) (figure 5). Fracture lines are classified as concentric (1 genus), irregular (4 genera), reticulate (6 genera), or transverse (10 genera).

Rim. The vast majority of testas lack a rim (413 genera), and only a few have one (10 genera). The winglike rims are either around the seed (1 genus) or along one side of the seed (1 genus).

Wings. The vast majority of testas do not have a wing (375 genera); only three genera, *Amburana* (1.15) in Swartzieae (1), *Inocarpus* (2.10) in Sophoreae (2), and *Phylacium* (11.22) in Desmodieae (11), have one. The wing of *Amburana* is described as being at one end of the seed

Raphe

Visibility. The raphe is the part of the funiculus that is fused to the ovule. Consequently the site of funicular abscission, that is, the hilum, is further from its place of insertion. The vascular bundle runs through the raphe (Werker *1997*). On many seeds, the raphe is not visible (336 genera), though it is visible on some (135 genera).

Position. The raphe is described as running from the hilum through the lens to the base of the seed and then terminating (39 genera), running from the hilum through the lens to the base of the seed and then bifurcating (5 genera), running from the hilum to the lens (28 genera), running from the hilum to near the base of the seed and then terminating (34 genera), running from the hilum through the lens and the base of the seed to a point opposite the hilum (13 genera), running from the hilum through the lens and terminating

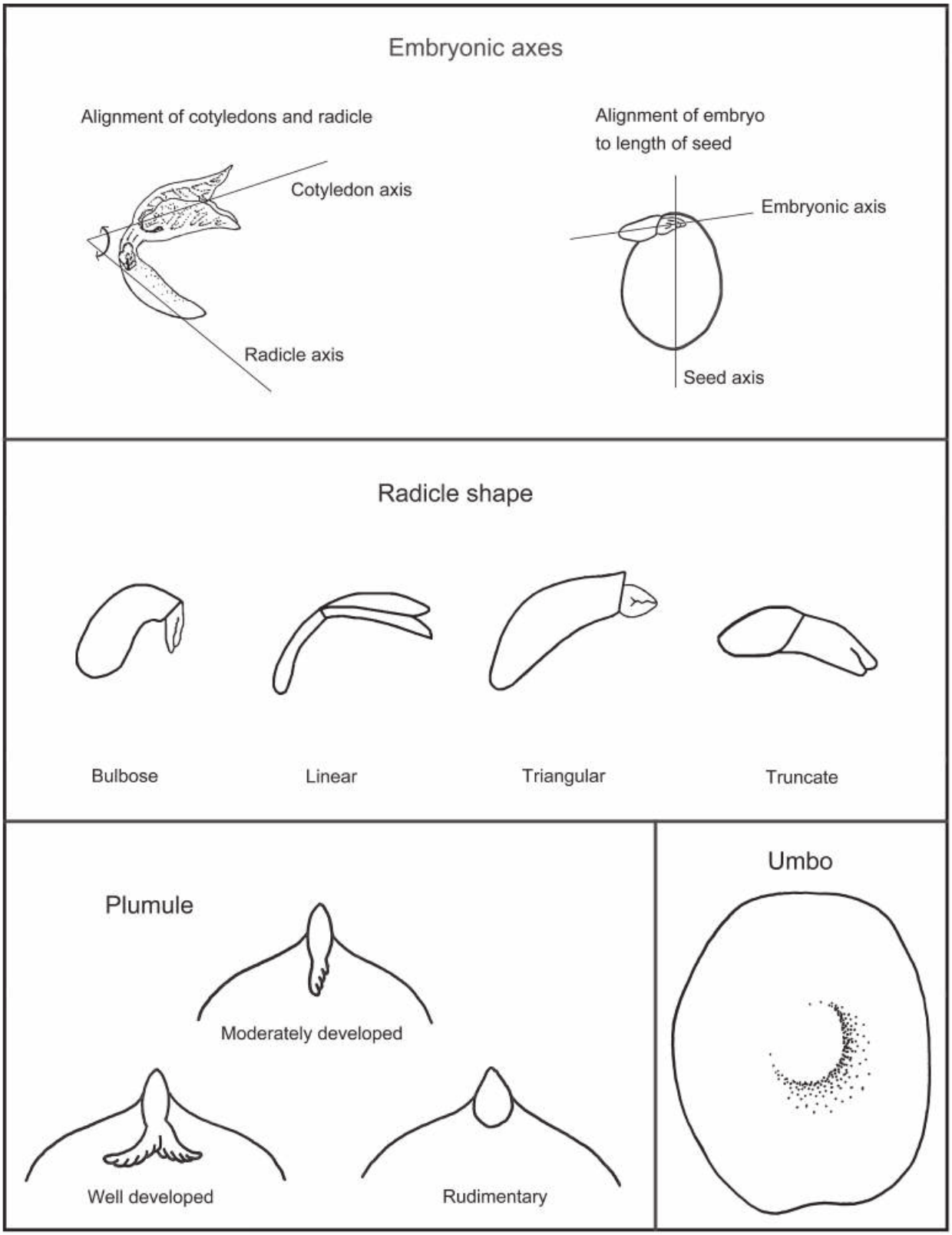


Figure 7. Selected terms for describing seeds of the subfamily Faboideae

before the base of the seed (15 genera), running from the hilum through the base of the seed and then up the other side (6 genera), running from the lens to the base of the seed and then terminating (9 genera), or running from the lens to the base of the seed and then bifurcating (3 genera).

Bifurcation. The vast majority of the raphes do not bifurcate (123 genera), but the raphes of 7 genera do.

Coloration. The color of the raphes is described as the same color as the testa (62 genera), a lighter color than the testa (9 genera), or a darker color than the testa (80 genera). Those raphes that are not the same color as the testa are black (25 genera), brown (63 genera), reddish purple (1 genus), or tan (5 genera).

Elevation. Raphes are catagorized as raised (66 genera), flush (55 genera), or recessed (26 genera).

Hilum

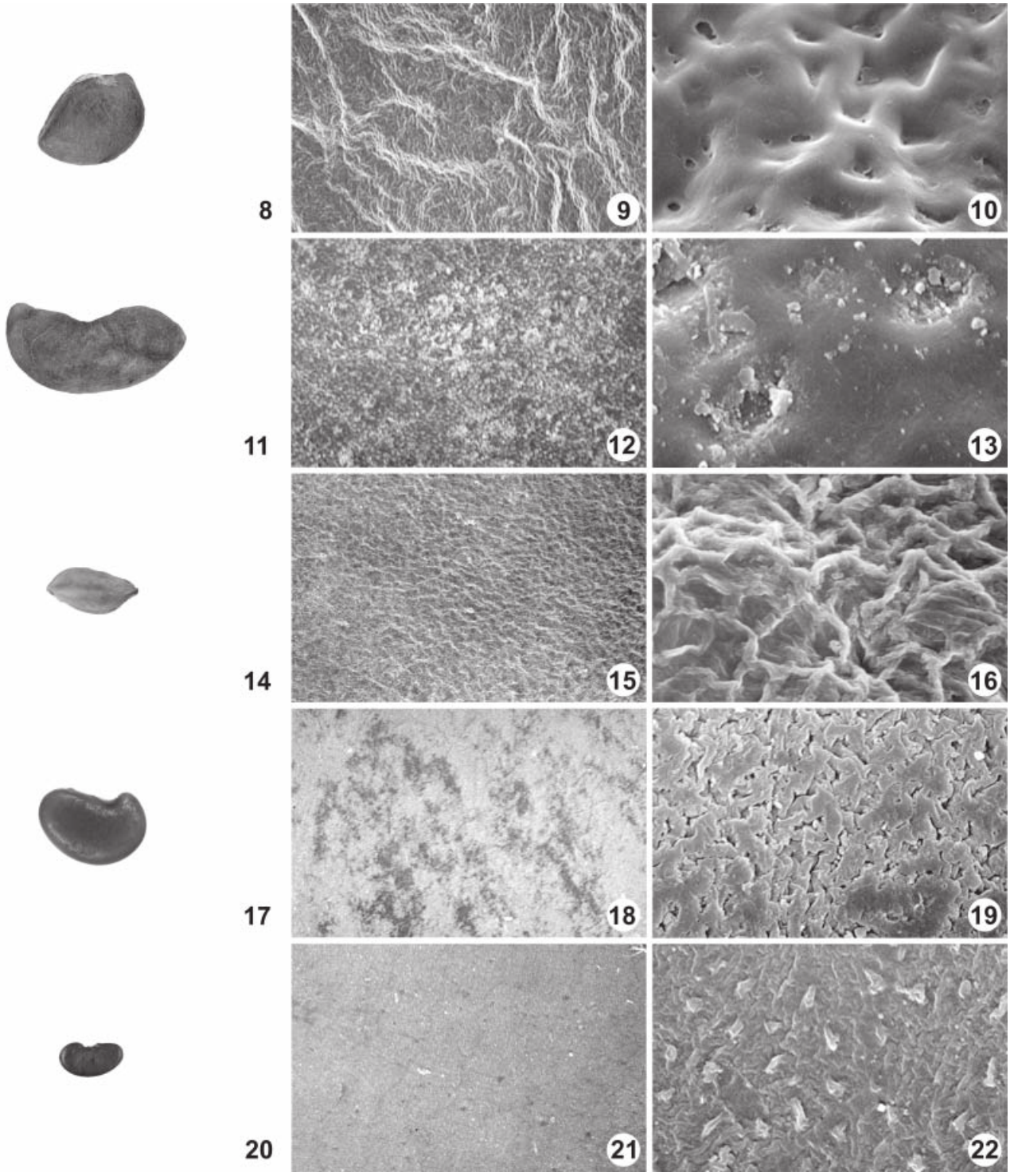
Concealment. The majority of seeds have the hilum concealed, either fully (146 genera) or partially (179 genera). Slightly less than half have the hilum completely visible or exposed (204 genera). When the hilum is concealed, it is concealed by an aril (141 genera), an aril remnant (4 genera), a funiculus (24 genera), a funicular remnant (127 genera), fusion to an endocarp (1 genus), a radicle lobe (18 genera), or a wing (24 genera). Lackey *(1981a)* pointed out the taxonomic usefulness of the funicular remnant, which he called the epihilum, in defining the subtribes of Phaseoleae (10). We found that 72 genera in 18 tribes have their hila partially concealed by funicular remnants and that 96 genera in 23 tribes have their hila fully concealed by funicular remnants. Given the widespread occurrence of hila concealed by funicular remnants, this characteristic should be further investigated to confirm our conclusions, which were formed based on a limited sample.

Faboid split. The faboid split, or hilar groove, bisects the hilum lengthwise. It is found only in the Faboideae and is an important characteristic defining the subfamily. Most faboid hila have a faboid split (321 genera), but some do not (94 genera). Of the 94 genera lacking a faboid split, 86 have overgrown seeds and 13 do not. The most reliable feature of overgrown seeds is the poorly differentiated seed testa. Obviously one of the features not developed on overgown seeds of Faboideae is the faboid split. The testas of the 86 genera should be examined anatomically to determine whether or not their seeds are overgrown. Their lack of a faboid split probably indicates that their seeds are overgrown. Of those hila with a faboid split, most have the lips of the faboid split the same color as the rest of the testa (290 genera), but some have the lips that are lighter colored than the rest of the testa (36 genera).

Size. Most hila are 0.3 mm or more in diameter (292 genera), but many are less than 0.3 mm in diameter, that is, punctiform (157 genera). Hilar length ranges from 0.1 to 90 mm and averages 3.0 mm. Only 17 genera have hila longer than 10 mm, and the longest hila are found in the genus *Mucuna* (10.03) in Phaseoleae (10), which range in length from 6 mm to 90 mm.

Shape. Hilar shape is organized according to the form of the overall outline as follows: angular (10 genera); curved (247 genera); or straight, including linear (66 genera). Those with curved outlines were categorized as circular (91 genera), elliptic (162 genera), fusiform (8 genera), heart-shaped (1 genus), or oval (40 genera) (figure 3). Those with angular outlines are characterized as irregular (3 genera), triangular (4 genera), or wedge-shaped (4 genera). And those with straight outlines are either oblong (35 genera) or linear (35 genera).

Figures 8–22. Selected surface patterns of testa of faboid seeds (left column, × 1; middle column, × 50; right column, × 1,000):
- 8–10, *Candolleodendron brachystachyum* (A.-P. de Candolle) R.S. Cowan
- 11–13, *Baphiopsis parviflora* G. Bentham ex J.G. Baker
- 14–16, *Luetzelburgia praecox* (H.A.T. Harms) H.A.T. Harms
- 17–19, *Ateleia herbert-smithii* H.F. Pittier
- 20–22, *Cyathostegia matthewsii* (G. Bentham) R.W. Schery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Position. The position of the hilum is described relative to the radicle. The seed must be carefully dissected to determine this. The relative hilum position is categorized as apical at apex of radicle tip, or nearly so (38 genera); subapical to radicle tip (51 genera); apical according to radicle tip but marginal according to seed length (105 genera); marginal according to radicle tip, or nearly so (146 genera); or between cotyledon and radicle lobe (150 genera) (figure 5).

Elevation. Hila are either raised (29 genera), flush (159 genera), or recessed (252 genera).

Encirling structures. The majority of hila have a structure around them that is described as a corona (31 genera), halo (103 genera), or rim (198 genera). The minority of hila have no structure around them (199 genera). The hilar coronas are either lighter in color than the testa (8 genera) or darker (25 genera). The hilar halos are the same color as the testa (11 genera), lighter in color than the testa (45 genera), or darker in color than the testa (59 genera). The hilar rims are also described as the same color as the testa (116 genera), lighter in color than the testa (33 genera), or darker in color than the testa (103 genera).

Lens

Visibility. On most of the testas, the lens is discernible (344 genera), but in some it is not (145 genera). On some seeds the lens is difficult to discern and can only be studied using anatomical techniques.

Size. The lens ranges from 0.1 mm to 9 mm long and averages 0.8 mm. Only one genus, *Physostigma* (10.52) in Phaseoleae (10), has a lens longer than 5 mm. Its lenses range from 0.9 mm to 9 mm long. One hundred and twenty five genera have lenses shorter than 0.5 mm.

Shape. Overall lens shape is classified as either straight (231 genera) or curved (217 genera). The straight lens shapes are categorized as diamond-shaped (10 genera), irregular (14 genera), linear (135 genera), oblong (57 genera), rectangular (2 genera), rhombic (5 genera), square (1 genus), triangular (31 genera), or wedge-shaped (28 genera). The most common straight shape is linear. The curved lens shapes are characterized as circular (115 genera), elliptic (57 genera), hourglass- or dumbbell-shaped (3 genera), irregular (13 genera), key-hole shaped (5 genera), two circular mounds separated by groove (6 genera), two oblong mounds separated by a groove (4 genera), oblong (49 genera), ovate (8 genera), or punctiform (8 genera). The most common curved shape is circular, and the next most common curved shapes are elliptic and oblong.

Position. Rarely the lens is in the groove of the raphe (14 genera), but in the vast majority of cases it is not (337 genera). The position of the lens is described relative to the hilum. The vast majority of lenses are relatively close to the hilum. The majority of lenses are confluent with the hilum (touching the hilum or hilar rim) (208 genera), and most of the rest are adjacent to the hilum (not touching the hilum or the hilar rim but less than 45 degrees of the seed circumference away from the hilum) (164 genera). Two genera, *Hymenolobium* (4.03) in Dalbergieae (4) and *Pictetia* (14.05) in Aeschynomeneae (14), have the lens 180 degrees from the hilum, and two other genera, *Poitea* (8.05) in Robinieae (8) and *Vicia* (19.01) in Fabeae (19), have some of their lenses 180 degrees from the hilum. Only one genus, *Lennea* (8.03) in Robinieae, has its lens positioned 270 degrees from the hilum, and one genus, *Vicia* in Fabeae, rarely has its lenses 270 degrees from the hilum.

When the lens does not touch the hilum or the hilar rim, its distance from the hilum ranges from 0.1 mm to 13 mm and

Figures 23–37. Selected faboid testa surface patterns (left column, × 1; middle column, × 50; right column, × 1,000).
23–25, *Platymiscium filipes* G. Bentham
26–28, *Myrocarpus frondosus* F.F. Allemão e Cysneiro
29–31, *Leucomphalos capparideus* G. Bentham ex L.D. Planchon
32–34, *Dussia lehmannii* H.A.T. Harms
35–37, *Platycelyphium voense* (H.G.A. Engler) H. Wild

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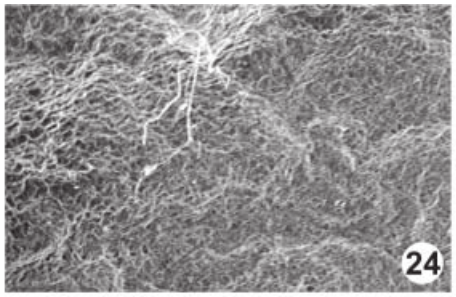

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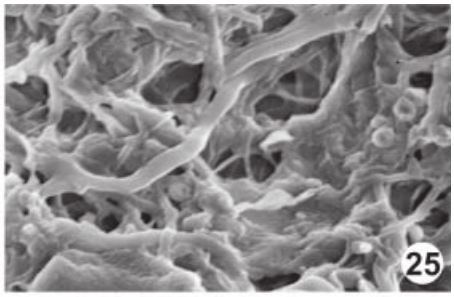

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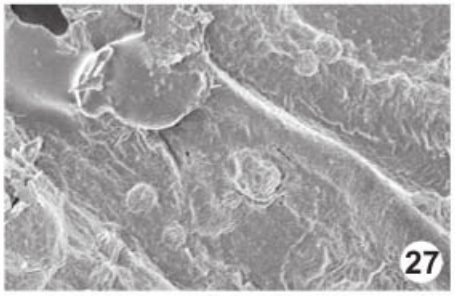

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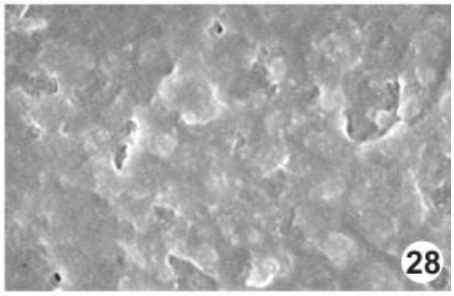

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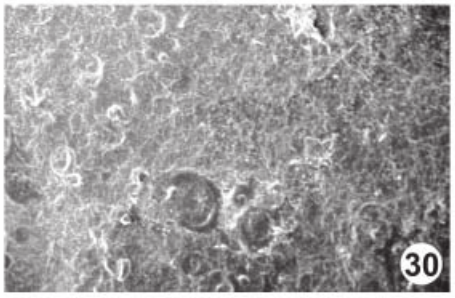

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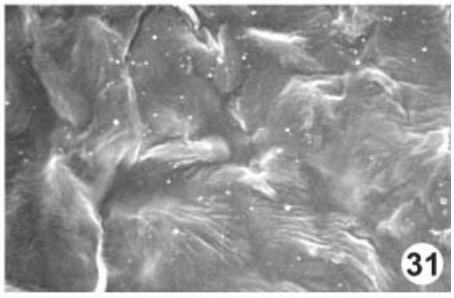

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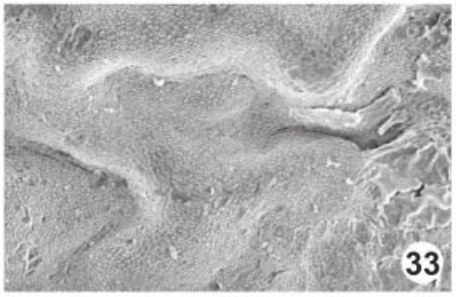

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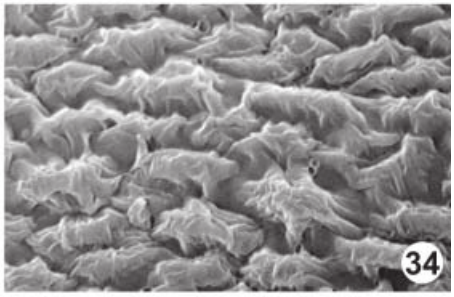

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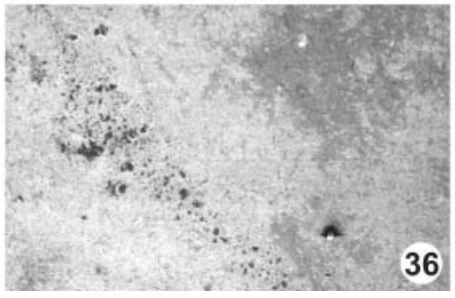

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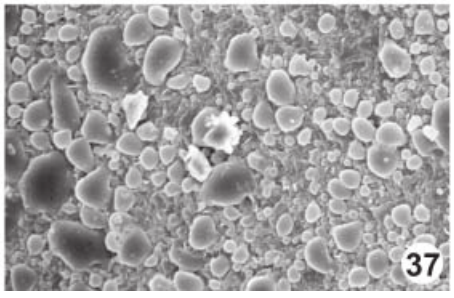

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averages 0.8 mm. The lens of *Vicia* is furthest from the hilum, ranging from 0.1 mm to 13 mm away. Ninety-six genera have lenses less than 0.5 mm from the hilum.

Elevation. Lenses are either mounded (203 genera), flush (128 genera), or recessed (49 genera).

Coloration. The majority of lenses are the same color as the testa (91 genera) or a similar color (156 genera). A minority of lenses are a dissimilar color from that of the testa (156 genera). Amongst those lenses similar in color to the testa, most are darker than the testa (263 genera) and the remainder are lighter (43 genera). The lens colors are categorized as black (112 genera); brown, including various shades of brown (209 genera); gray (1 genus); green (2 genera); orange (1 genus); reddish purple (2 genera); red (15 genera); tan (36 genera); or yellow (1 genus). The commonest lens color is brown, followed by black.

Encicling structures. The majority of lenses have no structure around them (289 genera). Those with a structure have either a corona (20 genera), halo (30 genera), or rim (41 genera). The coronas are either lighter in color than the testa (4 genera) or darker (16 genera). The halos are described as the same color as the testa (1 genus), lighter in color than the testa (7 genera), or darker in color than the testa (23 genera). Also, the rims are described as the same color as the testa (28 genera), lighter in color than the testa (3 genera), or darker in color than the testa (20 genera).

Endosperm

Presence. Most seeds have endosperm (289 genera), but some do not (154 genera). The presence or absence of endosperm is a useful characteristic for the identification of legume seeds. It is slightly more difficult than external characteristics because it requires that the seed be dissected, and when the endosperm is very reduced it can be difficult to detect. Most agriculturally important legumes lack endosperm. From our observations and from a survey of the literature, there is no perisperm or chalazosperm in legumes (Gunn *1981a,b, 1984*, *1991*).

Thickness. Endosperm thickness is described as thick (97 genera), thin (177 genera), or trace (34 genera). Sometimes when the endosperm is merely a trace, it can be difficult to detect.

Pluglike. Two genera, *Isotropis* (24.06) in Mirbelieae (24) and *Rhynchosia* (10.80) in Phaseoleae (10), are described as having endosperm that is pluglike and resembles the tip of the radicle. For the remainder of the genera with endosperm, the endosperm is not pluglike and does not resemble the radicle (286 genera).

Covering of embryo. The endosperm of most seeds completely covers the embryo (252 genera). For a few seeds the endosperm covers at least half of the embryo but not all of it (15 genera), and for some seeds the endosperm is restricted to the region of the embryo (36 genera).

Adnation. In most seeds the endosperm is adnate to the testa (218 genera), but in some it is adnate to the embryo encasing it (112 genera).

Cotyledons

Surface. The outer or abaxial surface of most cotyledons is smooth (365 genera), but on some cotyledons it is not (90 genera). The features of the outer surface of nonsmooth cotyledons are categorized as convoluted (3 genera), dimpled once (2 genera), glandular dotted (yellow latex-like substance inside) (2 genera), 1 to 3 grooves on each face (14 genera), 4 to 6 grooves on each face (1 genus), 5–7-branched grooves (from veins of testa) on each face (5 genera), pitted (1 genus), rugose (4 genera), ruminate (1 genus), sulcate (14 genera), or wrinkled (33 genera).

Figures 38–52. Selected faboid testa surface patterns (left column, × 2; middle column, × 50; right column, × 1,000)
- 38–40, *Cullen americanum* (C. Linnaeus) P.A. Rydberg
- 41–43, *Cochlianthus gracilis* G. Bentham
- 44–46, *Tripodion teraphyllum* (C. Linnaeus) J.P. Fourreau
- 47–49, *Rhynchotropis poggei* (P.H.W. Taubert) H.A.T. Harms
- 50–52, *Hesperolaburnum platycarpum* (R.C.J.E. Maire) R.C.J.E. Maire.

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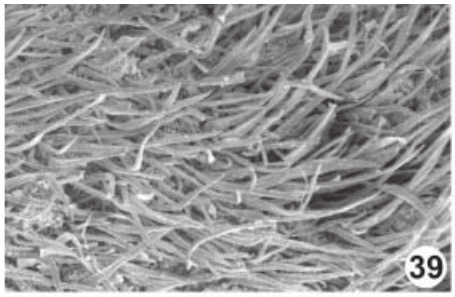

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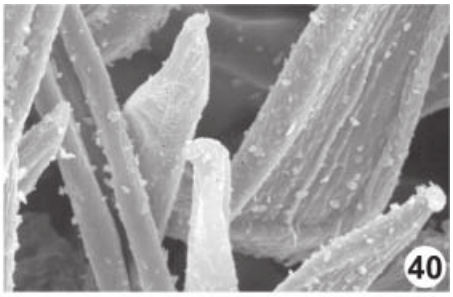

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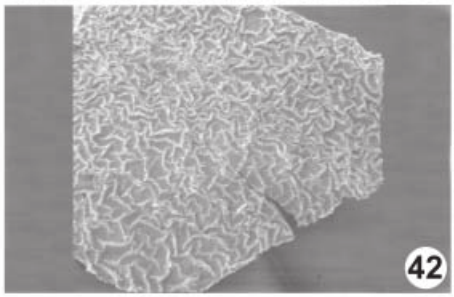

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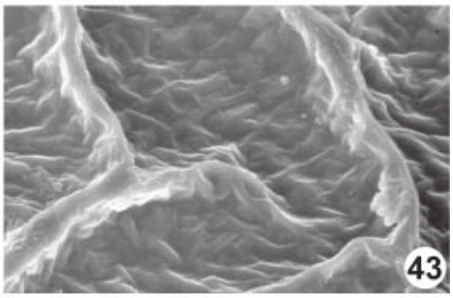

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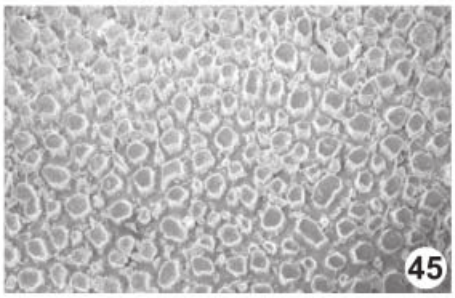

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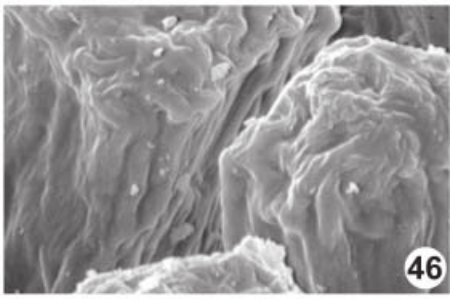

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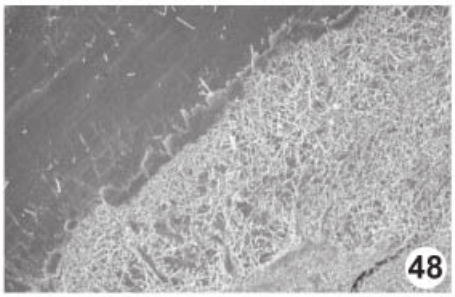

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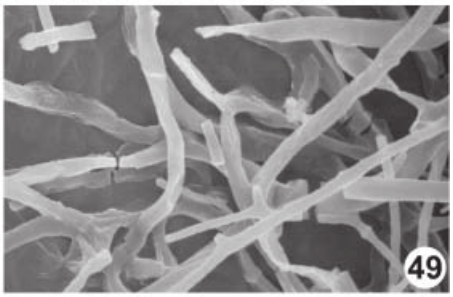

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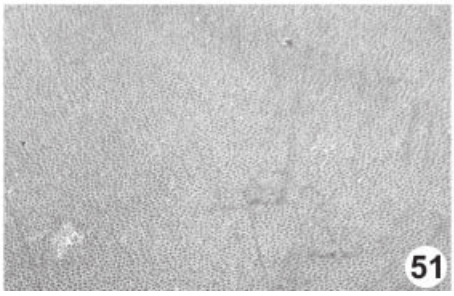

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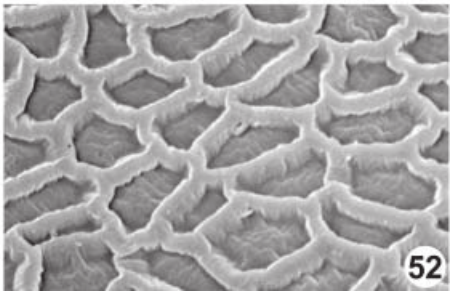

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Topography. The overall topography of the outer surface of the cotyledons is characterized as outer face of one cotyledon flat and the other cotyledon convex (5 genera), outer face of one cotyledon flat and the other cotyledon concave (1 genus), both outer faces convex (414 genera), outer face of one cotyledon concave and the other cotyledon convex (2 genera), both outer faces flat (4 genera), or with two outer faces on each cotyledon, one flat and the other convex (1 genus). The vast majority of cotyledons had both outer faces convex.

Relative thickness and length. In the vast majority of seeds, the two cotyledons are the same thickness (418 genera), but in a few seeds one cotyledon is thicker than the other (13 genera). Again in the vast majority of seeds, the two cotyledons are about the same approximate length (418 genera), but a few have one cotyledon longer than the other (12 genera).

Folding. The vast majority of cotyledons are not folded (414 genera). Of those that are folded, a few have both cotyledons folded (16 genera), and very few have just a single cotyledon of the pair folded (5 genera). Sometimes the cotyledons are folded over so far that their inner face touches itself (9 genera), but most are not folded that far (14 genera). Generally the cotyledons' portions of the inner folded face were unequal (17 genera), but in one genus, *Melilotus* (21.03) in Trifolieae (21), the cotyledons' portions of the inner folded face were equal.

Margin. Most cotyledons have the margin 180 degrees opposite the base of the radicle entire (407 general), but a few do not (27 genera). Nonentire margins 180 degrees from the base of the radicle are described as bearing flaps (2 genera), notched (15 genera), or wavy (6 genera). The vast majority of cotyledons are similar at the apex (413 genera), but six genera have cotyledons differing at the apex (one cotyledon concealed by the overarching radicle and the other auriculate and concealing the radicle).

A slight majority of cotyledons do not conceal the radicle (241 genera), that is, the radicle is exposed and visible (figure 6). Those that conceal the radicle do so either fully (30 genera) or partially (179 genera). Concealment of the radicle by the cotyledons is a useful characteristic for identifications of seeds.

The cotyledon margin over the radicle is described as entire (170 genera), notched (133 genera), or split (134 genera) (figure 6). The arrangement of cotyledon and radicle in two genera, *Chordospartium* (17.03) and *Streblorrhiza* (17.01), both in Carmichaelieae (17), is rare in that one cotyledon is scooped out to accommodate a plicate radicle and the other cotyledon is entire.

The occurrence and condition of cotyledon lobes over the radicle are important characteristics for identification of genera. Most of the cotyledons do not have lobes over the radicle (307 genera), but some do (137 genera) (figure 6). The lobes are either overlapping (8 genera), touching (auriculate) (27 genera), or not touching (59 genera). Some of the lobed cotyledons have a basal groin formed by the lobes (17 genera), but most do not (43 genera).

The vast majority of cotyledons have the interface division terminating at the base of the radicle (412 genera). Only a few cotyledons have the interface division terminating in the radicle tissue (11 genera).

Most cotyledons do not have recessed cotyledon margins (398 genera), but a few do (33 genera), mainly in the tribes Phaseoleae (10) and Sophoreae (2). Most of the recessed cotyledons are recessed on just one margin (25 genera); just six genera are recessed on both margins so that the cotyledons are dumbbell-shaped in transection. The position of the recession is described as on the same side as the hilum (terminal radicle) (5 genera), on the same side as the radicle (17 genera), or on the side opposite from the radicle (3 genera).

Coloration. Cotyledon color was categorized as brown (76 genera), green (46 genera), orange (8 genera), pink (4 genera), red (12 genera), tan (217 genera), white (75 genera), or yellow (144 genera). The most common cotyledon color was various shades of brown, followed by yellow.

Inner face topography. Most cotyledons have flat inner faces (408 genera). Some cotyledon inner faces are not flat and are described as concave (16 genera), wavy (8 genera), having a central ridge on one cotyledon inner face and a matching central groove on the other (6 genera), or wrinkled (7 genera). One genus, *Antheroporum* in Millettieae (7), has some flat cotyledon inner faces and some with glands having the inside dotted with a yellow latex-like substance.

Pubescence. One genus, *Haplormosia* (2.16) in Sophoreae (2), has pubescent cotyledons around the base of the radicle; the rest have glabrous cotyledons around the base of the radicle (421 genera).

Smith *(1983)* studied cotyledon anatomy of approximately 900 species representing all major legume tribes and

recognized the following four cotyledon types: foliar, intermediate (sharing characteristics of foliar and storage types), storage, and anomalous (not fitting the first three types). The anomalous type is found in the following Faboideae: *Caragana* (16.11) in Galegeae (16), *Hippocrepis* (13.13) in Loteae (13), *Leptoderris nobilis* (F.M.J. Welwitsch ex J.G. Baker) S.T. Dunn in Millettieae (7), *Scorpiurus* (13.14) in Loteae, and *Sophora davidii* (A.R. Franchet) H.C. Skeels (2.45) in Sophoreae (2). Table 1 shows the distribution of the three cotyledon types in the Faboideae.

Table 1. Distribution of cotyledon types in the Faboideae

Tribe	Cotyledon type		
	Foliar	Intermediate	Storage
	(%)		
Swartzieae	10	0	90
Sophoreae	35	5	60
Dipteryxeae	0	0	100
Dalbergieae	70	10	20
Abreae	0	0	100
Amorpheae	100	0	0
Millettieae	30	20	50
Robinieae	90	0	10
Indigofereae	100	0	0
Phaseoleae	20	5	75
Desmodieae	100	0	0
Psoraleeae	100	0	0
Loteae	100	0	0
Aeschynomeneae	90	0	10
Adesmieae	100	0	0
Galegeae	80	0	20
Carmichaelieae	100	0	0
Hedysareae	93	5	2
Fabeae	0	0	100
Cicereae	0	0	100
Trifolieae	100	0	0
Brongniartieae	0	100	0
Bossiaeeae	15	55	30
Mirbelieae	55	35	10
Podalyrieae	100	0	0
Crotalarieae	100	0	0
Euchresteae	0	0	100
Thermopsideae	100	0	0
Genisteae	92	5	3

Source: Smith *1983.*

Embryonic axis

Alignment of cotyledons and radicle. The embryonic axis is characterized by the alignment of the cotyledons and radicle relative to each other (figure 7). The embryonic axis is described as deflexed (radicle-cotyledon axis deflexed) (228 genera), oblique (radicle-cotyledon axis oblique) (122 genera), parallel (radicle length parallel to cotyledon length) (13 genera), right angled (radicle right angled to length of cotyledons) (53 genera), or straight (radicle-cotyledon axis aligned) (58 genera). Most embryonic axes are bent, that is, not straight (375 genera), but there are 58 genera that have straight embryonic axes, the predominant type in the Caesalpinioideae and Mimosoideae (Gunn *1984*, *1991*).

The other orientation recorded was that between the axis of the embryo and the longest axis of the seed (which was also measured and recorded as the length of the seed). The orientation of these two axes is categorized as oblique (328 genera), parallel (73 genera), perpendicular (71 genera), or plicate (1 genus). Most embryonic axes are oblique to the longest axis of the seed.

Joint. A few embryonic axes have an evident joint between the radicle and the cotyledons (18 genera), but most do not (407 genera).

Radicle

Differentiation. The vast majority of radicles are clearly differentiated from the cotyledons (425 genera). Two genera, however, *Dussia* (2.24) in Sophoreae (2) and *Holocalyx* (1.12) in Swartzieae (1), have radicles and cotyledons not differentiated from each other. One genus, *Swartzia* (1.01) also in Swartzieae, mostly has radicles that are differentiated from the cotyledons and rarely has radicles that are not differentiated from the cotyledons. The undifferentiated radicle-cotyledons usually occur when the entire embryo is poorly developed.

Shape. The radicle shape is characterized as bulbose (191 genera), linear (230 genera), triangular (55 genera), or truncate (3 genera). Radicle shape is very useful for identification, especially when linear is contrasted against bulbose, triangular, and truncate. The very tip of the radicle has its own shape, independent of the overall radicle shape and is described as either straight (217 genera), curved (116 genera), or hooked (13 genera). Radicle tip shapes are also useful for identification.

Alignment with cotyledons. The alignment of just the radicle with the cotyledons is categorized as deflexed and parallel to cotyledon length (164 genera); deflexed and parallel to cotyledon width (92 genera); oblique to cotyledons (146 genera); with 90-degree turn (20 genera); with 180-degree turn (8 genera); with 360-degree turn (3 genera); or straight with embryonic axis, as is the case for mimosoids and caesalpinioids (43 genera). The vast majority of radicles are centered between the two cotyledons (411 genera). A few radicles are not centered between the two cotyledons, rather the radicle is outside of one cotyledon and inside of the other, so that the junction for each of the two cotyledons is different (15 genera).

Relative length. Radicle length is recorded relative to cotyledon length and is categorized as less than 1/2 the length of the cotyledons (360 genera), 1/2 to nearly the length of the cotyledons (82 genera), equal to the length of the cotyledons (16 genera), or exceeding the length of the cotyledons (10 genera). This characteristic is also useful for identifications.

Plumule

Development. Plumule development is characterized as rudimentary (283 genera), moderately developed (144 genera), or well developed (71 genera) (figure 7). This is especially useful for identification when rudimentary is contrasted against moderately and well developed. Most of the rudimentary plumules occur on embryos that have well-developed radicles.

Pubescence. The vast majority of plumules are glabrous, that is, completely lacking hairs (419 genera). Two genera, *Haplormosia* (2.16) in Sophoreae (2) and *Ormocarpopsis* (14.02) in Aeschynomeneae (14), have pubescent plumules.

Seed Key to Three Subfamilies of Fabaceae

1. Hilum split longitudinally (the faboid split), except flattened seeds; tracheid bar present in subhilar tissue; pleurogram absent; embryonic axis usually deflexed so that radicle nearly parallel to cotyledons or radicle once coiled; radicle not concealed by cotyledons ..... Faboideae
   Hilum without longitudinal split; tracheid bar absent from subhilar tissue; pleurogram present or absent; embryonic axis usually straight, rarely deflexed, thus radicle rarely parallel to cotyledons; radicle either concealed or exposed 2

2. Pleurogram usually present; radicle straight or at most slightly deflexed and tip not near cotyledons, either concealed or partially concealed by cotyledons or cotyledons notched and radicle exposed ..... Mimosoideae, see Gunn *(1984)*
   Pleurogram usually absent; radicle straight to deflexed and not concealed by cotyledons ..... Cesalpinioideae, see Gunn *(1991)*

Seed Keys to Genera of Subfamily Faboideae

Master Key to 16 Seed Keys and One Genus

1. Aril present 2
   Aril absent 11

2. Aril fleshy 3
   Aril dry 5

3. Cotyledons entire over radicle ..... Subkey 1
   Cotyledons notched at or split over radicle 4

4. Cotyledons notched at radicle ..... Subkey 2
   Cotyledons split over radicle ..... Subkey 3

5. Cotyledons entire over radicle 6
   Cotyledons notched at or split over radicle or 1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire 7

6. Hilum raised or flush ..... Subkey 4
   Hilum recessed ..... Subkey 5

7. Cotyledons notched at or split over radicle 8
   1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire ..... *Panurea*, 2.30

8. Cotyledons notched at radicle 9
   Cotyledons split over radicle 10

9. Endosperm present ..... Subkey 6
   Endosperm absent ..... Subkey 7

10. Hilum raised or flush ..... Subkey 8
    Hilum recessed ..... Subkey 9

11. Cotyledons entire over radicle 12
    Cotyledons notched at or split over radicle or 1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire 14

12. Endosperm present 13
    Endosperm absent ..... Subkey 10

13. Hilum raised or flush ..... Subkey 11
    Hilum recessed ..... Subkey 12

14. Cotyledons notched at or split over radicle 15
    1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire ..... Subkey 13

15. Cotyledons notched at radicle ..... Subkey 14
    Cotyledons split over radicle 16

16. Hilum raised or flush ..... Subkey 15
    Hilum recessed ..... Subkey 16

Seed Key 1: Aril present; fleshy. Cotyledons entire over radicle.

1. Endosperm present 2
   Endosperm absent 20

2. Radicle bulbose 3
   Radicle linear 12

3. Endosperm thick 4
   Endosperm thin 9

4. Plumule rudimentary 5
   Plumule moderately or well developed 6

5. Seed 10–12 mm long; aril crenate; testa dull; raphe not visible; hilum marginal according to radicle tip; lens linear ..... *Vandasina*, 10.49
   Seed 2.5–3.5 mm long; aril entire; testa glossy; raphe visible; hilum apical according to radicle tip but marginal according to seed length; lens oblong ..... *Xiphotheca*, 25.01

6. Hilum flush; seed terete; raphe not visible; cotyledons not smooth ..... *Kennedia*, 10.47
Hilum recessed; seed compressed; raphe visible; cotyledons smooth 7

7. Hilum visible, with straight outline; radicle oblique to cotyledons ..... *Podalyria*, 25.06
Hilum partially concealed, with curved outline; radicle deflexed and parallel to cotyledon width .. 8

8. Aril annular; seed with umbo on seed faces; embryonic axis oblique, perpendicular to length of seed; raphe lighter than testa ..... *Cyclopia*, 25.05
Aril cupshaped; seed without umbo on seed faces; embryonic axis deflexed, oblique to length of seed; raphe darker than testa ..... *Liparia*, 25.04

9. Hilum punctiform; seed terete; testa black; cotyledons with margins recessed; radicle 1/2 to nearly length of cotyledons ..... *Goodia*, 23.05
Hilum larger than punctiform; seed compressed; testa brown; cotyledons without margins recessed; radicle less than 1/2 length of cotyledons 10

10. Plumule rudimentary; seed without umbo on seed faces; aril brown; lens discernible 11
Plumule moderately or well developed; seed with umbo on seed faces; aril tan; lens not discernible ..... *Codariocalyx*, 11.10

11. Testa dull; hilum visible, with curved outline, between cotyledon and radicle lobe, within halo or rim; cotyledons green ..... *Coelidium*, 25.03
Testa glossy; hilum partially concealed, with straight outline, marginal according to radicle tip, not within halo or rim; cotyledons tan ... *Nemcia*, 24.15

12. Hilum punctiform 13
Hilum larger than punctiform 14

13. Seed 2 mm long; aril cupshaped; seed compressed; testa brown; hilum within rim; cotyledons without margins recessed ..... *Latrobea*, 24.18
Seed 2.7–4 mm long; aril hooked; seed terete; testa black; hilum not within rim; cotyledons with margins recessed ..... *Goodia*, 23.05

14. Plumule rudimentary 15
Plumule moderately or well developed 18

15. Hilum partially concealed; seed without umbo on seed faces 16
Hilum fully concealed; seed with umbo on seed faces ..... *Platylobium*, 23.07

16. Cotyledons partially concealing radicle; testa chartaceous; embryonic axis straight; hilum with curved outline ..... *Ophrestia*, 10.11
Cotyledons not concealing radicle; testa coriaceous; embryonic axis deflexed; hilum with straight outline 17

17. Endosperm thick; aril white; radicle deflexed and parallel to cotyledon width; cotyledons yellow; lens circular ..... *Hypocalyptus*, 26.01
Endosperm thin; aril brown; radicle deflexed and parallel to cotyledon length; cotyledons tan; lens oblong ..... *Nemcia*, 24.15

18. Hilum flush ..... *Leptodesmia*, 11.20
Hilum recessed 19

19. Hilum within rim; endosperm thin, adnate to testa; embryonic axis deflexed, parallel to length of seed ..... *Abrus*, 5.01
Hilum not within rim; endosperm thick, adnate to embryo; embryonic axis oblique, oblique to length of seed ..... *Virgilia*, 25.08

20. Hilum flush 21
Hilum recessed 22

21. Hilum punctiform; seed not angular; without umbo on seed faces; testa coriaceous; hilum not within halo ..... *Bocoa*, 1.02
Hilum larger than punctiform; seed angular; with umbo on seed faces; testa chartaceous; hilum within halo ..... *Candolleodendron*, 1.03

22. Testa coriaceous 23
Testa chartaceous 24

23. Seed 3.6–4.7 mm long; radicle less than 1/2 length of cotyledons; rim-aril 2-lipped; seed symmetrical; without visible radicle and cotyledon lobes; hilum partially concealed ..... *Chrysoscias*, 10.78
Seed 2.7–3 mm long; radicle 1/2 to nearly length of cotyledons; aril cupshaped; seed asymmetrical, with visible radicle and cotyledon lobes; hilum visible ..... *Amphithalea*, 25.02

24. Hilum with faboid split; cotyledons with margins recessed; radicle linear; seed with shallow hilar sinus; cuticle absent; lens discernible ..... *Platysepalum*, Millettieae
Hilum without faboid split; cotyledons without margins recessed; radicle triangular; seed without hilar sinus; cuticle present; lens not discernible ..... *Swartzia*, 1.01

Seed Key 2: Aril present; fleshy. Cotyledons notched at radicle.

1. Radicle lobe tip curved 2
   Radicle lobe tip straight 19

2. Plumule rudimentary 3
   Plumule moderately or well developed 8

3. Hilum flush 4
   Hilum recessed 5

4. Testa osseous or coriaceous; hilum marginal according to radicle tip; embryonic axis oblique, oblique or perpendicular to length of seed; radicle triangular, oblique to cotyledons ..... *Mucuna*, 10.03
   Testa chartaceous; hilum apical at apex of or subapical to radicle tip; embryonic axis straight, parallel to length of seed; radicle bulbose, straight with embryonic axis ..... *Alexa*, 2.12a

5. Seed asymmetrical; aril brown or tan; hilum not within rim 6
   Seed symmetrical; aril cream or white; hilum within rim 7

6. Testa mottled; hilum circular or oval; endosperm absent; cotyledons yellow, without lobes ..... *Xeroderris,* Millettieae
   Testa monochrome; hilum elliptic; endosperm present; cotyledons brown, with lobes ..... *Uribea*, 2.04

7. Endosperm present; cotyledons not smooth, white or yellow; radicle with 90 degree turn ..... *Teramnus*, 10.36
   Endosperm absent; cotyledons smooth, tan; radicle oblique to cotyledons ..... *Piscidia,* Millettieae

8. Radicle linear or triangular 9
   Radicle bulbose 14

9. Cotyledons brown or tan ..... *Mucuna*, 10.03
   Cotyledons white 10

10. Testa coriaceous 11
    Testa chartaceous 12

11. Hilum raised or flush; lens within rim, punctiform; cotyledons without margins recessed ..... *Eriosema*, 10.81
    Hilum recessed; lens not within rim, oblong or ovate; cotyledons with margins recessed ..... *Vigna*, 10.66

12. Hilum flush, marginal according to radicle tip; lens flush ..... *Dipogon*, 10.63
    Hilum recessed, apical according to radicle tip but marginal according to seed length; lens mounded 13

13. Endocarp cobwebby or fibrous; lens linea ..... *Macroptilium*, 10.71
    Endocarp pithy or smooth; lens oblong or ovate ..... *Vigna*, 10.66

14. Endocarp nonseptate; hilum raised or flush; lens punctiform ..... *Eriosema*, 10.81
    Endocarp septate or subseptate; hilum recessed; lens much larger than punctiform 15

15. Endosperm absent 16
    Endosperm present 17

16. Hilum apical according to radicle tip but marginal according to seed length; lens not within rim, oblong or ovate ..... *Vigna*, 10.66
    Hilum marginal according to radicle tip; lens within rim, elliptic or linear ..... *Lablab*, 10.61

17. Lens mounded, oblong or ovate; endosperm trace, restricted to region of embryo ..... *Vigna*, 10.66
    Lens flush, circular or linear; endosperm thick, covering entire embryo 18

18. Seed without umbo on seed faces; testa not smooth; lens linear; embryonic axis perpendicular to length of seed ..... *Teyleria*, 10.39
    Seed with umbo on seed faces; testa smooth; lens circular; embryonic axis oblique to length of seed ..... *Teramnus*, 10.36

19. Cotyledons margin not entire 180 degrees from base of radicle 20
    Cotyledons margin entire 180 degrees from base of radicle 22

20. Seed 11–12 mm long; testa red, smooth; hilum recessed; cotyledons without lobes; radicle triangular ..... *Baphiastrum*, 2.22
    Seed 17–70 mm long; testa brown, not smooth; hilum raised or flush; cotyledons with lobes; radicle bulbose or truncate 21

21. Testa mottled; hilum raised, within rim; radicle truncate ..... *Uleanthus*, 2.29
    Testa monochrome; hilum flush, not within rim; radicle bulbose ..... *Clathrotropis*, 2.26

22. Testa absent 23
    Testa present 24

23. Seed ca. 35 mm long, ca. 25.5 mm wide, ovate, flattened, with surface smooth; cotyledons with lobes; radicle bulbose ..... *Monopteryx*, 2.31
Seed 15–20 mm long, 9–10 mm wide, elliptic, terete, with surface wrinkled; cotyledons without lobes; radicle triangular .....*Angylocalyx*, 2.13

24. Plumule rudimentary 25
Plumule moderately or well developed 28

25. Seed D-shaped or reniform; endosperm present; embryonic axis deflexed, oblique to length of seed; radicle linear .....*Dalbergiella,* Millettieae
Seed bilobed (cicerlike), circular, elliptic, oblong, or ovate; endosperm absent; embryonic axis straight, parallel to length of seed; radicle bulbose or triangular 26

26. Aril ivory, olive, or tan; hilum recessed, within corona; radicle triangular ..... *Bowringia*, 2.21
Aril black, brown, or yellow; hilum flush, not within corona or within rim; radicle bulbose 27

27. Seed 23–38 mm long; aril crenate, black or brown; testa brown, chartaceous ..... *Alexa*, 2.12a
Seed 13.5–20 mm long; aril fimbriate, yellow; testa black or red, coriaceous ..... *Leucomphalos*, 2.23

28. Hilum recessed 29
Hilum raised or flush 32

29. Cotyledons white 30
Cotyledons pink or tan 31

30. Aril cream; lens equal to or greater than 0.5 mm in length, not within corona, oblong or ovate ..... *Vigna*, 10.66
Aril tan; lens less than 0.5 mm in length, within corona, linear ..... *Austrodolichos*, 10.59

31. Endosperm present; cotyledons tan; radicle bulbose .....*Rhynchosia*, 10.80
Endosperm absent; cotyledons pink; radicle linea ..... *Decorsea*, 10.54

32. Endosperm present 33
Endosperm absent 34

33. Hilum with straight outline; lens punctiform, similar color as testa; cotyledons white .... *Eriosema*, 10.81
Hilum with curved outline; lens elliptic or linear, dissimilar color from testa; cotyledons tan .....*Rhynchosia*, 10.80

34. Hilum with straight outline 35
Hilum with curved outline 37

35. Testa chartaceous ..... *Dolichos*, 10.64
Testa coriaceous 36

36. Seed elliptic, oblong, or quadrangular; hilum within rim; lens mounded, within rim, punctiform ..... *Eriosema*, 10.81
Seed ovate; hilum not within rim; lens flush, not within rim, linear ..... *Nesphostylis*, 10.58

37. Testa chartaceous; lens within corona or rim; fruit rounded or short tapered at base .... *Dolichos*, 10.64
Testa coriaceous; lens not within corona or rim or within halo; fruit tapered at base 38

38. Seed compressed; lens circular, mounded, within halo .....*Dunbaria*, 10.74
Seed terete; lens linear, flush, lens not within halo ..... *Cajanus*, 10.73

Seed Key 3: Aril present; fleshy. Cotyledons split at radicle.

1. Cotyledons completely or partially concealing radicle 2
Cotyledons not concealing radicle 15

2. Hilum raised or flush 3
Hilum recessed 8

3. Testa not smooth; endosperm absent; cotyledons not smooth 4
Testa smooth; endosperm present; cotyledons smooth 5

4. Cotyledons margin not entire 180 degrees from base of radicle, with lobes touching (auriculate) or not touching, brown; embryonic axis oblique to length of seed .....*Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of radicle, with lobes overlapping, orange; embryonic axis parallel to length of seed ..... *Dalhousiea*, 2.20

5. Plumule moderately or well developed; raphe visible; radicle bulbose 6
Plumule rudimentary; raphe not visible; radicle linear 7

6. Hilum marginal according to radicle tip; lens similar color as testa, brown; embryonic axis oblique to length of seed ..... *Hovea*, 23.04
Hilum subapical to radicle tip; lens dissimilar color from testa, black; embryonic axis parallel to length of seed ..... *Plagiocarpus*, 23.03

7. Aril flat from apex to near base, tan; hilum marginal according to radicle tip, not within rim; cotyledons with lobes not touching ..... *Bossiaea*, 23.06
Aril caplike or cupshaped, brown; hilum subapical to radicle tip, within rim; cotyledons with lobes touching (auriculate) ..... *Templetonia*, 23.01

8. Plumule moderately or well developed; fruit long tapered or tapered at base 9
Plumule rudimentary; fruit rounded or short tapered at base 10

9. Aril brown or tan; lens adjacent to hilum, elliptic or linear; cotyledons tan; embryonic axis straight ..... *Brongniartia*, 22.01
Aril cream; lens confluent with hilum, oblong or ovate; cotyledons white; embryonic axis oblique or right angled ..... *Vigna*, 10.66

10. Radicle linear or triangular 11
Radicle bulbose 13

11. Seed 3–3.5 mm long; aril flat from apex to near base; cotyledons with lobes not touching, yellow; radicle deflexed and parallel to cotyledon width ..... *Bossiaea*, 23.06
Seed 5–37 mm long; aril cupshaped, hooked, 2-lipped rim-aril, or topknotlike; cotyledons with lobes overlapping or touching (auriculate), tan or white; radicle oblique to cotyledons or straight with embryonic axis 12

12. Seed 5–15 mm long; hilum fully concealed, elliptic; endosperm present; cotyledons both more or less of equal length; radicle linear ..... *Harpalyce*, 22.02
Seed 20–37 mm long; hilum visible, heart-shaped or oval; endosperm absent; cotyledons 1 longer than other; radicle triangular ..... *Camoensia*, 2.39

13. Seed 20–37 mm long; hilum heart-shaped or oval, within corona or rim; lens lighter than testa; endosperm absent; cotyledons 1 longer than other ..... *Camoensia*, 2.39
Seed 5.3–8 mm long; hilum elliptic, not within corona or rim or within halo; lens darker than testa; endosperm present; cotyledons both more or less of equal length 14

14. Seed oblong; aril cupshaped; endosperm covering entire embryo; cotyledons with lobes, yellow ..... *Lamprolobium*, 23.02
Seed reniform; aril hippocrepiform rim-aril; endosperm covering at least 1/2 of embryo but not entire embryo; cotyledons without lobes, green ..... *Cruddasia*, 10.13

15. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 16
Radicle less than 1/2 length of cotyledons 26

16. Seed with umbo on seed faces; cuticle wrinkled ..... *Chamaecytisus*, 30.15A
Seed without umbo on seed faces; cuticle not wrinkled 17

17. Endosperm thin 18
Endosperm thick 22

18. Aril yellow; seed mitaform; hilum flush ..... *Eutaxia*, 24.26
Aril brown, red, tan, or white; seed circular, D-shaped, irregular, oblong, ovate, quadrangular, rectangular, reniform, rhombic, or triangular; hilum recessed 19

19. Radicle linear 20
Radicle bulbose 21

20. Hilum visible or fully concealed, circular; lens elliptic or oblong ..... *Genista*, 30.22
Hilum partially concealed, elliptic; lens circular ..... *Urodon*, 24.22

21. Fruit rounded at apex; epicarp smooth; funiculus flattened ..... *Stauracanthus*, 30.24
Fruit tapered or short tapered at apex; epicarp not smooth; funiculus filiform, thick, or triangular ..... *Genista*, 30.22

22. Hilum within halo; endocarp glossy ..*Dillwynia*, 24.25
Hilum within rim; endocarp dull 23

23. Hilum elliptic or oval; epicarp smooth 24
Hilum circular; epicarp not smooth 25

24. Seed 2–3 mm long; aril brown, cream, ivory, or tan; hilum fully concealed; radicle bulbose; lens key-hole shaped or oblong ..... *Ulex*, 30.25
Seed 4–5 mm long; aril yellow; hilum partially concealed; radicle linear; lens circular ..... *Cytisophyllum*, 30.12

25. Testa glossy ..... *Genista*, 30.22
Testa dull ..... *Cytisus*, 30.15

26. Plumule moderately or well developed 27
Plumule rudimentary 31

27. Hilum flush, marginal according to radicle tip 28
Hilum recessed, apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobe 29

28. Seed with umbo on seed faces; endosperm thin, adnate to testa; cotyledons with lobes, white or yellow; radicle triangular ..... *Vicia*, 19.01
Seed without umbo on seed faces; endosperm thick, adnate to embryo; cotyledons without lobes, tan; radicle bulbose ..... *Hardenbergia*, 10.48

29. Aril cream; hilum apical according to radicle tip but marginal according to seed length; cotyledons white; lens oblong or ovate ..... *Vigna*, 10.66
Aril brown or tan; hilum between cotyledon and radicle lobe; cotyledons tan or yellow; lens circular or key-hole shaped 30

30. Hilum with curved outline; lens key-hole shaped; endosperm thick, adnate to embryo ..... *Brachysema*, 24.16
Hilum with straight outline; lens circular; endosperm thin, adnate to testa ..... *Almaleea*, 24.24

31. Aril covering 1/2 to nearly all of seed 32
Aril covering less than 1/2 of seed 33

32. Aril cupshaped; hilum not within rim or within halo; lens elliptic; cotyledons yellow ..... *Daviesia*, 24.04
Aril marginal hilar or topknotlike; hilum within rim; lens circular or oblong; cotyledons brown or tan ..... *Gastrolobium*, 24.13

33. Hilum elliptic, within rim; endosperm thin; lens circular ..... *Pultenaea*, 24.23
Hilum circular or oval, not within rim or within halo; endosperm thick; lens key-hole shaped or oblong 34

34. Aril cupshaped; testa monochrome; hilum oval; lens key-hole shaped ..... *Brachysema*, 24.16
Aril topknotlike; testa streaked; hilum circular; lens oblong ..... *Dillwynia*, 24.25

Seed Key 4: Aril present; dry. Cotyledons entire over radicle. Hilum raised or flush.

1. Radicle 1/2 to nearly length of cotyledons 2
Radicle less than 1/2 length of cotyledons 8

2. Radicle linear; fruit compressed 3
Radicle bulbose; fruit flattened or terete 5

3. Seed 3–4 mm long, with surface grooved; hilum not within halo or rim; cotyledons with both folded, differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) .... *Cyamopsis*, 9.06
Seed 1.2–2.3 mm long, with surface smooth; hilum within halo or rim; cotyledons not folded, similar at apex; radicle centered between cotyledons 4

4. Seed 1.5–2.3 mm long; hilum within halo; endosperm adnate to testa; cotyledons tan; radicle deflexed and parallel to cotyledon width; plumule moderately developed ..... *Kummerowia*, 11.25
Seed 1.2–1.3 mm long; hilum within rim; endosperm adnate to embryo; cotyledons white; radicle deflexed and parallel to cotyledon length; plumule rudimentary ..... *Melliniella*, 11.19

5. Aril brown; testa chartaceous; hilum within rim; lens diamond-shaped; plumule moderately developed ..... *Biserrula*, 16.15A
Aril white; testa coriaceous; hilum not within rim or within halo; lens circular, elliptic, or linear; plumule rudimentary 6

6. Seed 2–2.5 mm long; lens elliptic; endosperm thin ..... *Sphaerophysa*, 16.07
Seed 3.5–4 mm long; lens circular or linear; endosperm thick 7

7. Seed with external groove between radicle and cotyledon lobes; hilum between cotyledon and radicle lobe; cotyledons outer face of 1 cotyledon flat and other cotyledon convex .. *Swainsona*, 16.02
Seed without external groove between radicle and cotyledon lobes; hilum marginal according to radicle tip; cotyledons both outer faces convex ..... *Clianthus*, 16.01

8. Endosperm absent 9
Endosperm present 11

9. Seed 25–30 mm long, D-shaped or rectangular; testa mottled, osseous; hilum not within rim; cotyledons 1 thicker than the other ... *Macropsychanthus*, 10.22
Seed 7–12 mm long, circular, elliptic, ovate, or reniform; testa monochrome, coriaceous or chartaceous; hilum within rim; cotyledons both the same thickness 10

10. Aril fimbriate; testa coriaceous; cotyledons margin not entire 180 degrees from base of radicle; embryonic axis perpendicular to length of seed, with a joint evident between the radicle and the cotyledons ..... *Cleobulia*, 10.20
Aril entire; testa chartaceous; cotyledons margin entire 180 degrees from base of radicle; embryonic axis parallel to length of seed, without a joint evident between the radicle and the cotyledons ..... *Apurimacia,* Millettieae

11. Hilum punctiform 12
Hilum larger than punctiform 17

12. Aril brown; epicarp pubescent and indurate or pubescent but soon deciduous 13
Aril white; epicarp glabrous 14

13. Lens similar color as testa, elliptic; cotyledons tan; radicle bulbose; plumule rudimentary ..... *Oxytropis*, 16.17
Lens dissimilar color from testa, oblong; cotyledons white; radicle linear; plumule moderately developed ..... *Mecopus*, 11.15

14. Endosperm thick; radicle bulbose ..... *Clianthus*, 16.01
Endosperm thin; radicle linear 15

15. Aril tongue-aril; hilum within halo; cotyledons margin not entire 180 degrees from base of radicle ..... *Ptychosema*, 23.09
Aril hooded or rim-aril; hilum not within halo; cotyledons margin entire 180 degrees from base of radicle 16

16. Aril hooded; testa black; hilum concealed by aril; cotyledons yellow; radicle oblique to cotyledons ..... *Aenictophyton*, 23.10
Aril rim-aril; testa brown or orange; hilum concealed by funicular remnant; cotyledons tan; radicle deflexed and parallel to cotyledon length ..... *Caragana*, 16.11

17. Cotyledons not concealing radicle 18
Cotyledons completely or partially concealing radicle 20

18. Endosperm adnate to embryo; radicle bulbose ..... *Cologania*, 10.43
Endosperm adnate to testa; radicle linear 19

19. Aril white; hilum circular; cotyledons tan; embryonic axis oblique to length of seed; lens circular, elliptic, or wedge-shaped ..... *Caragana*, 16.11
Aril tan; hilum elliptic; cotyledons yellow; embryonic axis parallel to length of seed; lens linear ..... *Psoralea*, 12.09

20. Cotyledons white ..... *Ophrestia*, 10.11
Cotyledons brown or tan 21

21. Cotyledons inner face with central ridge on 1 and central groove on other; embryonic axis parallel ..... *Chadsia,* Millettieae
Cotyledons inner face flat; embryonic axis deflexed, oblique, or straight 22

22. Seed ca. 4 mm long; lens circular, mounded; endosperm covering entire embryo; cotyledons completely concealing radicle; radicle deflexed and parallel to cotyledon length ..... *Eleiotis*, 11.21
Seed 5–27 mm long; lens linear, flush or recessed; endosperm covering at least 1/2 of embryo, but not entire embryo or restricted to region of embryo; cotyledons partially concealing radicle; radicle oblique to cotyledons, with 90-, or with 180-degree turn 23

23. Seed elliptic, rectangular, or reniform; lens flush, not within halo or rim; radicle linear; radicle lobe tip curved ..... *Ophrestia*, 10.11
Seed oblong or ovate; lens recessed, within halo or rim; radicle bulbose or triangular; radicle lobe tip straight ..... *Dioclea*, 10.18

Seed Key 5: Aril present; dry. Cotyledons entire over radicle. Hilum recessed.

1. Radicle bulbose 2
Radicle linear, triangular, or truncate 29

2. Embryonic axis with a joint evident between the radicle and the cotyledons 3
Embryonic axis without a joint evident between the radicle and the cotyledons 6

3. Hilum punctiform; aril white 4
Hilum larger than punctiform; aril brown 5

4. Testa coriaceous; hilum visible; endosperm thick, adnate to embryo; cotyledons partially concealing radicle ..... *Lessertia*, 16.04
Testa chartaceous; hilum partially or fully concealed; endosperm thin, adnate to testa; cotyledons not concealing radicle ..... *Eremosparton*, 16.09

5. Seed ca. 20 mm long; symmetrical; aril crenate; testa chartaceous; endosperm absent; cotyledons with lobes ..... *Panurea*, 2.30
Seed 3.5–4.5 mm long; asymmetrical; aril entire; testa coriaceous; endosperm present; cotyledons without lobes ..... *Galega*, 16.20

6. Endosperm present 7
Endosperm absent 26

7. Endosperm thick 8
Endosperm thin 18

8. Cotyledons similar at apex 9
Cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle) ..... *Carmichaelia*, 17.05

9. Hilum punctiform 10
Hilum larger than punctiform 14

10. Seed with umbo on seed faces; rim present ..... *Smirnowia*, 16.08
Seed without umbo on seed faces; rim absent 11

11. Endocarp present 12
Endocarp absent ..... *Sutherlandia*, 16.03

12. Endocarp dull 13
Endocarp glossy ..... *Jacksonia*, 24.08

13. Epicarp veined ..... *Astragalus*, 16.15
Epicarp not veined ..... *Crotalaria*, 27.07

14. Cotyledons with lobes; cotyledons with margins recessed ..... *Sophora*, 2.45
Cotyledons without lobes; cotyledons without margins recessed 15

15. Cotyledons inner face flat 16
Cotyledons inner face concave ..... *Colutea*, 16.05

16. Radicle deflexed and parallel to cotyledon length; endocarp dull, nonseptate 17
Radicle deflexed and parallel to cotyledon width; endocarp glossy, septate ..... *Bobgunnia*, 1.01A

17. Epicarp veined ..... *Astragalus*, 16.15
Epicarp not veined ..... *Crotalaria*, 27.07

18. Hilum within corona, halo, or rim 19
Hilum not within corona, halo, or rim 23

19. Cotyledons with lobes ..... *Sophora*, 2.45
Cotyledons without lobes 20

20. Embryonic axis oblique to length of seed 21
Embryonic axis parallel to length of seed ..... *Astracantha*, 16.16

21. Fruit a legume; endocarp nonseptate 22
Fruit a loment (or a loment segment); endocarp septate ..... *Uraria*, 11.16

22. Fruit with persistent calyx ..... *Astragalus*, 16.15
Fruit with deciduous calyx ..... *Halimodendron*, 16.10

23. Epicarp glabrous 24
Epicarp pubescent 25

24. Fruit with persistent calyx ..... *Astragalus*, 16.15
Fruit with deciduous calyx ..... *Poitea*, 8.05

25. Hilum marginal according to radicle tip; endocarp glossy ..... *Nemcia*, 24.15
Hilum between cotyledon and radicle lobe; endocarp dull ..... *Astragalus*, 16.15

26. Cotyledons with lobes, with margins recessed ..... *Sophora*, 2.45
Cotyledons without lobes, without margins recessed 27

27. Seed 10–20 mm long; radicle lobe tip straight; hilum within corona, halo, or rim 28
Seed ca. 6 mm long; radicle lobe tip curved; hilum not within corona, halo, or rim ..... *Craspedolobium,* Millettieae

28. Seed 10–11 mm long; hilum visible; lens discernible; epicarp veined; testa glossy; cotyledons tan ..... *Sakoanala*, 2.35
Seed 16–20 mm long; hilum partially concealed; lens not discernible; epicarp not veined; testa dull; cotyledons brown ..... *Craibia,* Millettieae

29. Plumule rudimentary 30
Plumule moderately or well developed 71

30. Testa coriaceous 31
Testa chartaceous 64

31. Seed symmetrical 32
Seed asymmetrical 35

32. Epicarp veined; seed wings present . *Phylacium*, 11.22
Epicarp not veined; seed wings absent 33

33. Hilum elliptic; raphe visible 34
Hilum oval; raphe not visible ..... *Camptosema*, 10.24

34. Cotyledons with lobes, with margins recessed; hilum with faboid split ..... *Sophora*, 2.45
Cotyledons without lobes, without margins recessed; hilum without faboid split ..... *Craibia,* Millettieae

35. Embryonic axis oblique to length of seed 36
Embryonic axis parallel or perpendicular to length of seed 62

36. Testa not modified by a bloom 37
Testa modified by a bloom 61

37. Cotyledons 1 longer than other; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) ..... *Lennea*, 8.03
Cotyledons both more or less of equal length; radicle centered between cotyledons 38

38. Raphe visible 39
Raphe not visible 40

39. Seed 3–5 mm long; endosperm present; hilum not within rim; hilum with faboid split ..... *Poitea*, 8.05
Seed 16–20 mm long; endosperm absent; hilum within rim; hilum without faboid split ..... *Craibia,* Millettieae

40. Radicle deflexed and parallel to cotyledon length ... 41
Radicle deflexed and parallel to cotyledon width 60

41. Radicle less than 1/2 length of cotyledons 42
Radicle 1/2 to nearly length of cotyledons 58

42. Testa smooth 43
Testa not smooth 56

43. Seed angular 44
Seed not angular 46

44. Epicarp veined; endocarp glossy ..... *Oxylobium*, 24.09
Epicarp not veined; endocarp dull 45

45. Endosperm adnate to testa; fruit inflated; endocarp nonseptate ..... *Crotalaria*, 27.07
Endosperm adnate to embryo; fruit not inflated; endocarp septate ..... *Alhagi*, 16.21

46. Epicarp veined 47
Epicarp not veined 53

47. Hilum within corona, halo, or rim 48
Hilum not within corona, halo, or rim 50

48. Endocarp septate; fruit wings present ..... *Desmodium*, 11.09
Endocarp nonseptate; fruit wings absent 49

49. Hilum marginal according to radicle tip; endosperm thin; rim-aril; endocarp dull ..... *Lespedeza*, 11.24
Hilum between cotyledon and radicle lobe; endosperm thick; tongue-aril; endocarp glossy ..... *Oxylobium*, 24.09

50. Fruit wings present ..... *Desmodium*, 11.09
Fruit wings absent 51

51. Endosperm thick ..... *Oxylobium*, 24.09
Endosperm thin 52

52. Endocarp dull; epicarp glabrous; fruit with deciduous calyx ..... *Poitea*, 8.05
Endocarp glossy; epicarp pubescent; fruit with persistent calyx ..... *Nemcia*, 24.15

53. Seed with visible radicle and cotyledon lobes 54
Seed without visible radicle and cotyledon lobes 55

54. Endosperm thick; fruit inflated ..... *Crotalaria*, 27.07
Endosperm thin; fruit not inflated ..... *Poitea*, 8.05

55. Fruit wings present; fruit with persistent calyx ..... *Desmodium*, 11.09
Fruit wings absent; fruit with deciduous calyx ..... *Poitea*, 8.05

56. Seed with visible radicle and cotyledon lobes; lens adjacent to hilum, mounded; fruit wings absent; endocarp nonseptate 57
Seed without visible radicle and cotyledon lobes; lens confluent with hilum, flush; fruit wings present; endocarp septate ..... *Desmodium*, 11.09

57. Lens less than 0.5 mm in length; endocarp glossy; fruit not inflated ..... *Jacksonia*, 24.08
Lens equal to or greater than 0.5 mm in length; endocarp dull; fruit inflated ..... *Crotalaria*, 27.07

58. Endosperm thick; fruit inflated ..... *Crotalaria*, 27.07
Endosperm thin; fruit not inflated 59

59. Seed 2–2.5 mm long; hilum within rim; epicarp pubescent ..... *Melolobium*, 30.01
Seed 3–5 mm long; hilum not within rim; epicarp glabrous ..... *Poitea*, 8.05

60. Endosperm thick; radicle lobe tip curved ..... *Mirbelia*, 24.11
Endosperm thin; radicle lobe tip straight .. *Poitea*, 8.05

61. Seed 2.5–4.5 mm long, with visible radicle and cotyledon lobes; endosperm present; cotyledons not concealing radicle; radicle lobe tip curved ..... *Baptisia*, 29.05
Seed 16–20 mm long, without visible radicle and cotyledon lobes; endosperm absent; cotyledons partially concealing radicle; radicle lobe tip straight ..... *Craibia,* Millettieae

62. Hilum visible; not within corona, halo, or rim; with faboid split; lens discernible; fruit a loment (or a loment segment) ..... *Trifidacanthus*, 11.05
Hilum partially or fully concealed; within corona, halo, or rim; without faboid split; lens not discernible; fruit a legume 63

63. Testa dull; hilum larger than punctiform; endosperm absent; cotyledons partially concealing radicle; brown ..... *Craibia,* Millettieae
Testa glossy; hilum punctiform; endosperm present; cotyledons not concealing radicle; yellow ..... *Cullen*, 12.01

64. Cotyledons with lobes ..... *Sophora*, 2.45
Cotyledons without lobes 65

65. Seed with shallow hilar sinus; cotyledons with margins recessed ..... *Platysepalum,* Millettieae
Seed without hilar sinus; cotyledons without margins recessed 66

66. Lens discernible 67
Lens not discernible 70

67. Lens less than 0.5 mm in length 68
Lens equal to or greater than 0.5 mm in length 69

68. Cotyledons partially concealing radicle; embryonic axis straight; lens similar color as testa; radicle oblique to cotyledons ..... *Ophrestia,* 10.11
Cotyledons not concealing radicle; embryonic axis deflexed; lens dissimilar color from testa; radicle deflexed and parallel to cotyledon length ..... *Desmodium*, 11.09

69. Lens confluent with hilum, flush, dissimilar color from testa; embryonic axis deflexed, oblique to length of seed ..... *Desmodium*, 11.09
Lens adjacent to hilum, mounded, similar color as testa; embryonic axis oblique, parallel to length of seed ..... *Cladrastis*, 2.41

70. Seed 16–20 mm long; hilum elliptic, concealed by aril; raphe visible; cotyledons partially concealing radicle; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Craibia,* Millettieae
Seed ca. 11 mm long; hilum oval, concealed by funicular remnant; raphe not visible; cotyledons not concealing radicle; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Hesperothamnus,* Millettieae

71. Cotyledons 1 longer than other 72
Cotyledons both more or less of equal length 74

72. Testa coriaceous; endosperm present; cotyledons completely or partially concealing radicle; embryonic axis deflexed, oblique to length of seed 73
Testa chartaceous; endosperm absent; cotyledons not concealing radicle; embryonic axis oblique, perpendicular to length of seed ..... *Bergeronia,* Millettieae

73. Seed 3.2–6 mm long, with visible radicle and cotyledon lobes; hilum punctiform; cotyledons smooth ..... *Thermopsis*, 29.04
Seed 9–12 mm long, without visible radicle and cotyledon lobes; hilum larger than punctiform; cotyledons not smooth ..... *Lennea*, 8.03

74. Seed with umbo on seed faces 75
Seed without umbo on seed faces 78

75. Hilum visible; radicle less than 1/2 length of cotyledons 76
Hilum fully concealed; radicle 1/2 to nearly length of cotyledons ..... *Polhillia*, 30.04

76. Endosperm adnate to testa 77
Endosperm adnate to embryo ..... *Pseudarthria*, 11.11

77. Seed 1.2–1.5 mm long; hilum punctiform; endosperm thin; cotyledons not folded, partially concealing radicle; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Aphyllodium*, 11.08
Seed 2.5–3.7 mm long; hilum larger than punctiform; endosperm thick; cotyledons both folded, not concealing radicle; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Tadehagi*, 11.13

78. Fruit inflated 79
Fruit not inflated 81

79. Seed with visible radicle and cotyledon lobes; lens mounded ..... *Crotalaria*, 27.07
Seed without visible radicle and cotyledon lobes; lens flush 80

80. Lens confluent with hilum; fruit wings present; endocarp septate ..... *Desmodium*, 11.09
Lens adjacent to hilum; fruit wings absent; endocarp nonseptate ..... *Pycnospora*, 11.12

81. Cotyledons both folded 82
Cotyledons not folded 84

82. Hilum circular, not within halo or rim; raphe not visible; embryonic axis with a joint evident between the radicle and the cotyledons ... *Tadehagi*, 11.13
Hilum elliptic, within halo or rim; raphe visible; embryonic axis without a joint evident between the radicle and the cotyledons 83

83. Cotyledons with lobes; margins recessed; hilum with faboid split ..... *Sophora*, 2.45
Cotyledons without lobes; margins not recessed; hilum without faboid split ..... *Craibia,* Millettieae

84. Seed symmetrical 85
Seed asymmetrical 90

85. Hilum within corona, halo, or rim 86
Hilum not within corona, halo, or rim ..... *Phyllodium*, 11.07

86. Hilum punctiform; epicarp veined ..... *Muelleranthus*, 23.08
Hilum larger than punctiform; epicarp not veined ... 87

87. Cotyledons with lobes 88
Cotyledons without lobes 89

88. Testa dull; cotyledons with margins recessed, with basal groin formed by lobes ..... *Sophora*, 2.45
Testa glossy; cotyledons without margins recessed, without basal groin formed by lobes ..... *Abrus*, 5.01

89. Seed 16–20 mm long; testa dull; hilum without faboid split; endosperm absent; cotyledons partially concealing radicle; radicle oblique to cotyledons ..... *Craibia,* Millettieae
Seed 3.5–7 mm long; testa glossy; hilum with faboid split; endosperm present; cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon length ..... *Abrus*, 5.01

90. Hilum within corona, halo, or rim 91
Hilum not within corona, halo, or rim 95

91. Seed 16–20 mm long; cotyledons partially concealing radicle; lens not discernible; raphe visible ..... *Craibia,* Millettieae
Seed 0.7–12.5 mm long; cotyledons not concealing radicle; lens discernible; raphe not visible 92

92. Lens same color as testa; embryonic axis right angled; radicle oblique to cotyledon ..... *Cratylia*, 10.25
Lens dissimilar color from testa; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length 93

93. Lens mounded ..... *Uraria*, 11.16
Lens flush 94

94. Fruit wings present; endocarp septate ..... *Desmodium*, 11.09
Fruit wings absent; endocarp nonseptate ..... *Lespedeza*, 11.24

95. Fruit wings present ..... *Desmodium*, 11.09
Fruit wings absent 96

96. Testa coriaceous; epicarp glabrous; fruit with deciduous calyx ..... *Poitea*, 8.05
Testa chartaceous; epicarp pubescent; fruit with persistent calyx ..... *Phyllodium*, 11.07

Seed Key 6: Aril present; dry. Cotyledons notched at radicle. Endosperm present.

1. Seed with umbo on seed faces 2
Seed without umbo on seed faces 4

2. Seed 12–18 mm long, ovate; testa mottled, tan; hilum visible, not within halo or rim ..... *Platycelyphium*, 2.38
Seed 2.8–5.5 mm long, circular, oblong, or reniform; testa monochrome, brown; hilum partially concealed or fully concealed, within halo or rim 3

3. Seed oblong or reniform; hilum within rim; endosperm thick, covering entire embryo; cotyledons white or yellow; radicle bulbose; radicle lobe tip curved ..... *Teramnus*, 10.36
Seed circular; hilum within halo; endosperm trace, restricted to region of embryo; cotyledons orange; radicle triangular; radicle lobe tip straight ..... *Nogra*, 10.33

4. Radicle lobe tip curved 5
Radicle lobe tip straight 59

5. Plumule moderately or well developed 6
Plumule rudimentary 36

6. Radicle bulbose 7
Radicle linear or triangular 23

7. Hilum raised or flush 8
Hilum recessed 13

8. Hilum visible, with straight outline; cotyledons margin not entire 180 degrees from base of radicle ..... *Canavalia*, 10.21
Hilum partially concealed or fully concealed, with curved outline; cotyledons margin entire 180 degrees from base of radicle 9

9. Testa coriaceous 10
Testa chartaceous 11

10. Lens adjacent to hilum, dissimilar color from testa; embryonic axis deflexed or right angled; radicle deflexed and parallel to cotyledon length or oblique to cotyledons ..... *Periandra*, 10.15
Lens confluent with hilum, same color as testa or similar color as testa; embryonic axis oblique or straight; radicle with 180-degree turn ..... *Glycine*, 10.35

11. Hilum raised; fruit terete, ligneous ..... *Disynstemon,* Millettieae
Hilum flush; fruit compressed or flattened, chartaceous or coriaceous 12

12. Testa papillate, reticulate, or tuberculate when not smooth; fruit wings absent; fruit with all layers dehiscing ..... *Glycine*, 10.35
Testa wrinkled when not smooth; fruit wings present; fruit indehiscent ..... *Derris,* Millettieae

13. Hilum visible 14
Hilum partially or fully concealed 17

14. Lens oblong or ovate; cotyledons with margins recessed, white ..... *Vigna*, 10.66
Lens linear; cotyledons without margins recessed, green, tan, or yellow 15

15. Seed terete, with shallow hilar sinus; embryonic axis parallel to length of seed; radicle with 90-degree turn ..... *Sarcodum,* Millettieae
Seed compressed, without hilar sinus; embryonic axis oblique or perpendicular to length of seed; radicle oblique to cotyledons or with 180-degree turn ... 16

16. Lens recessed, not within corona; cotyledons partially concealing radicle, yellow ..... *Macrotyloma*, 10.65
Lens mounded or flush, within halo or rim; cotyledons not concealing radicle, green or tan ..... *Calopogonium*, 10.45

17. Lens oblong, ovate, or triangular 18
Lens linear 19

18. Lens oblong or ovate; cotyledons white .. *Vigna*, 10.66
Lens triangular; cotyledons brown or tan ..... *Derris,* Millettieae

19. Cotyledons brown or tan 20
Cotyledons white or yellow 21

20. Testa papillate, reticulate, or tuberculate when not smooth; radicle with 180-degree turn; fruit wings absent; fruit with all layers dehiscing ..... *Glycine*, 10.35
Testa wrinkled when not smooth; radicle oblique to cotyledons or with 90-degree turn; fruit wings present; fruit indehiscent ..... *Derris,* Millettieae

21. Hilum concealed by funicular remnant; mesocarp thick ..... *Macrotyloma*, 10.65
Hilum concealed by aril; mesocarp thin 22

22. Testa papillate, reticulate, or tuberculate when not smooth; lens mounded or recessed; embryonic axis parallel to length of seed; plumule well developed ..... *Glycine*, 10.35
Testa rugose; lens flush; embryonic axis oblique to length of seed; plumule moderately developed ..... *Pseudeminia*, 10.30

23. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 24

24. Hilum visible 25
Hilum partially or fully concealed 28

25. Hilum raised or flush; cotyledons margin not entire 180 degrees from base of radicle ..... *Canavalia*, 10.21
Hilum recessed; cotyledons margin entire 180 degrees from base of radicle 26

26. Lens oblong or ovate; cotyledons white, with margins recessed ..... *Vigna*, 10.66
Lens linear; cotyledons brown, green, or tan, without margins recessed 27

27. Hilum marginal according to radicle tip; cotyledons not concealing radicle; plumule well developed ..... *Calopogonium*, 10.45
Hilum apical according to radicle tip but marginal according to seed length; cotyledons partially concealing radicle; plumule moderately developed ..... *Lonchocarpus,* Millettieae

28. Cotyledons brown or tan 29
Cotyledons white or yellow 32

29. Aril crenate; testa rugose; lens circular or diamond-shaped ..... *Ateleia*, 1.13
Aril entire; testa wrinkled; lens linear or triangular 30

30. Rim-aril entire ..... *Derris,* Millettieae
Rim-aril 2-lipped 31

31. Seed ovate or reniform; testa mottled; hilum within rim; radicle triangular ..... *Amphicarpaea*, 10.44
Seed circular, elliptic, or irregular; testa bichrome or monochrome; hilum not within or rim within corona; radicle linear ..... *Baphia*, 2.18

32. Cotyledons not smooth; lens circular or diamond-shaped 33
Cotyledons smooth; lens linear, oblong, or ovate 34

33. Aril entire, cream or tan; seed elliptic, irregular, or ovate; hilum concealed by aril; cotyledons not concealing radicle ..... *Calpurnia*, 25.09
Aril crenate, white; seed C-shaped or reniform; hilum concealed by funicular remnant; cotyledons partially concealing radicle ..... *Ateleia*, 1.13

34. Lens less than 0.5 mm in length; hilum marginal according to radicle tip; cotyledons yellow ..... *Dolichopsis*, 10.69
Lens equal to or greater than 0.5 mm in length; hilum apical according to radicle tip but marginal according to seed length; cotyledons white 35

35. Lens mounded, oblong or ovate; cotyledons with margins recessed ..... *Vigna,* 10.66
Lens flush, linear; cotyledons without margins recessed ..... *Amphicarpaea*, 10.44

36. Cotyledons not concealing radicle 37
Cotyledons partially concealing radicle 40

37. Aril tan or yellow; seed elliptic or oblong; testa smooth; cotyledons margin not entire 180 degrees from base of radicle ..... *Bolusanthus*, 2.37
Aril cream; seed rectangular or reniform; testa not smooth; cotyledons margin entire 180 degrees from base of radicle 38

38. Seed rectangular; hilum punctiform, not within corona or rim; cotyledons both outer faces flat; radicle 1/2 to nearly length of cotyledons ..... *Sphinctospermum*, 8.12
Seed reniform; hilum larger than punctiform, within corona or rim; cotyledons both outer faces convex; radicle less than 1/2 length of cotyledons 39

39. Lens recessed; endosperm thick, adnate to embryo ..... *Shuteria*, 10.41
Lens flush; endosperm thin, adnate to testa ..... *Sinodolichos*, 10.34

40. Radicle linear or triangular 41
Radicle bulbose 50

41. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 42

42. Aril crenate ..... *Ateleia*, 1.13
Aril entire 43

43. Hilum partially concealed or fully concealed 44
Hilum visible 47

44. Testa glaucous; lens diamond-shaped; endocarp septate; funiculus filiform ..... *Pericopsis*, 2.17
Testa dull or glossy; lens linear or triangular; endocarp subseptate or nonseptate; funiculus flattened 45

45. Testa reticulate; cotyledons green, white, or yellow, inner face wrinkled ..... *Tephrosia,* Millettieae
Testa wrinkled; cotyledons brown or tan, inner face flat or concave 46

46. Rim-aril entire; fruit indehiscent ..... *Derris,* Millettieae
Rim-aril 2-lipped; fruit with all layers dehiscing ..... *Baphia*, 2.18

47. Seed symmetrical; lens linear 48
Seed asymmetrical; lens diamond-shaped or triangular 49

48. Aril cream; testa reticulate; hilum within corona; lens within halo; cotyledons inner face wrinkled ..... *Tephrosia,* Millettieae
Aril tan or white; testa rugose or wrinkled; hilum not within corona or within halo or rim; lens not within halo or within rim; cotyledons inner face flat ..... *Lonchocarpus,* Millettieae

49. Seed 2.5–3.5 mm long; aril tan; testa mottled; hilum within halo; cotyledons yellow; radicle 1/2 to nearly length of cotyledons ..... *Ptycholobium,* Millettieae
Seed 7.2–12.5 mm long; aril white; testa monochrome; hilum within rim; cotyledons white; radicle less than 1/2 length of cotyledons ..... *Maackia*, 2.40

50. Lens diamond-shaped 51
Lens linear or triangular 52

51. Seed 6.3–7 mm long; hilum concealed by radicle lobe, circular, not within halo; cotyledons without lobes ..... *Salweenia*, 2.42
Seed 9–16.5 mm long; hilum concealed by aril remnant or funiculus, elliptic, within halo; cotyledons with lobes ..... *Pericopsis*, 2.17

52. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; cotyledons margin not entire 180 degrees from base of radicle ..... *Barbieria*, 10.16A
Hilum with the lips of the faboid split the same color as the rest of the hilum; cotyledons margin entire 180 degrees from base of radicle 53

53. Seed with deep or shallow hilar sinus 54
Seed without hilar sinus 56

54. Aril cream; hilum within corona; lens within halo; cotyledons inner face wrinkled ..... *Tephrosia,* Millettieae
Aril brown or tan; hilum within halo or rim; lens not within halo; cotyledons inner face flat 55

55. Seed 5–7.5 mm long; testa monochrome; seed terete; hilum within rim; lens linear; radicle less than 1/2 length of cotyledons ..... *Sarcodum,* Millettieae
Seed 2.5–3.5 mm long; testa mottled; seed compressed; hilum within halo; lens triangular; radicle 1/2 to nearly length of cotyledons ..... *Ptycholobium,* Millettieae

56. Cotyledons brown or tan; fruit wings present; fruit indehiscent ..... *Derris,* Millettieae
Cotyledons green, white, or yellow; fruit wings absent; fruit with all layers dehiscing 57

57. Aril with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; lens flush; embryonic axis parallel to length of seed ..... *Pseudovigna*, 10.31
Aril with 1 tongue or flap on 1 lip of 2-lipped rim-aril; lens recessed; embryonic axis oblique or perpendicular to length of seed 58

58. Lens within corona or within rim; cotyledons inner face flat; embryonic axis oblique to length of seed ..... *Shuteria*, 10.41
Lens within halo; cotyledons inner face wrinkled; embryonic axis perpendicular to length of seed ..... *Tephrosia,* Millettieae

59. Testa absent ..... *Monopteryx*, 2.31
Testa present 60

60. Cotyledons with lobes 61
Cotyledons without lobes 76

61. Cotyledons with basal groin formed by lobes 62
Cotyledons without basal groin formed by lobes 70

62. Hilum raised or flush, marginal according to radicle tip ..... *Canavalia*, 10.21
Hilum recessed, apical at apex of radicle tip, subapical to radicle tip, or apical according to radicle tip but marginal according to seed length 63

63. Seed with shallow hilar sinus 64
Seed without hilar sinus 65

64. Lens mounded, oblong or ovate, not within rim; cotyledons white; plumule moderately or well developed ..... *Vigna*, 10.66
Lens recessed, circular, within rim; cotyledons tan; plumule rudimentary ..... *Pongamia,* Millettieae

65. Cotyledons white or yellow 66
Cotyledons brown, green, or tan 68

66. Cotyledons white; fruit nonstipitate; funiculus flattened ..... *Vigna*, 10.66
Cotyledons yellow; fruit stipitate or substipitate; funiculus filiform or thick 67

67. Testa dull; hilum apical according to radicle tip but marginal according to seed length; lens linear or triangular; cotyledons notched ..... *Sophora*, 2.45
Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped; cotyledons wavy ..... *Pericopsis*, 2.17

68. Rim-aril 2-lipped; hilum not within halo or rim or within corona ..... *Baphia*, 2.18
Rim-aril not 2-lipped; hilum within halo or rim 69

69. Testa dull; hilum apical according to radicle tip but marginal according to seed length; lens linear or triangular; cotyledons notched ..... *Sophora*, 2.45
Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped; cotyledons wavy ..... *Pericopsis*, 2.17

70. Cotyledons margin not entire 180 degrees from base of radicle ..... *Canavalia*, 10.21
Cotyledons margin entire 180 degrees from base of radicle 71

71. Cotyledons white or yellow 72
Cotyledons brown or tan 74

72. Aril white; lens linear; cotyledons yellow; plumule rudimentary ..... *Peteria*, 8.10
Aril brown or cream; lens circular, oblong, or ovate; cotyledons white; plumule moderately or well developed 73

73. Lens oblong or ovate, equal to or greater than 0.5 mm in length, mounded ..... *Vigna*, 10.66
Lens circular, less than 0.5 mm in length, recessed ..... *Schefflerodendron,* Millettieae

74. Tongue-aril; hilum punctiform ..... *Genistidium*, 8.11
Rim-aril 2-lipped; hilum larger than punctiform 75

75. Rim-aril entire or fimbriate; fruit indehiscent 113
Rim-aril 2-lipped; fruit with all layers dehiscing ..... *Baphia*, 2.18

76. Testa osseous or coriaceous 77
Testa chartaceous 94

77. Hilum raised or flush 78
Hilum recessed 84

78. Cotyledons not concealing radicle 79
Cotyledons partially concealing radicle 80

79. Testa brown; hilum marginal according to radicle tip; lens confluent with hilum, brown ..... *Physostigma*, 10.52
Testa black, orange, or red; hilum subapical to radicle tip or apical according to radicle tip but marginal according to seed length; lens adjacent to hilum, red ..... *Ormosia*, 2.15

80. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; cotyledons margin not entire 180 degrees from base of radicle ..... *Canavalia*, 10.21
Hilum with the lips of the faboid split the same color as the rest of the hilum; cotyledons margin entire 180 degrees from base of radicle 81

81. Seed without hilar sinus 82
Seed with shallow hilar sinus 83

82. Testa coriaceous; lens mounded or flush, dissimilar color from testa; endosperm trace ..... *Rhynchosia*, 10.80
Testa osseous; lens recessed, similar color as testa; endosperm thin ..... *Dioclea*, 10.18

83. Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; hilum partially concealed, flush; endosperm trace ..... *Flemingia*, 10.77
Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; hilum fully concealed, raised; endosperm thin ..... *Bolusafra*, 10.75

84. Cotyledons tan 85
Cotyledons pink, white, or yellow 88

85. Radicle bulbose ..... *Rhynchosia*, 10.80
Radicle linear 86

86. Rim-aril not 2-lipped; seed with shallow hilar sinus; hilum with straight outline; cotyledons not concealing radicle ..... *Adenodolichos*, 10.83
Rim-aril 2-lipped; seed without hilar sinus; hilum with curved outline; cotyledons partially concealing radicle 87

87. Seed 6–9.5 mm long; aril cream or white; seed reniform, terete; testa mottled; hilum visible ..... *Paracalyx*, 10.82
Seed 10–25 mm long; aril ivory or tan; seed circular, elliptic, or irregular, compressed or flattened; testa bichrome or monochrome; hilum partially or fully concealed ..... *Baphia*, 2.18

88. Plumule moderately or well developed 89
Plumule rudimentary 92

89. Aril gray or tan 90
Aril cream 91

90. Testa brown; lens confluent with hilum, mounded; radicle linear ..... *Adenodolichos*, 10.83
Testa black, orange, or red; lens adjacent to hilum, flush; radicle bulbose ..... *Ormosia*, 2.15

91. Lens confluent with hilum, mounded, not within rim ..... *Vigna*, 10.66
Lens adjacent to hilum, flush, within rim ..... *Ormosia*, 2.15

92. Lens red, adjacent to hilum ..... *Ormosia*, 2.15
Lens brown, confluent with hilum 93

93. Seed compressed; hilum not within halo or rim or within rim; lens darker than testa, not within halo or within rim ..... *Physostigma*, 10.52
Seed terete; hilum within halo; lens lighter than testa, within halo ..... *Xanthocercis*, 2.14

94. Cotyledons inner face wavy, with central ridge on 1 and central groove on other, or wrinkled 95
Cotyledons inner face flat or concave 98

95. Hilum within corona; lens confluent with hilum, recessed, within halo; cotyledons inner face wrinkled ..... *Tephrosia,* Millettieae
Hilum within rim; lens adjacent to hilum, mounded or flush, not within halo or within rim; cotyledons inner face wavy or with central ridge on 1 and central groove on other 96

96. Lens brown; cotyledons with both folded, partially concealing radicle; radicle linear ..... *Pongamiopsis,* Millettieae
Lens red; cotyledons not folded, not concealing radicle; radicle bulbose 97

97. Lens not within rim; endosperm thick or thin, covering entire embryo; cotyledons inner face with central ridge on 1 and central groove on other ..... *Bowdichia*, 2.28
Lens within rim; endosperm trace, restricted to region of embryo; cotyledons inner face wavy ..... *Ormosia*, 2.15

98. Cotyledons pink, white, or yellow 99
Cotyledons brown, green, or tan 104

99. Lens within corona or rim 100
Lens not within corona or rim 101

100. Hilum rim color darker than testa; lens brown, confluent with hilum, within corona; cotyledons partially concealing radicle ..... *Pueraria*, 10.32
Hilum rim color same as testa; lens red, adjacent to hilum, within rim; cotyledons not concealing radicle ..... *Ormosia*, 2.15

101. Plumule moderately or well developed 102
Plumule rudimentary 103

102. Lens oblong or ovate; cotyledons white .. *Vigna*, 10.66
Lens circular, elliptic, or linear; cotyledons pink or yellow ..... *Sphenostylis*, 10.57

103. Testa black; hilum elliptic; lens linear; endosperm covering entire embryo; radicle linear ..... *Cochlianthus*, 10.08
Testa brown; hilum circular; lens diamond-shaped; endosperm restricted to region of embryo; radicle bulbose ..... *Salweenia*, 2.42

104. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 105

105. Hilum visible 106
Hilum partially or fully concealed 109

106. Lens linear 107
Lens circular 108

107. Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; endosperm restricted to region of embryo; radicle bulbose or triangular ..... *Dioclea*, 10.18
Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; endosperm covering entire embryo or at least 1/2 of embryo, but not entire embryo; radicle linear ..... *Lonchocarpus,* Millettieae

108. Seed 4.7–11.6 mm long, without hilar sinus; hilum raised; lens mounded or flush, within halo; plumule moderately or well developed ... *Centrosema*, 10.14
Seed 12–35 mm long, with shallow hilar sinus; hilum recessed; lens recessed, within rim; plumule rudimentary ..... *Pongamia,* Millettieae

109. Cotyledons green; hilum marginal according to radicle tip ..... *Pueraria*, 10.32
Cotyledons brown or tan; hilum apical at apex of radicle tip, subapical to radicle tip, or apical according to radicle tip but marginal according to seed length 110

110. Seed with shallow hilar sinus; hilum concealed by funicular remnant, within rim ..... *Pongamia,* Millettieae
Seed without hilar sinus; hilum concealed by aril, funiculus, or radicle lobe, not within rim or within corona or halo 111

111. Seed with visible radicle and cotyledon lobes; hilum concealed by radicle lobe; lens diamond-shaped ..... *Salweenia*, 2.42
Seed without visible radicle and cotyledon lobes; hilum concealed by aril or funiculus; lens linear or triangular 112

112. Rim-aril entire; fruit indehiscent ..... *Derris,* Millettieae
Rim-aril 2-lipped; fruit with all layers dehiscing ..... *Baphia*, 2.18

113. Aril fimbriate; cotyledons with lobes not touching, inner faces with central ridge on one and central groove on other; fruit without wings ..... *Acosmium,* 2.01
Aril entire; cotyledons with lobes touching (auriculate), inner faces flot or concave; fruit with wings ..... *Derris,* Millettieae

Seed Key 7: Aril present; dry. Cotyledons notched at radicle. Endosperm absent.

1. Cotyledons not concealing radicle 2
Cotyledons completely or partially concealing radicle 21

2. Radicle lobe tip curved 3
Radicle lobe tip straight 9

3. Cotyledons green or tan 4
Cotyledons white or yellow 6

4. Seed 1.8–2.2 mm long, circular or terete; hilum within halo; radicle with 90-degree turn, 1/2 to nearly length of cotyledons ..... *Requienia,* Millettieae
Seed 4–15 mm long, elliptic, irregular, or reniform, compressed or flattened; hilum within rim; radicle oblique to cotyledons, less than 1/2 length of cotyledons 5

5. Seed elliptic or reniform; hilum visible, elliptic; lens circular; cotyledons tan ..... *Piscidia,* Millettieae
Seed irregular; hilum partially concealed, circular; lens wedge-shaped; cotyledons green ..... *Neoharmsia*, 2.34

6. Aril tan; hilum flush; lens adjacent to hilum, flush ..... *Cyathostegia*, 1.14
Aril cream or white; hilum recessed; lens confluent with hilum, mounded or recessed 7

7. Plumule moderately or well developed; cotyledons with margins recessed ..... *Vigna*, 10.66
Plumule rudimentary; cotyledons without margins recessed 8

8. Testa green or tan; seed with shallow hilar sinus; lens less than 0.5 mm in length, mounded ..... *Mundulea,* Millettieae
Testa brown; seed without hilar sinus; lens equal to or greater than 0.5 mm in length, recessed ..... *Dicraeopetalum*, 2.33

9. Cotyledons with lobes 10
Cotyledons without lobes 12

10. Seed ca. 20 mm long, flattened; testa black; cotyledons with both outer faces flat; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Panurea*, 2.30
Seed 2–18 mm long, terete or compressed; testa brown, cream, red, tan, or white; cotyledons with both outer faces convex; embryonic axis without a joint evident between the radicle and the cotyledons 11

11. Cotyledons not sufficiently folded for inner face to touch itself, white ..... *Vigna*, 10.66
Cotyledons sufficiently folded for inner face to touch itself, brown, green, tan, or yellow ... *Sophora*, 2.45

12. Plumule rudimentary 13
Plumule moderately or well developed 15

13. Rim-aril entire or partial or tongue-aril, tan or white; seed with shallow hilar sinus; testa chartaceous ..... *Wisteria,* Millettieae
Rim-aril hippocrepiform or 2-lipped, cream; seed without hilar sinus; testa coriaceous 14

14. Rim-aril hippocrepiform; seed symmetrical; hilum fully concealed, with curved outline; radicle with 90-degree turn ..... *Otoptera*, 10.56
Rim-aril 2-lipped; seed asymmetrical; hilum visible or partially concealed, with straight outline; radicle oblique to cotyledons, with 180-degree turn, or straight with embryonic axis .... *Physostigma*, 10.52

15. Lens not within corona or rim 16
Lens within corona or rim 18

16. Hilum flush; lens circular, elliptic, or linear ..... *Sphenostylis*, 10.57
Hilum recessed; lens oblong, ovate, or triangular 17

17. Aril cream; hilum visible or fully concealed; cotyledons white ..... *Vigna*, 10.66
Aril tan or white; hilum partially concealed; cotyledons tan or yellow ..... *Wisteria,* Millettieae

18. Seed with shallow hilar sinus; aril tan or white; lens mounded ..... *Wisteria,* Millettieae
Seed without hilar sinus; aril cream; lens flush or recessed 19

19. Hilum with the lips of the faboid split the same color as the rest of the hilum, not within halo or rim or within corona; cotyledons tan, white, or yellow ..... *Dolichos*, 10.64
Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, within halo or rim; cotyledons brown 20

20. Seed 5.5–9.5 mm long, compressed or flattened; tongue-aril; hilum within rim; lens darker than testa; radicle linear ..... *Ramirezella*, 10.66A
Seed 35–39 mm long, mounded on 1 side and straight on other side; rim-aril; hilum within halo; lens lighter than testa; radicle bulbose ..... *Castanospermum*, 2.12

21. Testa osseous or coriaceous 22
Testa chartaceous 51

22. Hilum raised or flush 23
Hilum recessed 32

23. Hilum with curved outline 24
Hilum with straight outline 28

24. Radicle linear; epicarp glandular; funiculus hooked ..... *Cajanus*, 10.73
Radicle bulbose or triangular; epicarp eglandular; funiculus contorted, curved, straight, or triangular 25

25. Radicle lobe tip curved 26
Radicle lobe tip straight 27

26. Embryonic axis right angled or straight to seed length; seed length transverse to fruit length ..... *Mucuna*, 10.03
Embryonic axis oblique to seed length; seed length parallel with fruit length ..... *Erythrina*, 10.01

27. Rim-aril 2-lipped; fruit quadrangular; epicarp warty ..... *Psophocarpus*, 10.51
Rim-aril partial (not 2-lipped) or tongue-aril; fruit compressed or terete; epicarp muricate or wrinkled ..... *Erythrina*, 10.01

28. Radicle triangular; endocarp septate or nonseptate 29
Radicle bulbose or linear; endocarp subseptate 30

29. Testa dull; cotyledons smooth, brown or tan; radicle lobe tip curved ..... *Mucuna*, 10.03
Testa glossy; cotyledons not smooth, yellow; radicle lobe tip straight ..... *Afgekia,* Millettieae

30. Plumule rudimentary; cotyledons with margins recessed ..... *Oxyrhynchus*, 10.68
Plumule well developed; cotyledons without margins recessed 31

31. Aril cream; hilum fully concealed; cotyledons margin entire 180 degrees from base of radicle ..... *Strophostyles*, 10.70
Aril tan; hilum visible; cotyledons margin not entire 180 degrees from base of radicle ..... *Canavalia*, 10.21

32. Radicle linear or triangular 33
Radicle bulbose 40

33. Radicle triangular 34
Radicle linear 37

34. Lens black ..... *Erythrina*, 10.01
Lens brown or red 35

35. Hilum within corona; lens less than 0.5 mm in length, within corona ..... *Austrodolichos*, 10.59
Hilum not within corona or within halo or rim; lens equal to or greater than 0.5 mm in length, not within corona or within rim 36

36. Hilum visible or fully concealed; lens mounded, oblong or ovate ..... *Vigna*, 10.66
Hilum partially concealed; lens flush, linear ..... *Amphicarpaea*, 10.44

37. Cotyledons pink or white 38
Cotyledons brown, green, tan, or yellow 39

38. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; lens mounded, oblong or ovate; cotyledons white ..... *Vigna*, 10.66
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; lens flush, linear; cotyledons pink ..... *Decorsea*, 10.54

39. Rim-aril not 2-lipped; testa bearing endocarp remnants; hilum within halo or rim ..... *Sophora*, 2.45
Rim-aril 2-lipped; testa not bearing endocarp; hilum not within halo or rim or within corona ..... *Baphia*, 2.18

40. Hilum within corona; cotyledons pubescent around base of radicle ..... *Alistilus*, 10.62
Hilum not within corona or within halo or rim; cotyledons glabrous around base of radicle 41

41. Cotyledons with lobes 42
Cotyledons without lobes 45

42. Cotyledons white 43
Cotyledons brown, green, tan, or yellow 44

43. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; testa smooth; hilum visible or fully concealed; lens not within rim ..... *Vigna*, 10.66
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; testa not smooth; hilum partially concealed; lens within rim ..... *Neorautanenia*, 10.60

44. Rim-aril hippocrepiform or 2-lipped, fimbriate ..... *Neorautanenia*, 10.60
Rim-aril entire ..... *Sophora*, 2.45

45. Cotyledons orange ..... *Dysolobium*, 10.50
Cotyledons tan, white, or yellow 46

46. Lens not within halo or rim 47
Lens within halo or rim 48

47. Lens brown or red ..... *Vigna*, 10.66
Lens black ..... *Erythrina*, 10.01

48. Aril fimbriate 49
Aril entire 50

49. Rim-aril hippocrepiform or 2-lipped; cotyledons completely concealing radicle ..... *Neorautanenia*, 10.60
Rim-aril partial (not 2-lipped) or tongue-aril; cotyledons partially concealing radicle ..... *Erythrina*, 10.01

50. Lens within rim; radicle with 90-degree turn or straight with embryonic axis ..... *Pachyrhizus*, 10.46
Lens within halo; radicle oblique to cotyledons or with 180-degree turn ..... *Erythrina*, 10.01

51. Plumule moderately or well developed 52
Plumule rudimentary 80

52. Hilum raised or flush 53
Hilum recessed 64

53. Testa minutely pubescent 54
Testa glabrous 55

54. Testa with 1 longitudinal ridge on each face; cotyledons yellow; radicle bulbose or triangular ..... *Psophocarpus*, 10.51
Testa rugose, veined, or wrinkled; cotyledons green or tan; radicle linear ..... *Callerya,* Millettieae

55. Cotyledons white or yellow 56
Cotyledons brown or tan 60

56. Lens flush 57
Lens mounded 58

57. Testa wrinkled; lens within corona or rim ..... *Dolichos*, 10.64
Testa with 1 longitudinal ridge on each face; lens not within corona or rim ..... *Psophocarpus*, 10.51

58. Aril fimbriate ..... *Phaseolus*, 10.72
Aril entire 59

59. Hilum oval; lens within rim; cotyledons white; radicle linear; radicle lobe tip curved ... *Mysanthus*, 10.72A
Hilum elliptic; lens not within rim; cotyledons yellow; radicle bulbose or triangular; radicle lobe tip straight ..... *Psophocarpus*, 10.51

60. Hilum not within halo or rim or within corona 61
Hilum within halo or rim 62

61. Fruit wings absent; fruit with all layers dehiscing; epicarp not veined, wrinkled; endocarp septate, without wings ..... *Dolichos*, 10.64
Fruit wings present; fruit indehiscent; epicarp veined, dotted; endocarp nonseptate, with wings extending into epicarp ..... *Derris,* Millettieae

62. Tongue-aril, fimbriate ..... *Phaseolus*, 10.72
Rim-aril 2-lipped or rim-aril, entire 63

63. Hilum concealed by funicular remnant; fruit wings absent; fruit with all layers dehiscing; epicarp not veined ..... *Fordia,* Millettieae
Hilum concealed by aril or funiculus; fruit wings present; fruit indehiscent; epicarp veined ..... *Derris,* Millettieae

64. Cotyledons white or yellow 65
Cotyledons brown, green, or tan 74

65. Radicle lobe tip straight 66
Radicle lobe tip curved 70

66. Cotyledons white 67
Cotyledons yellow 68

67. Lens circular or triangular ..... *Phaseolus*, 10.72
Lens oblong or ovate ..... *Vigna*, 10.66

68. Aril fimbriate; hilum fully concealed ..... *Phaseolus*, 10.72
Aril entire; hilum visible or partially concealed 69

69. Seed reniform; cotyledons without lobes; embryonic axis parallel to length of seed; radicle triangular, with 180-degree turn ..... *Eminia*, 10.29
Seed circular, elliptic, ovate, or rhombic; cotyledons with lobes; embryonic axis oblique to length of seed or perpendicular to length of seed; radicle bulbose or linear, oblique to cotyledons or with 90-degree turn ..... *Sophora*, 2.45

70. Lens circular, oblong, ovate, or triangular 71
Lens linear 72

71. Lens circular or triangular ..... *Phaseolus*, 10.72
Lens oblong or ovate ..... *Vigna*, 10.66

72. Lens recessed; cotyledons yellow; radicle bulbose ..... *Macrotyloma*, 10.65
Lens mounded or flush; cotyledons white; radicle linear or triangular 73

73. Hilum not within rim or within corona or halo; lens mounded; radicle linear ..... *Macroptilium*, 10.71
Hilum within rim; lens flush; radicle triangular ..... *Amphicarpaea*, 10.44

74. Aril fimbriate ..... *Phaseolus*, 10.72
Aril entire 75

75. Seed with deep hilar sinus; rim-aril hippocrepiform ..... *Platycyamus,* Millettieae
Seed without hilar sinus; rim-aril 2-lipped or tongue-aril 76

76. Testa bearing endocarp remnants ..... *Sophora*, 2.45
Testa rugose, veined, or wrinkled 77

77. Testa minutely pubescent; funiculus thick ..... *Callerya,* Millettieae
Testa glabrous; funiculus flattened 78

78. Testa mottled; hilum within rim ..... *Amphicarpaea*, 10.44
Testa bichrome or monochrome; hilum not within rim or within corona or halo 79

79. Rim-aril entire, not 2-lipped ..... *Derris,* Millettieae
Rim-aril 2-lipped ..... *Baphia*, 2.18

80. Hilum visible 81
Hilum partially concealed or fully concealed 89

81. Hilum within corona or halo 82
Hilum not within corona or halo or within rim 85

82. Cotyledons with lobes ..... *Sophora*, 2.45
Cotyledons without lobes 83

83. Aril tan; seed asymmetrical; lens flush, tan, triangular ..... *Ptycholobium,* Millettieae
Aril cream or white; seed symmetrical; lens mounded or recessed, brown, hourglass or linear 84

84. Hilum with the lips of the faboid split the same color as the rest of the hilum; lens recessed, within halo ..... *Tephrosia,* Millettieae
Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; lens mounded, not within halo ..... *Pyranthus,* Millettieae

85. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 86

86. Seed asymmetrical; radicle lobe tip curved 87
Seed symmetrical; radicle lobe tip straight 88

87. Seed ca. 4 mm long; aril fimbriate, tan; seed irregular; testa brown; lens linear; cotyledons tan ..... *Rhodopis*, 10.09
Seed 7.2–12.5 mm long; aril entire, white; seed reniform; testa tan; lens diamond-shaped; cotyledons white ..... *Maackia*, 2.40

88. Seed circular, elliptic, ovate, or rhombic; cotyledons with lobes ..... *Sophora*, 2.45
Seed reniform; cotyledons without lobes ..... *Sakoanala*, 2.35

89. Cotyledons inner face wavy or wrinkled 90
Cotyledons inner face flat or concave 92

90. Seed 24.5–26 mm long; aril brown; hilum within rim; lens oblong; cotyledons with lobes, brown ..... *Dewevrea,* Millettieae
Seed 3–12 mm long; aril cream or ivory; hilum not within rim or within corona; lens linear; cotyledons without lobes, green, tan, white, or yellow 91

91. Aril entire; hilum within corona; cotyledons green, white, or yellow, inner face wrinkled; radicle bulbose or linear ..... *Tephrosia,* Millettieae
Aril fimbriate; hilum not within corona; cotyledons tan, inner face wavy; radicle triangular ..... *Airyantha*, 2.19

92. Hilum raised or flush 93
Hilum recessed 97

93. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 94

94. Cotyledons white ..... *Spathionema*, 10.55
Cotyledons brown or tan 95

95. Seed terete or quadrangular; hilum apical at apex of radicle tip ..... *Neorudolphia*, 10.10
Seed compressed or flattened; hilum apical according to radicle tip but marginal according to seed length 96

96. Hilum concealed by funicular remnant; fruit wings absent; fruit with all layers dehiscing; epicarp not veined ..... *Fordia,* Millettieae
Hilum concealed by aril or funiculus; fruit wings present; fruit indehiscent; epicarp veined ..... *Derris,* Millettieae

97. Testa minutely pubescent ..... *Callerya,* Millettieae
Testa glabrous 98

98. Aril fimbriate ..... *Amphimas*, 2.11
Aril entire 99

99. Rim-aril 2-lipped ..... *Baphia*, 2.18
Rim-aril not 2-lipped 100

100. Testa glaucous; lens diamond-shaped ..... *Pericopsis*, 2.17
Testa dull or glossy; lens linear, oblong, or triangular 101

101. Testa mottled, glossy; hilum circular; lens oblong ..... *Behaimia,* Millettieae
Testa monochrome, dull; hilum elliptic or oval; lens linear or triangular 102

102. Testa not bearing endocarp remnants; hilum concealed by aril or funiculus ..... *Derris,* Millettieae
Testa bearing endocarp remnants; hilum concealed by funicular remnant ..... *Sophora*, 2.45

Seed Key 8: Aril present; dry. Cotyledons split over radicle. Hilum raised or flush.

1. Cotyledons without lobes 2
Cotyledons with lobes 15

2. Testa chartaceous 3
Testa osseous or coriaceous 10

3. Radicle lobe tip curved 4
Radicle lobe tip straight 6

4. Rim-aril 2-lipped; hilum visible, raised, within rim ..... *Galactia*, 10.27
Rim-aril hippocrepiform or rim-aril; hilum partially concealed or fully concealed, flush or recessed, within halo or not within rim 5

5. Rim-aril hippocrepiform; cotyledons white or yellow; radicle deflexed and parallel to cotyledon length ..... *Pseudoeriosema*, 10.12
Rim-aril; cotyledons brown or tan; radicle oblique to cotyledons or with 90-degree turn ..... *Derris,* Millettieae

6. Cotyledons 1 thicker than the other; lens elliptic ..... *Clitoria*, 10.16
Cotyledons both the same thickness; lens linear, oblong, or triangular 7

7. Radicle linear or triangular 8
Radicle bulbose 9

8. Testa mottled; hilum visible, with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, with straight outline ..... *Collaea*, 10.26
Testa monochrome; hilum partially or fully concealed, with the lips of the faboid split the same color as the rest of the hilum, with curved outline ..... *Derris,* Millettieae

9. Rim-aril hippocrepiform, 2-lipped rim-aril, partial rim-aril, or tongue-aril; fruit with all layers dehiscing; epicarp not veined, epicarp lenticular, rugose, or verrucose-rugose ..... *Millettia,* Millettieae
Rim-aril; fruit indehiscent; epicarp veined, epicarp dotted ..... *Derris,* Millettieae

10. Plumule rudimentary 11
Plumule moderately or well developed 12

11. Seed 5–48 mm long; rim-aril 2-lipped; hilum larger than punctiform; cotyledons yellow; radicle centered between cotyledons, less than 1/2 length of cotyledons ..... *Physostigma*, 10.52
Seed 3–4 mm long; tongue-aril; hilum punctiform; cotyledons tan; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), 1/2 to nearly length of cotyledons ..... *Cyamopsis*, 9.06

12. Hilum with straight outline 13
Hilum with curved outline 14

13. Aril entire or fimbriate; testa dull; fracture lines absent; cotyledons margin not entire 180 degrees from base of radicle; radicle bulbose or linear ..... *Canavalia*, 10.21
Aril crenate; testa glossy; fracture lines present; cotyledons margin entire 180 degrees from base of radicle; radicle triangular ..... *Cymbosema*, 10.19

14. Cotyledons 1 thicker than the other; embryonic axis deflexed, right angled, or straight; mesocarp 3-layered; endocarp white, scurfy ..... *Clitoria*, 10.16
Cotyledons both the same thickness; embryonic axis oblique; mesocarp 1-layered or 2-layered; endocarp brown or tan, smooth ..... *Erythrina*, 10.01

15. Testa chartaceous 16
Testa osseous or coriaceous 22

16. Radicle bulbose 17
Radicle linear or triangular 18

17. Seed D-shaped; hilum punctiform; lens circular; cotyledons not concealing radicle, with lobes not touching ..... *Fiebrigiella*, 14.06
Seed elliptic, ovate, or reniform; hilum larger than punctiform; lens linear or triangular; cotyledons partially concealing radicle, with lobes touching (auriculate) ..... *Derris,* Millettieae

18. Hilum within rim; cotyledons margin not entire 180 degrees from base of radicle, with lobes not touching, inner face wrinkled ..... *Dewevrea,* Millettieae
Hilum within corona or halo or not within rim; cotyledons margin entire 180 degrees from base of radicle, with lobes touching (auriculate), inner face flat, concave, or glandular dotted (with yellow latex-like substance inside) 19

19. Testa mottled 20
Testa monochrome 21

20. Seed 6–8 mm long; aril ivory; testa not smooth; hilum within corona; radicle linear; plumule moderately developed ..... *Vatovaea*, 10.53
Seed 15–20 mm long; aril tan; testa smooth; hilum within halo; radicle triangular; plumule rudimentary ..... *Antheroporum,* Millettieae

21. Hilum flush or recessed; fruit not inflated, chartaceous or coriaceous, indehiscent; fruit wings present ..... *Derris,* Millettieae
Hilum raised; fruit inflated, ligneous, with all layers dehiscing; fruit wings absent ..... *Antheroporum,* Millettieae

22. Radicle bulbose 23
Radicle linear 28

23. Cotyledons margin not entire 180 degrees from base of radicle; plumule well developed ..... *Canavalia*, 10.21
Cotyledons margin entire 180 degrees from base of radicle; plumule rudimentary or moderately developed 24

24. Endosperm thick 25
Endosperm thin 26

25. Lens not discernible; seed with visible radicle and cotyledon lobes; fruit with the raised seed chambers not torulose, indehiscent ..... *Nissolia*, 14.08
Lens discernible; seed without visible radicle and cotyledon lobes; fruit with the raised seed chambers torulose, with all layers dehiscing .... *Sesbania*, 8.01

26. Hilum with straight outline; cotyledons completely concealing or not concealing radicle, brown, green, or tan; lens rhombic ..... *Gliricidia*, 8.06
Hilum with curved outline; cotyledons partially concealing radicle, red or yellow; lens circular, irregular, linear, or wedge-shaped 27

27. Seed elliptic or oblong; hilum elliptic; cotyledons with lobes touching (auriculate), cotyledons yellow; plumule moderately developed ..... *Hovea*, 23.04
Seed circular, D-shaped, quadrangular, or reniform; hilum circular; cotyledons with lobes not touching, cotyledons red; plumule rudimentary ..... *Humularia*, 14.15

28. Plumule moderately or well developed 29
Plumule rudimentary 31

29. Seed elliptic, oblong, or ovate; testa brown or ivory; hilum larger than punctiform; cotyledons margin not entire 180 degrees from base of radicle; lens linear ..... *Canavalia*, 10.21
Seed C-shaped or rhombic; testa tan; hilum punctiform; cotyledons margin entire 180 degrees from base of radicle; lens oblong or wedge-shaped 30

30. Seed 3–3.5 mm long, rhombic; hilum visible; endosperm absent; cotyledons with lobes overlapping; lens wedge-shaped ..... *Pachecoa*, 14.23
Seed 5–5.3 mm long, C-shaped; hilum fully concealed; endosperm present; cotyledons with lobes not touching; lens oblong ..... *Pictetia*, 14.05

31. Tongue-aril; cotyledons with both folded, differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), 1/2 to nearly length of cotyledons ..... *Cyamopsis*, 9.06
Rim-aril; cotyledons not folded, similar at apex; radicle centered between cotyledons, less than 1/2 length of cotyledons 32

32. Seed 1.2–1.8 mm long; aril tan; cotyledons yellow ..... *Sphaerolobium*, 24.02
Seed 2–4.7 mm long; aril white or yellow; cotyledons brown, green, red, or tan 33

33. Aril white; hilum partially concealed or fully concealed; endosperm present; cotyledons brown, green, or tan; lens circular ..... *Isotropis*, 24.06
Aril yellow; hilum visible; endosperm absent; cotyledons red; lens linear ..... *Kotschya*, 14.11

Seed Key 9: Aril present; dry. Cotyledons split over radicle. Hilum recessed.

1. Cotyledons completely or partially concealing radicle 2
Cotyledons not concealing radicle 36

2. Testa osseous or coriaceous 3
Testa chartaceous 17

3. Hilum punctiform 4
Hilum larger than punctiform 8

4. Seed symmetrical; cotyledons white; embryonic axis straight, parallel to length of seed 5
Seed asymmetrical; cotyledons brown, green, tan, or yellow; embryonic axis deflexed, oblique to length of seed 6

5. Seed 12–13 mm long, with umbo on seed faces; testa brown; hilum visible, not within rim; endosperm present ..... *Ramorinoa*, 4.11
Seed 8.5–9.5 mm long, without umbo on seed faces; testa black or tan; hilum partially or fully concealed, within rim; endosperm absent ..... *Pterodon*, 3.03

6. Radicle lobe tip straight; lens irregular, linear, or oblong 80
Radicle lobe tip curved or hooked; lens circular or elliptic 7

7. Tongue-aril; hilum partially concealed, not within rim; radicle lobe tip hooked; radicle deflexed and parallel to cotyledon length ..... *Jacksonia*, 24.08
Rim-aril; hilum visible, within rim; radicle lobe tip curved; radicle deflexed and parallel to cotyledon width ..... *Amorpha*, 6.04

8. Testa color modified by a bloom 9
Testa color not modified by a bloom 10

9. Aril cream; testa dull; plumule moderately or well developed; lens oblong or ovate ..... *Vigna*, 10.66
Aril brown; testa glaucous; plumule rudimentary; lens linear ..... *Dumasia*, 10.42

10. Cotyledons white 11
Cotyledons brown, green, tan, or yellow 12

11. Lens brown or red ..... *Vigna*, 10.66
Lens black ..... *Erythrina*, 10.01

12. Rim-aril 2-lipped; hilum without faboid split ..... *Baphia*, 2.18
Rim-aril partial (not 2-lipped) or tongue-aril; hilum with faboid split 13

13. Hilum with straight outline; endocarp spongy ..... *Gliricidia*, 8.06
Hilum with curved outline; endocarp scurfy or smooth 14

14. Hilum elliptic or oval; embryonic axis oblique or right angled; seeds with length parallel with fruit length 15
Hilum circular; embryonic axis deflexed or straight; seeds with length transverse to fruit length 16

15. Cotyledons without lobes ..... *Erythrina*, 10.01
Cotyledons with lobes ..... *Sophora*, 2.45

16. Seed ca. 6.3 mm long; aril fimbriate; endosperm absent; embryonic axis straight; radicle lobe tip curved ..... *Mastersia*, 10.38
Seed 3–5 mm long; aril entire; endosperm present; embryonic axis deflexed; radicle lobe tip straight ..... *Poitea*, 8.05

17. Hilum apical at apex of radicle tip or subapical to radicle tip 18
Hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip 22

18. Testa glaucous; hilum within halo; lens diamond-shaped ..... *Pericopsis*, 2.17
Testa dull or glossy; hilum not within halo or within corona or rim; lens linear, oblong, or triangular . 19

19. Radicle bulbose ..... *Millettia,* Millettieae
Radicle linear 20

20. Hilum visible; cotyledons green or yellow ..... *Ammodendron*, 2.46
Hilum partially or fully concealed; cotyledons tan .. 21

21. Seed 10–25 mm long; rim-aril 2-lipped; hilum not within rim or within corona ..... *Baphia*, 2.18
Seed 5–9.5 mm long; rim-aril not 2-lipped or tongue-aril; hilum within rim ..... *Cadia*, 2.36

22. Radicle deflexed and parallel to cotyledon length or width 23
Radicle oblique to cotyledons or with 90- or 180-degree turn 27

23. Cotyledons orange; plumule well developed ..... *Meizotropis*, 10.06
Cotyledons tan, white, or yellow; plumule rudimentary or moderately developed 24

24. Rim-aril hippocrepiform ..... *Pseudoeriosema*, 10.12
Rim-aril 2-lipped or tongue-aril 25

25. Seed 10–25 mm long, circular, elliptic, or irregular; endocarp brown, gray, or purple ..... *Baphia*, 2.18
Seed 4.6–8.3 mm long, obovate, ovate, rectangular, or reniform; endocarp tan or white 26

26. Seed 4.6–5.6 mm long; aril white; hilum within halo; endosperm present; cotyledons not smooth ..... *Neonotonia*, 10.40
Seed 6.4–8.3 mm long; aril brown or tan; hilum not within halo or within rim; endosperm absent; cotyledons smooth ..... *Apios*, 10.07

27. Cotyledons white 28
Cotyledons brown, green, orange, tan, or yellow 29

28. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; lens mounded ..... *Vigna*, 10.66
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; lens flush ..... *Millettia,* Millettieae

29. Testa mottled ..... *Diphyllarium*, 10.37
Testa bichrome or monochrome 30

30. Rim-aril hippocrepiform, rim-aril 2-lipped, or tongue-aril 31
Rim-aril not 2-lipped or rim-aril partial 33

31. Radicle bulbose ..... *Millettia,* Millettieae
Radicle linear or triangular 32

32. Seed 6.4–8.3 mm long, obovate, ovate, rectangular, or reniform; fruit terete; endocarp white, septate *Apios*,10.07
Seed 10–25 mm long, circular, elliptic, or irregular; fruit compressed or flattened; endocarp brown, gray, or purple, nonseptate ..... *Baphia*, 2.18

33. Testa bearing endocarp remnants; fruit long tapered at base ..... *Sophora*, 2.45
Testa wrinkled; fruit rounded, tapered, or short tapered at base 34

34. Lens circular; seed length parallel with fruit length ..... *Pongamia,* Millettieae
Lens linear, oblong, or triangular; seed length oblique or transverse to fruit length 35

35. Rim-aril partial; fruit with all layers dehiscing; epicarp not veined, lenticular, rugose, or verrucose-rugose ..... *Millettia,* Millettieae
Rim-aril entire; fruit indehiscent; epicarp veined, dotted ..... *Derris,* Millettieae

36. Hilum punctiform 37
Hilum larger than punctiform 54

37. Endosperm absent ..... *Amicia,* 14.19
Endosperm present 38

38. Endosperm thin 39
Endosperm thick 45

39. Seed rim present 40
Seed rim absent 41

40. Testa glossy; hilum between cotyledon and radicle lobe; cotyledons brown; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Gonocytisus*, 30.20
Testa dull; hilum apical at apex of or subapical to radicle tip; cotyledons tan; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Coursetia*, 8.08

41. Hilum not within corona, halo, or rim 42
Hilum within rim 43

42. Seed 3–5 mm long; testa coriaceous; plumule rudimentary or moderately developed ..... *Poitea*, 8.05
Seed 17–20 mm long; testa osseous; plumule well developed ..... *Hebestigma*, 8.02

43. Seed 5–10 mm long; testa dull; cotyledons brown; radicle less than 1/2 length of cotyledons; plumule moderately developed ..... *Hybosema*, 8.04
Seed 1.5–4.2 mm long; testa glossy; cotyledons tan, white, or yellow; radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons; plumule rudimentary 44

44. Seed overgrown, mitaform, mounded on one side and straight on the other; outer face of one cotyledon flat and convex, one thicker than the other ..... *Adesmia,* 15.01
Seed not overgrown, with shape variable but not mitaform, terete, or compressed; cotyledons both outer faces convex, both the same thinkness 45

45. Fruit 2–9 times longer than wide, with persistent calyx ..... *Genista*, 30.22
Fruit more than 9 times longer than wide, with deciduous calyx ..... *Spartium*, 30.19

46. Hilum partially concealed or fully concealed 47
Hilum visible 50

47. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons; fruit rounded, tapered, or short tapered at apex 48
Radicle less than 1/2 length of cotyledons; fruit long tapered at apex 49

48. Hilum concealed by funiculus or funicular remnant; lens elliptic or oblong ..... *Genista*, 30.22
Hilum concealed by aril; lens circular or triangular ..... *Adenocarpus*, 30.05

49. Testa color modified by a bloom, black; hilum concealed by funicular remnant, within rim; embryonic axis parallel to length of seed ..... *Pickeringia*, 29.06
Testa color not modified by a bloom, brown; hilum concealed by radicle lobe or wing, not within rim; embryonic axis oblique to length of seed ..... *Jacksonia*, 24.08

50. Cuticle wrinkled; plumule moderately developed ..... *Echinospartum*, 30.23
Cuticle not wrinkled; plumule rudimentary 51

51. Hilum within halo; cotyledons brown; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) ..... *Erinacea*, 30.18
Hilum within rim; cotyledons tan, white, or yellow; radicle centered between cotyledons 52

52. Cotyledons not smooth ..... *Argyrolobium*, 30.03
Cotyledons smooth 53

53. Fruit without beak, coriaceous; mesocarp coriaceous ..... *Genista*, 30.22
Fruit with beak, ligneous; mesocarp ligneous ..... *Calicotome*, 30.17

54. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 55
Radicle less than 1/2 length of cotyledons 68

55. Endosperm thin 56
Endosperm thick 59

56. Hilum not within halo or rim 57
Hilum within halo or rim 58

57. Rim-aril; lens circular or elliptic ..... *Lupinus*, 30.08
Tongue-aril; lens irregular, linear, or oblong ..... *Poitea*, 8.05

58. Endocarp scurfy or smooth; seeds in 1 series ..... *Genista*, 30.22
Endocarp spongy; seeds in 2 or more series ..... *Lupinus*, 30.08

59. Seed symmetrical; hilum with straight outline ..... *Petteria*, 30.13
Seed asymmetrical; hilum with curved outline 60

60. Hilum partially or fully concealed 61
Hilum visible 64

61. Hilum elliptic or oval; hilum rim color lighter than testa or darker than testa 62
Hilum circular; hilum rim color of testa 64

62. Seed 2–3 mm long; aril brown, cream, ivory, or tan; lens key-hole shaped or oblong, same or similar color as testa, brown; cotyledons tan .... *Ulex*, 30.25
Seed 3.5–4 mm long; aril white; lens linear, dissimilar color from testa, tan; cotyledons yellow ..... *Argyrocytisus*, 30.14

63. Hilum concealed by funiculus or funicular remnant; lens elliptic or oblong ..... *Genista*, 30.22
Hilum concealed by aril; lens circular or triangular ..... *Adenocarpus*, 30.05

64. Cotyledons not smooth ..... *Argyrolobium*, 30.03
Cotyledons smooth 65

65. Testa glossy 66
Testa dull 67

66. Fruit without beak, coriaceous; mesocarp coriaceous ..... *Genista*, 30.22
Fruit with beak, ligneous; mesocarp ligneous ..... *Calicotome*, 30.17

67. Fruit with beak, ligneous; mesocarp ligneous; funiculus filiform ..... *Calicotome*, 30.17
Fruit without beak, chartaceous or coriaceous; mesocarp coriaceous; funiculus triangular ..... *Cytisus*, 30.15

68. Embryonic axis oblique, parallel, right angled, or straight 69
Embryonic axis deflexed 73

69. Cotyledons white ..... *Vigna*, 10.66
Cotyledons brown, green, tan, or yellow 70

70. Rim-aril 2-lipped or tongue-aril; cotyledons without lobes 71
Rim-aril not 2-lipped; cotyledons with lobes 72

71. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril, cream; testa coriaceous; hilum with straight outline ..... *Physostigma*, 10.52
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril, brown or tan; testa chartaceous; hilum with curved outline ..... *Apios*, 10.07

72. Seed 3–17 mm long; aril entire; seed terete or compressed; testa brown, red, or tan; cotyledons with basal groin formed by lobes; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Sophora*, 2.45
Seed ca. 20 mm long; aril crenate; seed flattened; testa black; cotyledons without basal groin formed by lobes; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Panurea*, 2.30

73. Tongue-aril; lens irregular, linear, oblong, or rhombic 74
Rim-aril; lens circular or elliptic 75

74. Seed 5.5–12 mm long; hilum with straight outline; lens rhombic ..... *Gliricidia*, 8.06
Seed 3–5 mm long; hilum with curved outline; lens irregular, linear, or oblong ..... *Poitea*, 8.05

75. Radicle bulbose 76
Radicle linear or triangular 77

76. Seed 1.6–3 mm long; hilum oval, within rim; lens less than 0.5 mm in length, confluent with hilum ..... *Gompholobium*, 24.01
Seed 4–6 mm long; hilum circular, within halo; lens equal to or greater than 0.5 mm in length, adjacent to hilum ..... *Robinia*, 8.07

77. Aril white; endosperm thin ..... *Lupinus*, 30.08
Aril brown or tan; endosperm thick 78

78. Hilum partially or fully concealed, oval, within rim; cotyledons orange or yellow ..... *Chorizema,* 24.10
Hilum visible, circular, within halo or not within rim; cotyledons tan 79

79. Testa monochrome; seed rim present; hilum not within halo; radicle deflexed and parallel to cotyledon width ..... *Viminaria*, 24.03
Testa mottled or streaked; seed rim absent; hilum within halo; radicle deflexed and parallel to cotyledon length ..... *Callistachys*, 24.12

80. Seed 3–5 mm long; endosperm thin; cotyledons margin entire 180 degrees from radicle base, brown, green, or tan; fruit a legume ..... *Poitea,* 8.05
Seed 1 mm long; endosperm thick; cotyledons margin not entire 180 degrees from radicle base, yellow; fruit a loment (or a loment segment) ..... *Soemmeringia,* 14.10

Seed Key 10: Aril absent. Cotyledons entire over radicle. Endosperm absent.

1. Seed symmetrical 2
   Seed asymmetrical 10

2. Seed with surface wrinkled 3
   Seed with surface smooth 4

3. Seed 8.9–16 mm long, circular, terete; testa free from endocarp; cotyledons completely concealing radicle, brown or yellow ..... *Holocalyx*, 1.12
   Seed ca. 23 mm long, elliptic, compressed; testa fused to endocarp, at most a transparent brown tissue; cotyledons not concealing radicle, tan ..... *Myrocarpus*, 2.05

4. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous 5
   Hilum with the lips of the faboid split the same color as the rest of the hilum 7

5. Cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon width; plumule well developed ..... *Lathyrus*, 19.02
   Cotyledons completely or partially concealing radicle; radicle deflexed and parallel to cotyledon length or straight with embryonic axis; plumule rudimentary 6

6. Seed 4–5 mm long, compressed; cotyledons partially concealing radicle; embryonic axis perpendicular to length of seed; radicle triangular *Vavilovia*, 19.05
   Seed 20–80 mm long, terete; cotyledons completely concealing radicle; embryonic axis oblique or parallel to length of seed; radicle linear ..... *Andira*, 4.04

7. Seed elliptic, ovate, or rhombic 8
   Seed circular or oblong 9

8. Cotyledons without margins recessed; fruit linear, with epicarp and mesocarp dehiscing and endocarp not dehiscing; endocarp separating into 1-seeded winged segments ..... *Endosamara,* Millettieae
   Cotyledons with margins recessed; fruit coiled or moniliform, with all layers dehiscing, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscing along suture; endocarp entire ..... *Sophora*, 2.45

9. Seed 20–80 mm long; testa not bearing endocarp remnants; cotyledons without lobes; embryonic axis deflexed or straight; radicle deflexed and parallel to cotyledon length or straight with embryonic axis ..... *Andira*, 4.04
   Seed 3–17 mm long; testa bearing endocarp remnants; cotyledons with lobes; embryonic axis oblique or right angled; radicle oblique to cotyledons or with 90-degree turn ..... *Sophora*, 2.45

10. Seed with visible radicle and cotyledon lobes 11
    Seed without visible radicle and cotyledon lobes 17

11. Hilum punctiform; raphe visible 12
    Hilum larger than punctiform; raphe not visible 14

12. Seed ca. 8 mm long, with surface grooved; testa chartaceous; raphe raised; hilum flush, within rim ..... *Tipuana*, 4.13
    Seed 5–6 or ca. 17 mm long, with surface smooth; testa coriaceous; raphe recessed; hilum recessed, not within rim 13

13. Seed 5–6 mm long; testa smooth; raphe from hilum through lens to base of seed and terminating; hilum visible; lens discernible ..... *Cascaronia*, 4.16
    Seed ca. 17 mm long; testa not smooth; raphe from hilum to near base of seed and terminating; hilum fully concealed; lens not discernible ..... *Platypodium*, 4.14

14. Testa chartaceous 15
    Testa coriaceous 16

15. Seed ca. 8 mm long, flattened; cotyledons not concealing radicle, red; radicle bulbose; radicle lobe tip curved ..... *Discolobium*, 14.17
    Seed ca. 1.4 mm long, compressed; cotyledons partially concealing radicle, brown; radicle linear; radicle lobe tip straight ..... *Paramachaerium*, 4.10

16. Seed mitaform, oblong, rhombic, or triangular; testa dull; seed rim absent; lens within rim ..... *Medicago*, 21.05
    Seed ovate or reniform; testa glossy; seed rim present; lens not within rim ..... *Desmodiastrum*, 11.18A

17. Cotyledons not smooth 18
    Cotyledons smooth 24

18. Cotyledons not concealing radicle 19
    Cotyledons completely or partially concealing radicle 20

19. Lens mounded or recessed; radicle deflexed and parallel to cotyledon width ..... *Lathyrus*, 19.02
Lens flush; radicle deflexed and parallel to cotyledon length ..... *Desmodium*, 11.09

20. Plumule moderately or well developed; endocarp coriaceous 21
Plumule rudimentary; endocarp chartaceous 22

21. Seed irregular; testa present; cotyledons margin not entire 180 degrees from base of radicle; embryonic axis with a joint evident between the radicle and the cotyledons; radicle linear ....*Spatholobus*, 10.05
Seed ovate or reniform; testa absent; cotyledons margin entire 180 degrees from base of radicle; embryonic axis without a joint evident between the radicle and the cotyledons; radicle triangular ..... *Cordyla*, 1.06

22. Seed flattened, with surface grooved; embryonic axis straight, perpendicular to length of seed; radicle linear ..... *Etaballia*, 2.09
Seed terete or compressed, with surface smooth; embryonic axis deflexed or parallel, oblique or parallel to length of seed; radicle triangular or truncate 23

23. Seed with umbo on seed faces; testa coriaceous; hilum flush; radicle truncate, deflexed and parallel to cotyledon width ..... *Phylloxylon*, 9.01
Seed without umbo on seed faces; testa chartaceous; hilum recessed; radicle triangular, straight with embryonic axis ..... *Swartzia*, 1.01

24. Hilum punctiform 25
Hilum larger than punctiform 32

25. Hilum recessed 26
Hilum flush 29

26. Lens not discernible; cotyledons completely or partially concealing radicle; embryonic axis parallel to length of seed; radicle triangular, straight with embryonic axis ..... *Swartzia*, 1.01
Lens discernible; cotyledons not concealing radicle; embryonic axis oblique to length of seed; radicle linear, deflexed and parallel to cotyledon length or oblique to cotyledons 27

27. Lens adjacent to hilum, same color as testa; cotyledons brown; embryonic axis straight; radicle oblique to cotyledons ..... *Rhynchotropis*, 9.03
Lens confluent with hilum, dissimilar color from testa; cotyledons green, tan, or yellow; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length 28

28. Lens mounded; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Hymenocarpos*, 13.04
Lens flush; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Desmodium*, 11.09

29. Seed reniform; hilum fully concealed; radicle bulbose or linear; radicle deflexed and parallel to cotyledon length; plumule moderately or well developed ... 30
Seed D-shaped, oblong, or ovate; hilum visible; radicle triangular, deflexed and parallel to cotyledon width; plumule rudimentary 31

30. Hilum within rim; lens circular; cotyledons yellow; radicle linear; plumule moderately developed ..... *Arthroclianthus*, 11.03
Hilum not within rim; lens oblong; cotyledons brown or tan; radicle bulbose; plumule well developed ..... *Platymiscium*, 4.08

31. Seed D-shaped; testa chartaceous; hilum marginal according to radicle tip; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Baphiopsis*, 1.05
Seed oblong or ovate; testa coriaceous; hilum subapical to radicle tip; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Bocoa*, 1.02

32. Testa chartaceous 33
Testa osseous or coriaceous 41

33. Seed with shallow hilar sinus; testa fused to endocarp, at most a transparent brown tissue; cotyledons with only 1 folded ..... *Ostryocarpus,* Millettieae
Seed without hilar sinus; testa free from endocarp; cotyledons with both folded or not folded 34

34. Seed terete 35
Seed compressed or flattened 36

35. Testa streaked; hilum flush; cotyledons tan ..... *Harleyodendron*, 1.09
Testa monochrome or mottled; hilum recessed; cotyledons brown or green ..... *Swartzia*, 1.01

36. Lens discernible 37
Lens not discernible 38

37. Fruit wings present, stipitate or substipitate; fruit apex aligned or oblique with longitudinal axis of fruit; epicarp glabrous or glabrate, eglandular ..... *Desmodium*, 11.09
Fruit wings absent, nonstipitate; fruit apex right-angled with longitudinal axis of fruit; epicarp pubescent and indurate, glandular ..... *Cranocarpus*, 11.02

38. Hilum apical according to radicle tip but marginal according to seed length 39
Hilum apical at apex of radicle tip, subapical to radicle tip, marginal according to radicle tip, or between cotyledon and radicle lobe 40

39. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, without beak, membranous; epicarp monochrome ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume, elliptic, falcate, fusiform, moniliform, or oblong, with beak, chartaceous; epicarp multicolored ..... *Austrosteenisia,* Millettieae

40. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, membranous, nonstipitate ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume, circular, elliptic, moniliform, oblong, or ovate, fleshy, leathery, or ligneous, stipitate or substipitate ..... *Swartzia*, 1.01

41. Hilum within corona, halo, or rim 42
Hilum not within corona, halo, or rim 44

42. Testa red; hilum within corona; lens wedge-shaped, within corona; embryonic axis parallel to length of seed ..... *Rupertia*, 12.05
Testa brown, green, olive, or tan; hilum within halo or rim; lens circular, elliptic, 2 circular mounds separated by groove, or oblong, not within corona; embryonic axis oblique to length of seed 43

43. Hilum flush; cotyledons brown ..... *Campylotropis*, 11.23
Hilum recessed; cotyledons green, tan, or yellow ..... *Desmodium*, 11.09

44. Seed flattened 45
Seed compressed 46

45. Fruit apex aligned or oblique with longitudinal axis of fruit, stipitate or substipitate; fruit wings present; epicarp glabrous or glabrate ..... *Desmodium*, 11.09
Fruit apex right-angled with longitudinal axis of fruit, nonstipitate; fruit wings absent; epicarp pubescent and indurate ..... *Cranocarpus*, 11.02

46. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 47
Radicle less than 1/2 length of cotyledons 48

47. Seed 1.2–7 mm long; testa papillate, transversely ridged, rugose, or wrinkled; fruit 2–9 times or more than 9 times longer than wide, with orifice formed by curving of fruit or fruit segments; mesocarp absent ..... *Medicago*, 21.05
Seed 8–30 mm long; testa shagreen or veined; fruit length less than twice as long as width, without orifice formed by curving of fruit or fruit segments; mesocarp present ..... *Lecointea*, 1.08

48. Hilum with curved or straight outline, marginal according to radicle tip or between cotyledon and radicle lobe, recessed; lens discernible ..... *Desmodium*, 11.09
Hilum with angular outline, subapical to radicle tip, flush; lens not discernible ..... *Lecointea*, 1.08

Seed Key 11: Aril absent. Cotyledons entire over radicle. Hilum raised or flush. Endosperm present.

1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 20

2. Seed with external groove between radicle and cotyledon lobes 3
Seed without external groove between radicle and cotyledon lobes 8

3. Hilum partially concealed 4
Hilum visible 6

4. Seed mitaform or ovate, terete ..... *Ebenus*, 18.07
Seed oblong or reniform, compressed 5

5. Seed without hilar sinus; hilum within halo; cotyledons tan ..... *Onobrychis*, 18.06
Seed with shallow hilar sinus; hilum within rim; cotyledons white or yellow ..... *Hedysarum*, 18.02

6. Seed 1.2–1.3 mm long; hilum within rim; endosperm adnate to embryo; cotyledons white ..... *Melliniella*, 11.19
Seed 1.5–6 mm long; hilum not within rim or within halo; endosperm adnate to testa; cotyledons green or tan 7

7. Seed ca. 6 mm long, mitaform; hilum not within halo; cotyledons green; radicle less than 1/2 length of cotyledons; plumule rudimentary ..... *Oreophysa*, 16.06
Seed 1.5–2.3 mm long, elliptic, oblong, or ovate; hilum within halo; cotyledons tan; radicle 1/2 to nearly length of cotyledons; plumule moderately developed ..... *Kummerowia*, 11.25

8. Cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) 9
Cotyledons similar at apex; radicle centered between cotyledons 10

9. Seed 1.5–1.8 mm long, reniform; endosperm thin, adnate to testa; cotyledons not folded, yellow; plumule moderately developed ..... *Smithia*, 14.12
Seed 3–4 mm long, circular, elliptic, or rectangular; endosperm thick, adnate to embryo; cotyledons with both folded, tan; plumule rudimentary ..... *Cyamopsis*, 9.06

10. Hilum within halo or rim 11
Hilum not within halo or rim 15

11. Radicle linear; plumule moderately developed 12
Radicle bulbose; plumule rudimentary 13

12. Seed compressed; hilum punctiform, within rim; lens circular or elliptic, black ..... *Christia*, 11.17
Seed flattened; hilum larger than punctiform, within halo; lens irregular, linear, or wedge-shaped, brown ..... *Droogmansia*, 11.14

13. Seed terete; lens circular, similar color as testa; endosperm thick; radicle deflexed and parallel to cotyledon width ..... *Chaetocalyx*, 14.07
Seed compressed; lens linear or oblong, dissimilar color from testa; endosperm thin; radicle deflexed and parallel to cotyledon length 14

14. Seed 2–2.5 mm long; testa coriaceous; hilum within rim; lens not within halo; cotyledons not concealing radicle, yellow ..... *Pearsonia*, 27.01
Seed 1–1.5 mm long; testa chartaceous; hilum within halo; lens within halo; cotyledons partially concealing radicle, tan or white *Gueldenstaedtia*, 16.19

15. Seed with deep or shallow hilar sinus 16
Seed without hilar sinus 17

16. Seed circular, with umbo on seed faces; cotyledons yellow; radicle linear; plumule moderately developed ..... *Bolusia*, 27.08
Seed oblong or reniform, without umbo on seed faces; cotyledons brown; radicle bulbose; plumule rudimentary ..... *Calophaca*, 16.12

17. Seed rim present; fruit a loment (or a loment segment), moniliform, with beak ..... *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet, circular, coiled, dolabriform, elliptic, falcate, fusiform, lanceolate, linear, oblong, obovate, or ovate, without beak 18

18. Hilum partially concealed ..... *Melilotus*, 21.03
Hilum visible 19

19. Hilum punctiform; lens not within rim ..... *Trifolium*, 21.06
Hilum larger than punctiform; lens within rim ..... *Medicago*, 21.05

20. Hilum larger than punctiform 21
Hilum punctiform 32

21. Plumule moderately or well developed 22
Plumule rudimentary 27

22. Cotyledons not smooth 23
Cotyledons smooth 24

23. Cotyledons completely concealing radicle; lens lighter than testa; cotyledons yellow; radicle 1/2 to nearly length of cotyledons; plumule moderately developed ..... *Dichilus*, 30.02
Cotyledons not concealing radicle; lens darker than testa; cotyledons tan; radicle less than 1/2 length of cotyledons; plumule well developed ..... *Lathyrus*, 19.02

24. Hilum within halo; fruit C-shaped or moniliform ... 25
Hilum not within halo; fruit circular, elliptic, irregular, oblong, or reniform 26

25. Seed compressed; hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, with straight outline; lens circular; cotyledons completely concealing radicle, brown ..... *Eleiotis*, 11.21
Seed flattened; hilum with the lips of the faboid split the same color as the rest of the hilum, with curved outline; lens irregular, linear, or wedge-shaped; cotyledons not concealing radicle, tan ..... *Droogmansia*, 11.14

26. Seed circular, irregular, or oblong; testa green or red; cotyledons outer face of 1 cotyledon flat and other cotyledon concave, 1 thicker than the other, with only 1 or both folded ..... *Psoralidium*, 12.04
Seed reniform; testa brown; cotyledons both outer faces convex, both the same thickness, not folded ..... *Cranocarpus*, 11.02

27. Seed flattened 28
Seed terete or compressed 29

28. Seed reniform, without umbo on seed faces; testa dull, smooth ..... *Cranocarpus*, 11.02
Seed C-shaped, with umbo on seed faces; testa glossy, not smooth ..... *Riedeliella*, 2.08

29. Cotyledons not smooth, completely concealing radicle, cotyledons yellow ..... *Dichilus*, 30.02
Cotyledons smooth, not concealing radicle, brown or tan 30

30. Seed with deep hilar sinus; hilum partially or fully concealed ..... *Calophaca*, 16.12
Seed without hilar sinus; hilum visible 31

31. Seed mitaform, oblong, rhombic, or triangular; embryonic axis oblique to length of seed; radicle 1/2 to nearly length of or equaling length of cotyledons ..... *Medicago*, 21.05
Seed ovate or reniform; embryonic axis parallel to length of seed; radicle less than 1/2 length of cotyledons ..... *Orbexilum*, 12.07

32. Endosperm thick 33
Endosperm thin 41

33. Embryonic axis parallel to length of seed 34
Embryonic axis oblique to length of seed 35

34. Seed circular, oblong, ovate, or reniform; testa orange, red, or yellow; hilum within halo; lens circular; radicle bulbose ..... *Ornithopus*, 13.15
Seed rhombic; testa brown or tan; hilum not within halo; lens wedge-shaped; radicle linear ..... *Coronilla*, 13.11

35. Seed terete 36
Seed quadrangular, compressed, or flattened 38

36. Testa orange or red; cotyledons with both folded ..... *Scorpiurus*, 13.14
Testa brown, green, purple, tan, or yellow; cotyledons not folded 37

37. Lens key-hole shaped; embryonic axis with a joint evident between the radicle and the cotyledons; radicle less than 1/2 length of cotyledons ..... *Dorycnium*, 13.06
Lens circular, elliptic, or linear; embryonic axis without a joint evident between the radicle and the cotyledons; radicle 1/2 to nearly length of cotyledons ..... *Lotus*, 13.07

38. Testa chartaceous; cotyledons partially concealing radicle, brown ..... *Chesneya*, 16.14
Testa coriaceous; cotyledons not concealing radicle, green, tan, or yellow 39

39. Hilum visible; radicle oblique to cotyledons ..... *Antopetitia*, 13.16
Hilum partially or fully concealed; radicle deflexed and parallel to cotyledon length 40

40. Hilum without faboid split; fruit with beak; fruit margin with sulcus; mesocarp absent; endocarp with septa thicker than paper, firm ..... *Securigera*, 13.12
Hilum with faboid split; fruit without beak; fruit margin without sulcus; mesocarp present; endocarp with septa thin (like tissue paper), flexible ..... *Lotus*, 13.07

41. Hilum not within halo or rim 42
Hilum within halo or rim 44

42. Seed with deep hilar sinus; radicle lobe tip curved or hooked ..... *Calophaca*, 16.12
Seed without hilar sinus; radicle lobe tip straight 43

43. Testa black, green, red, tan, or yellow; hilum visible, between cotyledon and radicle lobe; embryonic axis without a joint evident between the radicle and the cotyledons ..... *Trifolium*, 21.06
Testa brown; hilum fully concealed, apical at apex of radicle tip; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Cytisopsis*, 13.01

44. Cotyledons brown, green, or tan 45
Cotyledons white or yellow 48

45. Seed reniform; cotyledons not smooth; plumule moderately developed ..... *Christia*, 11.17
Seed C-shaped, circular, irregular, mitaform, oblong, quadrangular, or triangular; cotyledons smooth; plumule rudimentary 46

46. Seed C-shaped; cotyledons brown; embryonic axis with a joint evident between the radicle and the cotyledons ..... *Vermifrux*, 13.10
Seed circular, irregular, mitaform, oblong, quadrangular, or triangular; cotyledons green or tan; embryonic axis without a joint evident between the radicle and the cotyledons 47

47. Hilum partially or fully concealed; lens black ..... *Lotus*, 13.07
Hilum visible; lens brown ..... *Anthyllis*, 13.02

48. Radicle bulbose 49
Radicle linear 50

49. Seed asymmetrical; testa brown or tan; hilum within rim; lens linear or oblong; endosperm adnate to embryo ..... *Pearsonia*, 27.01
Seed symmetrical; testa orange, red, or yellow; hilum within halo; lens circular; endosperm adnate to testa ..... *Ornithopus*, 13.15

50. Lens oblong; radicle less than 1/2 length of cotyledons ..... *Dorycniopsis*, 13.05
Lens circular, elliptic, or linear; radicle 1/2 to nearly length of cotyledons 51

51. Lens less than 0.5 mm in length, mounded, black; cotyledons smooth; plumule rudimentary ..... *Lotus*, 13.07
Lens equal to or greater than 0.5 mm in length, flush, brown; cotyledons not smooth; plumule moderately developed ..... *Alysicarpus*, 11.18

Seed Key 12: Aril absent. Cotyledons entire over radicle. Hilum recessed. Endosperm present.

1. Seed without visible radicle and cotyledon lobes 2
Seed with visible radicle and cotyledon lobes 36

2. Hilum larger than punctiform 3
Hilum punctiform 20

3. Hilum within corona, halo, or rim 4
Hilum not within corona, halo, or rim 8

4. Hilum within corona; fruit oblong; cotyledons with the interface division terminating in radicle tissue ..... *Pediomelum*, 12.03
Hilum within halo or rim; fruit circular, coiled, dolabriform, irregular, linear, moniliform, or samaroid; cotyledons with the interface division terminating at base of radicle 5

5. Seed D-shaped, linear, oblong, quadrangular, rectangular, or reniform; hilum marginal according to radicle tip or between cotyledon and radicle lobe 6
Seed circular, elliptic, ovate, or rhombic; hilum apical according to radicle tip but marginal according to seed length 7

6. Lens flush; radicle linear, deflexed and parallel to cotyledon length, less than 1/2 length of cotyledons ..... *Desmodium*, 11.09
Lens mounded; radicle bulbose, deflexed and parallel to cotyledon width, 1/2 to nearly length of cotyledons ..... *Bobgunnia*, 1.01A

7. Cotyledons without margins recessed; fruit linear, with epicarp and mesocarp dehiscing and endocarp not dehiscing; endocarp separating into 1-seeded winged segments, with wings not extending into epicarp ..... *Endosamara,* Millettieae
Cotyledons with margins recessed; fruit coiled or moniliform, with all layers dehiscing, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscing along suture; endocarp entire, without or with wings extending into epicarp ..... *Sophora*, 2.45

8. Testa partially adhering to endocarp; cotyledons with the interface division terminating in radicle tissue ..... *Pediomelum*, 12.03
Testa not adhering to endocarp; cotyledons with the interface division terminating at base of radicle ... 9

9. Seed with surface grooved 10
Seed with surface smooth 11

10. Seed with grooves longitudinal or oblique; lens circular, elliptic, or 2 circular mounds separated by groove or oblong; embryonic axis oblique to length of seed ..... *Desmodium*, 11.09
Seed with grooves transverse; lens hourglass shaped, irregular, or wedge-shaped; embryonic axis perpendicular to length of seed ..... *Indigofera*, 9.07

11. Cotyledons not smooth 12
Cotyledons smooth 13

12. Lens mounded or recessed; radicle deflexed and parallel to cotyledon width ..... *Lathyrus*, 19.02
Lens flush; radicle deflexed and parallel to cotyledon length ..... *Desmodium*, 11.09

13. Seed flattened 14
Seed compressed 15

14. Fruit apex aligned or oblique with longitudinal axis of fruit, stipitate or substipitate; fruit wings present; epicarp glabrous or glabrate, eglandular ..... *Desmodium*, 11.09
Fruit apex right-angled with longitudinal axis of fruit, nonstipitate; fruit wings absent; epicarp pubescent and indurate; epicarp glandular ..... *Cranocarpus*, 11.02

15. Testa chartaceous 16
Testa coriaceous 17

16. Hilum marginal according to radicle tip or between cotyledon and radicle lobe; lens discernible ..... *Desmodium*, 11.09
Hilum apical according to radicle tip but marginal according to seed length; lens not discernible ..... *Austrosteenisia,* Millettieae

17. Radicle 1/2 to nearly length of or equaling length of cotyledons 18
Radicle less than 1/2 length of cotyledons 19

18. Fruit with orifice formed by curving of fruit or fruit segments, circular, coiled, or falcate; fruit base right angled with longitudinal axis of fruit; fruit seed chambers externally invisible; mesocarp absent ..... *Medicago*, 21.05
Fruit without orifice formed by curving of fruit or fruit segments, linear or oblong; fruit base aligned or oblique with longitudinal axis of fruit; fruit seed chambers externally visible; mesocarp present ..... *Poitea*, 8.05

19. Aril cupshaped or rim-aril; fruit wings present; endocarp spongy, septate ..... *Desmodium*, 11.09
Aril tongue-aril; fruit wings absent; endocarp scurfy or smooth, subseptate or nonseptate .... *Poitea*, 8.05

20. Embryonic axis parallel to length of seed 21
Embryonic axis oblique to length of seed 26

21. Seed circular, elliptic, hippocrepiform, linear, oblong, or ovate; plumule moderately developed 22
Seed rectangular, reniform, or rhombic; plumule rudimentary 24

22. Seed hippocrepiform or linear, terete; endosperm adnate to embryo; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), less than 1/2 length of cotyledons ..... *Hippocrepis*, 13.13
Seed circular, elliptic, oblong, or ovate, compressed; endosperm adnate to testa; radicle centered between cotyledons, 1/2 to nearly length of cotyledons or exceeding length of cotyledons 23

23. Seed 2.5–5 mm long, circular, oblong, or ovate; hilum not within rim; lens discernible; cotyledons tan; radicle exceeding length of cotyledons ..... *Anarthrophyllum*, 30.06
Seed 5.5–6.7 mm long, elliptic; hilum within rim; lens not discernible; cotyledons yellow; radicle 1/2 to nearly length of cotyledons ..... *Hoita*, 12.06

24. Hilum not within corona or rim; seed rhombic ..... *Coronilla*, 13.11
Hilum within corona or rim; seed rectangular or reniform 25

25. Testa black; hilum within rim; endosperm thick; cotyledons tan; radicle less than 1/2 length of cotyledons ..... *Pickeringia*, 29.06
Testa brown or green; hilum within corona; endosperm thin; cotyledons yellow; radicle 1/2 to nearly length of cotyledons ..... *Cullen*, 12.01

26. Hilum within halo or rim 27
Hilum not within halo or rim 30

27. Lens flush; fruit wings present; endocarp spongy ..... *Desmodium*, 11.09
Lens mounded; fruit wings absent; endocarp smooth 28

28. Seed 3–3.6 mm long; hilum marginal according to radicle tip; testa glossy; lens confluent with hilum ..... *Dendrolobium*, 11.06
Seed 1–2.7 mm long; hilum between cotyledon and radicle lobe; testa dull; lens adjacent to hilum 29

29. Hilum partially concealed, within rim; lens irregular or key-hole shaped, black ..... *Melolobium*, 30.01
Hilum visible, within halo; lens elliptic or 2 circular mounds separated by groove, brown ..... *Acmispon*, 13.07A

30. Radicle 1/2 to nearly length of or equaling length of cotyledons 31
Radicle less than 1/2 length of cotyledons 33

31. Radicle oblique to cotyledons ..... *Hammatolobium*, 13.17
Radicle deflexed and parallel to cotyledon length or width 32

32. Testa black, green, red, tan, or yellow ..... *Trifolium*, 21.06
Testa brown ..... *Poitea*, 8.05

33. Testa not smooth 34
Testa smooth 35

34. Hilum partially concealed; fruit oblong, terete; fruit wings absent; endocarp with septa thin (like tissue paper), flexible ..... *Tripodion*, 13.03
Hilum visible or fully concealed; fruit circular, dolabriform, irregular, linear, or samaroid, compressed or flattened; fruit wings present; endocarp with septa thicker than paper, firm ..... *Desmodium*, 11.09

35. Aril cupshaped or rim-aril; fruit wings present; seed length parallel with fruit length ..... *Desmodium*, 11.09
Aril tongue-aril; fruit wings absent; seed length transverse to fruit length ..... *Poitea*, 8.05

36. Hilum not within corona, halo, or rim 37
Hilum within corona, halo or rim 61

37. Seed with surface grooved ..... *Indigofera*, 9.07
Seed with surface smooth 38

38. Radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) 39
Radicle centered between cotyledons 40

39. Testa black, brown, tan, or white; lens oblong; endosperm thin; radicle bulbose, less than 1/2 to nearly length of cotyledons .....*Aspalathus*, 27.06
Testa red; lens punctiform; endosperm thick; radicle linear, exceeding length of cotyledons ..... *Notospartium*, 17.02

40. Hilum larger than punctiform 41
Hilum punctiform 47

41. Seed rim present; fruit a loment (or a loment segment), moniliform ..... *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet, circular, coiled, elliptic, falcate, linear, oblong, or samaroid 42

42. Radicle lobe tip curved or hooked 43
Radicle lobe tip straight 44

43. Seed 1–8 mm long; hilum elliptic; lens discernible; radicle deflexed and parallel to cotyledon length ..... *Crotalaria*, 27.07
Seed 20–25 mm long; hilum oval; lens not discernible; radicle deflexed and parallel to cotyledon width..... *Vataireopsis*, 4.01

44. Endosperm thin or trace 45
Endosperm thick 46

45. Fruit with orifice formed by curving of fruit or fruit segments; fruit base right angled with longitudinal axis of fruit; fruit seed chambers externally invisible; mesocarp absent; seed length parallel with fruit length..... *Medicago*, 21.05
Fruit without orifice formed by curving of fruit or fruit segments; fruit base aligned or oblique with longitudinal axis of fruit; fruit seed chambers externally visible; mesocarp present; seed length transverse to fruit length ..... *Poitea*, 8.05

46. Lens not within rim; fruit without orifice formed by curving of fruit or fruit segments, inflated; fruit base aligned or oblique with longitudinal axis of fruit; epicarp not veined ..... *Crotalaria*, 27.07
Lens within rim; fruit with orifice formed by curving of fruit or fruit segments, not inflated; fruit base right angled with longitudinal axis of fruit; epicarp veined ..... *Medicago*, 21.05

47. Endosperm thick 48
Endosperm thin or trace 54

48. Radicle lobe tip curved or hooked 49
Radicle lobe tip straight 51

49. Lens equal to or greater than 0.5 mm in length; fruit inflated, rounded at base ..... *Crotalaria*, 27.07
Lens less than 0.5 mm in length; fruit not inflated, long or short tapered at base 50

50. Seed 2–3.5 mm long; testa not smooth; hilum partially concealed; lens not in groove of raphe, same color as testa ..... *Jacksonia*, 24.08
Seed 5–6 mm long; testa smooth; hilum visible; lens in groove of raphe, similar color as testa ..... *Cascaronia*, 4.16

51. Seed cordate or reniform 52
Seed circular, elliptic, linear, mitaform, oblong, ovate, quadrangular, rectangular, or rhombic 53

52. Lens equal to or greater than 0.5 mm in length, not in groove of raphe, tan ..... *Crotalaria*, 27.07
Lens less than 0.5 mm in length, in groove of raphe, brown ..... *Cascaronia*, 4.16

53. Fruit not plicate, rounded at base; fruit seed chambers externally invisible; epicarp not veined, shagreen ..... *Crotalaria*, 27.07
Fruit plicate, tapered or short tapered at base; fruit seed chambers externally visible; epicarp veined, warty ..... *Trigonella*, 21.04

54. Plumule moderately developed or well developed .. 55
Plumule rudimentary 58

55. Seed reniform 56
Seed circular, elliptic, linear, mitaform, oblong, obovate, ovate, quadrangular, rectangular, or rhombic 57

56. Lens irregular, linear, or oblong; fruit coriaceous, with all layers dehiscing; fruit seed chambers externally visible; seed length transverse to fruit length ..... *Poitea*, 8.05
Lens circular; fruit membranous, indehiscent; fruit seed chambers externally invisible; seed length parallel with fruit length ..... *Cascaronia*, 4.16

57. Fruit plicate; epicarp tan, warty; funiculus filiform, curved ..... *Trigonella*, 21.04
Fruit not plicate; epicarp brown, wrinkled; funiculus flattened or triangular, straight ..... *Poitea*, 8.05

58. Testa black, green, red, tan, or yellow; mesocarp absent ..... *Trifolium*, 21.06
Testa brown; mesocarp present 59

59. Hilum with faboid split; lens irregular, linear, or oblong; fruit seed chambers externally visible; fruit with all layers dehiscing; seed length transverse to fruit length ..... *Poitea*, 8.05
Hilum without faboid split; lens circular; fruit seed chambers externally invisible; fruit indehiscent; seed length parallel with fruit length 60

60. Seed 2–2.7 mm long; testa not smooth; raphe from hilum to lens, black, flush; hilum fully concealed ..... *Stracheya*, 18.04
Seed 5–6 mm long; testa smooth; raphe from hilum through lens to base of seed and terminating, brown, recessed; hilum visible ..... *Cascaronia*, 4.16

61. Radicle bulbose 62
Radicle linear 70

62. Endosperm thick 63
Endosperm thin 65

63. Fracture lines present; lens same color as testa; cotyledons partially concealing radicle ..... *Glycyrrhiza*, 16.22
Fracture lines absent; lens similar color as or dissimilar color from testa; cotyledons not concealing radicle 64

64. Lens tan; endosperm adnate to testa ..... *Crotalaria*, 27.07
Lens brown; endosperm adnate to embryo ..... *Lebeckia*, 27.10

65. Lens oblong 66
Lens circular or triangular 68

66. Seed reniform; hilum larger than punctiform; cotyledons red; radicle deflexed and parallel to cotyledon width ..... *Rafnia*, 27.05
Seed circular, mitaform, ovate, quadrangular, rectangular, or rhombic; hilum punctiform; cotyledons tan or yellow; radicle deflexed and parallel to cotyledon length 67

67. Seed circular, mitaform, quadrangular, or rhombic; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) ..... *Aspalathus*, 27.06
Seed ovate or rectangular; radicle centered between cotyledons ..... *Wiborgia*, 27.11

68. Testa purple, red, or yellow; endosperm adnate to embryo; cotyledons yellow ..... *Lotononis*, 27.09
Testa brown or tan; endosperm adnate to testa; cotyledons tan or white 69

69. Hilum partially concealed; lens dissimilar color from testa; cotyledons tan; embryonic axis oblique to length of seed; plumule moderately developed ..... *Piptanthus*, 29.02
Hilum visible or fully concealed; lens similar color as testa; cotyledons white; embryonic axis parallel to length of seed; plumule rudimentary ..... *Astracantha*, 16.16

70. Hilum marginal according to radicle tip 71
Hilum between cotyledon and radicle lobe 73

71. Seed 10–15 mm long, elliptic or oblong; hilum larger than punctiform; endosperm thick; radicle less than 1/2 length of cotyledons; plumule moderately developed ..... *Anagyris*, 29.03
Seed 1.9–5 mm long, circular or reniform; hilum punctiform; endosperm thin; radicle 1/2 to nearly length of or exceeding length of cotyledons; plumule rudimentary 72

72. Seed 1.9–2.1 mm long; circular, terete; hilum visible, within rim; cotyledons tan ..... *Corallospartium*, 17.04
Seed 2.5–5 mm mm long; reniform, compressed; hilum fully concealed, within corona; cotyledons yellow ..... *Cullen*, 12.01

73. Radicle deflexed and parallel to cotyledon width 74
Radicle deflexed and parallel to cotyledon length ... 75

74. Seed D-shaped, compressed; raphe from lens to base of seed and terminating; hilum within halo or rim; cotyledons margin entire 180 degrees from base of radicle ..... *Baptisia*, 29.05
Seed elliptic, terete; raphe from hilum to near base of seed and terminating; hilum within corona; cotyledons margin not entire 180 degrees from base of radicle ..... *Parryella*, 6.03

75. Embryonic axis straight; raphe visible ... *Ononis*, 12.01
Embryonic axis deflexed; raphe not visible 76

76. Cotyledons white; seeds in 2 or more series ..... *Parochetus*, 21.02
Cotyledons green, tan, or yellow; seeds in 1 series . 77

77. Lens elliptic or 2 circular mounds separated by groove ..... *Acmispon*, 13.07A
Lens circular, oblong, rectangular, or wedge-shaped 78

78. Endosperm thick; fruit inflated ..... *Crotalaria*, 27.07
Endosperm thin; fruit not inflated 79

79. Radicle 1/2 to nearly length of cotyledons 80
Radicle less than 1/2 length of cotyledons 81

80. Seed 1–1.2 mm long; hilum visible, within rim; lens wedge-shaped; cotyledons yellow; plumule moderately developed ..... *Robynsiophyton*, 27.03
Seed 3–3.7 mm long; hilum fully concealed, within halo; lens circular; cotyledons tan; plumule rudimentary ..... *Eversmannia*, 18.01

81. Seed 1–1.4 mm long; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); hilum visible; cotyledons tan or yellow ..... *Rothia*, 27.02
Seed 1.5–2.5 mm long; radicle centered between cotyledons; hilum partially concealed; cotyledons green ..... *Taverniera*, 18.03

Seed Key 13: Aril absent. One (1) cotyledon scooped out to accommodate plicate radicle and other cotyledon entire.

1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 5

2. Hilum larger than punctiform 3
Hilum punctiform 4

3. Seed ca. 6 mm long, rim absent; lens in groove of raphe; cotyledons not smooth, 1 longer than other, with only 1 folded ..... *Streblorrhiza*, 17.01
Seed 1.2–2 mm long, rim present; lens not in groove of raphe; cotyledons smooth, both more or less of equal length, not folded .... *Desmodiastrum*, 11.18A

4. Seed 2.5–3 mm long; testa red; raphe from hilum to lens; lens punctiform, red; cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle) ..... *Chordospartium*, 17.03
Seed 5–6 mm long; testa brown; raphe from hilum through lens to base of seed and terminating; lens circular, brown; cotyledons similar at apex ..... *Cascaronia*, 4.16

5. Seed terete; fruit with all layers dehiscing or with epicarp and mesocarp dehiscing and endocarp not dehiscing 6
Seed compressed or flattened; fruit indehiscent 7

6. Seed ca. 10 mm long, elliptic; testa monochrome; hilum apical according to radicle tip but marginal according to seed length, recessed, within rim ..... *Endosamara,* Millettieae
Seed 35–50 mm long, irregular or ovate; testa streaked; hilum apical at apex of radicle tip, flush, not within rim ..... *Harleyodendron*, 1.09

7. Testa not smooth ..... *Lecointea*, 1.08
Testa smooth 8

8. Seed flattened; fruit a loment (or a loment segment) ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume ..... *Austrosteenisia,* Millettieae

Seed Key 14: Aril absent. Cotyledons notched at radicle.

1. Testa absent 2
Testa present 6

2. Seed irregular, ovate, or reniform, with surface smooth 3
Seed circular, elliptic, oblong, obovate, or triangular, with surface ridged, grooved, or wrinkled 4

3. Seed ca. 35 mm long, ovate, flattened; cotyledons not smooth, with lobes; embryonic axis straight ..... *Monopteryx*, 2.31
Seed 11–16 mm long, irregular or reniform, terete; cotyledons smooth, without lobes; embryonic axis oblique, parallel, or right angled ... *Myroxylon*, 2.07

4. Testa partially adhering to endocarp; cotyledons with 5–7-branched grooves (from veins of testa) on each face; embryonic axis straight; radicle oblique to cotyledons ..... *Aldina*, 1.04
Testa not adhering to endocarp; cotyledons pitted or wrinkled; embryonic axis deflexed or right angled; radicle deflexed and parallel to cotyledon width or straight with embryonic axis 5

5. Seed circular, oblong, or obovate, compressed, with surface ridged; cotyledons not concealing radicle; radicle bulbose or linear ..... *Vatairea*, 4.02
Seed elliptic, terete, with surface wrinkled; cotyledons partially concealing radicle; radicle triangular ..... *Angylocalyx*, 2.13

6. Testa osseous or coriaceous 7
Testa chartaceous 36

7. Hilum punctiform 8
Hilum larger than punctiform 14

8. Seed without visible radicle and cotyledon lobes 9
Seed with visible radicle and cotyledon lobes 11

9. Testa purple; cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle bulbose ..... *Hymenolobium*, 4.03
Testa brown; cotyledons similar at apex; radicle linear or truncate 10

10. Seed with umbo on seed faces; testa wrinkled; hilum fully concealed; cotyledons not concealing radicle; radicle linear ..... *Poecilanthe,* Millettieae
Seed without umbo on seed faces; testa shagreen; hilum visible; cotyledons partially concealing radicle; radicle truncate ..... *Zollernia*, 1.11

11. Seed D-shaped; testa red ..... *Psorothamnus*, 6.06
Seed circular, elliptic, mitaform, or reniform; testa brown, green, olive, tan, or yellow 12

12. Hilum partially concealed, flush; lens confluent with hilum, dissimilar color from testa ..... *Melilotus*, 21.03
Hilum visible, recessed; lens adjacent to hilum, similar color as testa 13

13. Seed 1.2–2.5 mm long; testa olive or tan; hilum within rim; lens not in groove of raphe, tan, oblong ..... *Marina*, 6.07
Seed 5–6 mm long; testa brown; hilum not within rim; lens in groove of raphe, brown, circular ..... *Cascaronia*, 4.16

14. Seed asymmetrical 15
Seed symmetrical 25

15. Seed with visible radicle and cotyledon lobes 16
Seed without visible radicle and cotyledon lobes 19

16. Seed rim present; fruit a loment (or a loment segment) ..... *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet 17

17. Lens black; endosperm absent; embryonic axis oblique; radicle oblique to cotyledons or with 180-degree turn ..... *Erythrina*, 10.01
Lens brown; endosperm present; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length or width 18

18. Seed 5–8 mm long; endosperm thin; cotyledons partially concealing radicle, yellow; radicle linear, less than 1/2 length of cotyledons ..... *Ammopiptanthus*, 29.01
Seed 1.5–4.5 mm long; endosperm thick; cotyledons not concealing radicle, tan; radicle bulbose, 1/2 to nearly length of cotyledons ..... *Melilotus*, 21.03

19. Endosperm present 20
Endosperm absent 22

20. Seed angular, compressed; testa glossy; hilum within rim ..... *Centrolobium*, 4.12
Seed not angular, flattened; testa dull; hilum not within rim 21

21. Fruit a loment (or a loment segment), irregular or reniform, rounded at apex; fruit wings absent ..... *Cranocarpus*, 11.02
Fruit a legume, lanceolate or oblong, long tapered at apex; fruit wings present .. *Dalbergiella,* Millettieae

22. Seed flattened; fruit a loment (or a loment segment), membranous ..... *Cranocarpus*, 11.02
Seed terete or compressed; fruit a legume or nutlet, coriaceous, fleshy, or fragile, thinner than chartaceous like *Trifolium* (21.06), leathery, or ligneous 23

23. Hilum with angular outline, subapical to radicle tip ..... *Lecointea*, 1.08
Hilum with curved outline or straight outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip 24

24. Embryonic axis right angled or straight; seed length transverse to fruit length ..... *Mucuna*, 10.03
Embryonic axis oblique; seed length parallel with fruit length ..... *Erythrina*, 10.01

25. Hilum recessed 26
Hilum raised or flush 29

26. Cotyledons with lobes ..... *Sophora*, 2.45
Cotyledons without lobes 27

27. Seed irregular or mitaform; cotyledons not smooth, completely concealing radicle, inner face wrinkled; plumule rudimentary ..... *Dussia*, 2.24
Seed circular, elliptic, oblong, ovate, or reniform; cotyledons smooth, partially concealing radicle, inner face flat or concave; plumule moderately or well developed 28

28. Lens brown ..... *Amphicarpaea*, 10.44
Lens black ..... *Erythrina*, 10.01

29. Radicle linear 30
Radicle bulbose or triangular 31

30. Seed 3.4–9 mm long, terete; hilum within rim; cotyledons smooth, tan or white; embryonic axis oblique ..... *Cajanus*, 10.73
Seed 23–50 mm long, compressed; hilum not within rim; cotyledons not smooth, red or yellow; embryonic axis straight ..... *Dipteryx*, 3.01

31. Plumule rudimentary 32
Plumule moderately or well developed 33

32. Embryonic axis oblique; radicle lobe tip straight; radicle oblique to cotyledons ..... *Oxyrhynchus*, 10.68
Embryonic axis right angled or straight; radicle lobe tip curved; radicle with 90- or with 180-degree turn ..... *Mucuna*, 10.03

33. Radicle lobe tip curved 34
Radicle lobe tip straight 35

34. Embryonic axis right angled or straight; seed length transverse to fruit length ..... *Mucuna*, 10.03
Embryonic axis oblique; seed length parallel with fruit length ..... *Erythrina*, 10.01

35. Fruit quadrangular, rounded or truncate at base ..... *Psophocarpus*, 10.51
Fruit compressed or terete, long tapered or tapered at base ..... *Erythrina*, 10.01

36. Hilum within halo or rim 37
Hilum not within halo or rim 57

37. Hilum visible 38
Hilum partially or fully concealed 45

38. Seed with visible radicle and cotyledon lobes 39
Seed without visible radicle and cotyledon lobes 41

39. Seed with surface wrinkled; hilum within halo; endosperm absent ..... *Aganope,* Millettieae
Seed with surface smooth; hilum within rim; endosperm present 40

40. Hilum rim color darker than testa; lens circular, embryo adnate to testa; cotyledons both outer faces convex, brown or tan 75
Hilum rim color of or lighter than testa; lens ovate; endosperm adnate to embryo; cotyledons both outer faces flat, green ..... *Styphnolobium*, 2.44

41. Seed flattened, with surface wrinkled; testa mottled ..... *Butea*, 10.04
Seed terete or compressed, with surface smooth; testa monochrome 42

42. Testa fused to endocarp, at most a transparent brown tissue, clear ..... *Myroxylon*, 2.07
Testa free from endocarp, colored 43

43. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, apical at apex of radicle tip, subapical to radicle tip, or marginal according to radicle tip, raised ..... *Centrosema*, 10.14
Hilum with the lips of the faboid split the same color as the rest of the hilum, apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobes, recessed ... 44

44. Cotyledons without margins recessed; fruit circular, elliptic, linear, or oblong, emarginate, rounded, or short tapered at base 76
Cotyledons with margins recessed; fruit coiled or moniliform, long tapered at base ..... *Sophora*, 2.45

45. Seed samaroid; testa color modified by a bloom ..... *Amburana*, 1.15
Seed circular, D-shaped, elliptic, irregular, oblong, ovate, reniform, rhombic, or trapezoid; testa color not modified by a bloom 46

46. Seed with deep or shallow hilar sinus 47
Seed without hilar sinus 49

47. Lens mounded; endocarp monochrome 77
Lens flush or recessed; endocarp mottled 48

48. Seed compressed or flattened; hilum recessed; lens circular; cotyledons partially concealing radicle; radicle linear ..... *Pongamia,* Millettieae
Seed terete; hilum raised; lens linear; cotyledons not concealing radicle; radicle triangular ..... *Muellera,* Millettieae

49. Cotyledons with lobes 50
Cotyledons without lobes 52

50. Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped ..... *Pericopsis*, 2.17
Testa dull; hilum apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobe; lens linear, triangular, or not discernible 51

51. Testa wrinkled or smooth; cotyledons without basal groin formed by lobes 78
Testa bearing endocarp remnants; cotyledons with basal groin formed by lobes ..... *Sophora*, 2.45

52. Testa fused to endocarp, at most a transparent brown tissue ..... *Myroxylon*, 2.07
Testa free from endocarp 53

53. Cotyledons yellow 54
Cotyledons brown, tan, or white 55

54. Testa rugose or wrinkled; hilum fully concealed ..... *Phaseolus*, 10.72
Testa with 1 longitudinal ridge on each face; hilum partially concealed ..... *Psophocarpus*, 10.51

55. Hilum not within rim or within halo; fruit wings present ..... *Derris,* Millettieae
Hilum within rim; fruit wings absent 56

56. Lens circular or triangular, mounded; radicle bulbose or linear ..... *Phaseolus*, 10.72
Lens linear, flush; radicle triangular ..... *Amphicarpaea*, 10.44

57. Hilum visible 58
Hilum partially or fully concealed 64

58. Testa not smooth 59
Testa smooth 60

59. Seed reniform; testa fused to endocarp, at most a transparent brown tissue; cotyledons not concealing radicle, inner face flat; radicle linear ..... *Kunstleria,* Millettieae
Seed elliptic or irregular; testa free from endocarp; cotyledons partially concealing radicle, inner face with central ridge on 1 and central groove on other; radicle bulbose ..... *Diplotropis*, 2.27

60. Seed flattened; fruit membranous; epicarp veined ... 61
Seed terete or compressed; fruit chartaceous, coriaceous, or fleshy; epicarp not veined 62

61. Fruit a loment (or a loment segment), irregular or reniform, rounded at apex, nonstipitate; fruit wings absent ..... *Cranocarpus*, 11.02
Fruit a legume, lanceolate or oblong, long tapered at apex, substipitate; fruit wings present ..... *Dalbergiella,* Millettieae

62. Seed ca. 4.5 mm long; hilum apical according to radicle tip but marginal according to seed length, recessed ..... *Austrosteenisia,* Millettieae
Seed 4.7–50 mm long; hilum apical at apex of radicle tip, subapical to radicle tip, or marginal according to radicle tip, raised or flush 63

63. Seed 4.7–11.6 mm long, symmetrical; testa monochrome; hilum raised; endosperm present; plumule moderately or well developed ... *Centrosema*, 10.14
Seed 35–50 mm long, asymmetrical; testa streaked; hilum flush; endosperm absent; plumule rudimentary ..... *Harleyodendron*, 1.09

64. Cotyledons not concealing radicle 65
Cotyledons completely or partially concealing radicle 69

65. Seed terete 66
Seed compressed or flattened 67

66. Seed ovate or reniform, with deep hilar sinus; hilum raised; endosperm present; radicle triangular ..... *Muellera,* Millettieae
Seed linear, without hilar sinus; hilum flush; endosperm absent; radicle linear ..... *Fissicalyx*, 4.07

67. Seed irregular, compressed, with surface wrinkled; cotyledons not smooth ..... *Luetzelburgia*, 2.03
Seed reniform, flattened, with surface smooth; cotyledons smooth 68

68. Seed with visible radicle and cotyledon lobes; testa not smooth ..... *Discolobium*, 14.17
Seed without visible radicle and cotyledon lobes; testa smooth ..... *Cranocarpus*, 11.02

69. Seed with visible radicle and cotyledon lobes; testa orange ..... *Cyclolobium,* Millettieae
Seed without visible radicle and cotyledon lobes; testa black, brown, cream, white, or yellow 70

70. Cotyledons margin not entire 180 degrees from base of radicle ..... *Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of radicle 71

71. Seed symmetrical 72
Seed asymmetrical 73

72. Testa with 1 longitudinal ridge on each face; cotyledons yellow ..... *Psophocarpus*, 10.51
Testa wrinkled; cotyledons brown or tan ..... *Derris,* Millettieae

73. Seed terete; testa mottled, minutely pubescent ..... *Myrospermum*, 2.06
Seed compressed or flattened; testa monochrome, glabrous 74

74. Fruit a loment (or a loment segment), membranous; fruit apex right-angled with longitudinal axis of fruit; fruit wings absent; seed length parallel with fruit length ..... *Cranocarpus*, 11.02
Fruit a legume, chartaceous or coriaceous; fruit apex aligned or oblique with longitudinal axis of fruit; fruit wings present; seed length oblique or transverse to fruit length ..... *Derris,* Millettieae

75. Seed 2–9 mm wide; lens mounded; endosperm thin; radicle bulbose; plumule moderately developed ..... *Pterocarpus,* 4.17
Seed 12–21 mm wide; lens recessed; endosperm trace; radible linear; plumule rudimentary ..... *Pongamia,* Millettieae

76. Seeds D-shaped, irregular, or reniform; fruit 2–11 cm wide, indehiscent; epicarp with spines; endocarp entire ..... *Pterocarpus,* 4.17
Seeds elliptic; fruit 1–1.6 cm wide, with epicarp and mesocarp dehiscing and endocarp not dehiscing; epicarp without spines; endocarp separating into 1-seed winged segments ..... *Endosamara,* Millettieae

77. Endosperm present; fruit margin with a wing; fruit stipitate or substipitate, indehiscent ..... *Pterocarpus,* 4.17
Endosperm absent; fruit margin with thickened sutural areas; fruit nonstipitate, with all layers dehiscing ..... *Phaseolus,* 10.72

78. Seed without visible radicle and cotyledon lobes, without umbo on seed faces; hilum with faboid split, 1.4 mm long; cotyledons with lobes touching (auriculate) ..... *Derris,* Millettieae
Seed with visible radicle and cotyledon lobes, with umbo on seed faces; hilum without faboid split, 0.2–0.5 mm long; cotyledons with lobes not touching ..... *Brya,* 11.01

Seed Key 15: Aril absent. Cotyledons split over radicle. Hilum raised or flush.

1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 21

2. Seed terete 3
Seed compressed or flattened 7

3. Seed D-shaped; embryonic axis deflexed; plumule rudimentary ..... *Bryaspis*, 14.14
Seed circular, elliptic, oblong, ovate, or reniform; embryonic axis oblique or straight; plumule moderately or well developed 4

4. Embryonic axis straight; radicle deflexed and parallel to cotyledon width or straight with embryonic axis; endocarp cobwebby or scurfy 5
Embryonic axis oblique; radicle oblique to cotyledons or with 180 degree turn; endocarp smooth 6

5. Hilum flush; cotyledons smooth, tan; embryonic axis parallel to length of seed; radicle bulbose ..... *Arachis*, 14.26
Hilum raised; cotyledons not smooth, brown or red; embryonic axis oblique to length of seed; radicle linear ..... *Geoffroea*, 4.15

6. Seed 3.5–4 mm long; testa chartaceous; hilum punctiform, between cotyledon and radicle lobe; cotyledons completely concealing radicle, with lobes ..... *Chapmannia*, 14.24
Seed 5–45 mm long; testa osseous or coriaceous; hilum larger than punctiform, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; cotyledons partially concealing radicle, without lobes ..... *Erythrina*, 10.01

7. Hilum larger than punctiform 8
Hilum punctiform 15

8. Cotyledons not concealing radicle 9
Cotyledons completely or partially concealing radicle 12

9. Seed rim present ..... *Desmodiastrum*, 11.18A
Seed rim absent 10

10. Hilum fully concealed, with curved outline; embryonic axis perpendicular to length of seed; radicle bulbose, 1/2 to nearly length of cotyledons ..... *Aeschynomene*, 14.09
Hilum visible, with straight outline; embryonic axis oblique to length of seed; radicle linear, less than 1/2 length of cotyledons 11

11. Seed 4.5–5 mm long, circular, oblong, or reniform; lens circular, lighter than testa, tan; cotyledons tan ..... *Podocytisus*, 30.11
Seed ca. 4 mm long, D-shaped or rectangular; lens linear, darker than testa, brown; cotyledons green ..... *Euchilopsis*, 24.20

12. Seed with external groove between radicle and cotyledon lobes; testa chartaceous ..... *Ormocarpum*, 14.01
Seed without external groove between radicle and cotyledon lobes; testa osseous or coriaceous 13

13. Seed 1.2–2 mm long, rim present ..... *Desmodiastrum*, 11.18A
Seed 2.2–45 mm long, rim absent 14

14. Seed 2.2–2.4 mm long, D-shaped; hilum circular; endosperm present ..... *Apoplanesia*, 6.01
Seed 5–45 mm long, circular, elliptic, oblong, ovate, or reniform; hilum elliptic or oval; endosperm absent 51

15. Testa chartaceous 16
Testa coriaceous 18

16. Seed 3.5–3.7 mm long, circular; hilum fully concealed; cotyledons not concealing radicle; radicle lobe tip straight; plumule well developed ..... *Belairia*, 14.04
Seed 1.9–3.4 mm long, falcate, oblong, ovate, or reniform; hilum visible; cotyledons partially concealing radicle; radicle lobe tip curved; plumule rudimentary or moderately developed 17

17. Seed 1.9–3 mm long, rim absent; hilum not within rim; lens circular; cotyledons margin not entire 180 degrees from base of radicle, yellow ..... *Stylosanthes*, 14.25
Seed 3.2–3.4 mm long, rim present; hilum within rim; lens elliptic; cotyledons margin entire 180 degrees from base of radicle, tan..... ..... *Eysenhardtia*, 6.02

18. Hilum within halo or rim; cotyledons yellow 19
Hilum not within halo or rim; cotyledons tan 20

19. Seed compressed; testa smooth; hilum visible; lens 2 circular mounds separated by groove ..... *Zornia*, 14.21
Seed flattened; testa not smooth; hilum partially concealed; lens circular ..... *Poiretia*, 14.20

20. Seed 0.7–1.2 mm long, mitaform; cotyledons not folded, similar at apex, completely concealing radicle; radicle bulbose ..... *Cyclocarpa*, 14.16
Seed 3–4 mm long, circular, elliptic, or rectangular; cotyledons with both folded, differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle), partially concealing or not concealing radicle; radicle linear ..... *Cyamopsis*, 9.06

21. Endosperm present 22
Endosperm absent 37

22. Radicle 1/2 to nearly length, equaling length, or exceeding length of cotyledons 23
Radicle less than 1/2 length of cotyledons 25

23. Seed reniform, flattened ..... *Cranocarpus*, 11.02
Seed circular, irregular, or oblong, terete 24

24. Seed circular or irregular; hilum elliptic; cotyledons tan or white; radicle bulbose; plumule well developed ..... *Pisum*, 19.04
Seed oblong; hilum circular; cotyledons yellow; radicle linear; plumule rudimentary ..... *Otholobium*, 12.08

25. Endosperm thick 26
Endosperm thin or trace 27

26. Seed reniform, flattened; lens dissimilar color from testa ..... *Cranocarpus*, 11.02
Seed mitaform, oblong, quadrangular, or rectangular, terete or compressed; lens similar color as testa ..... *Sesbania*, 8.01

27. Seed circular, D-shaped, irregular, oblong, quadrangular, or triangular 28
Seed elliptic, ovate, or reniform 31

28. Cotyledons orange, white, or yellow 29
Cotyledons brown, green, or tan 30

29. Seed without umbo on seed faces; endosperm restricted to region of embryo; radicle linear ..... *Lens*, 19.03
Seed with umbo on seed faces; endosperm covering entire embryo; radicle triangular ..... *Vicia*, 19.01

30. Seed terete; lens linear; cotyledons without lobes; radicle linear or triangular ..... *Strongylodon*, 10.02
Seed compressed or flattened; lens rhombic or wedge-shaped; cotyledons with lobes; radicle bulbose ..... *Gliricidia*, 8.06

31. Testa chartaceous 32
Testa osseous or coriaceous 33

32. Fruit a loment (or a loment segment), membranous; fruit apex right-angled with longitudinal axis of fruit; fruit wings absent; seed length parallel with fruit length ..... *Cranocarpus*, 11.02
Fruit a legume, chartaceous or coriaceous; fruit apex aligned or oblique with longitudinal axis of fruit; fruit wings present; seed length oblique or transverse to fruit length ..... *Derris,* Millettieae

33. Seed reniform 34
Seed ovate 35

34. Seed terete or compressed; fruit a legume, circular or obovate, coriaceous; fruit seed chambers externally invisible ..... *Orbexilum*, 12.07
Seed flattened; fruit a loment (or a loment segment), irregular or reniform, membranous; fruit seed chambers externally visible ..... *Cranocarpus*, 11.02

35. Radicle bulbose; hilum apical at apex of radicle tip ..... *Gliricidia*, 8.06
Radicle linear or triangular; hilum marginal according to radicle tip 36

36. Seed with umbo on seed faces; cotyledons white or yellow; embryonic axis oblique to length of seed; radicle triangular; plumule well developed ..... *Vicia*, 19.01
Seed without umbo on seed faces; cotyledons tan; embryonic axis parallel to length of seed; radicle linear; plumule rudimentary ..... *Orbexilum*, 12.07

37. Seed terete 38
Seed compressed or flattened 41

38. Testa streaked; hilum apical at apex of radicle tip; plumule rudimentary ..... *Harleyodendron*, 1.09
Testa bichrome, monochrome, or mottled; hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; plumule moderately or well developed 39

39. Lens oblong; cotyledons with lobes, brown; embryonic axis with a joint evident between the radicle and the cotyledons; plumule pubescent ..... *Ormocarpopsis*, 14.02
Lens circular, elliptic, linear, ovate, punctiform, rhombic, or wedge-shaped; cotyledons without lobes, tan, white, or yellow; embryonic axis without a joint evident between the radicle and the cotyledons; plumule glabrous 40

40. Hilum without faboid split; epicarp rugose, exfoliating in part; funiculus partially filiform and partially thick ..... *Strongylodon*, 10.02
Hilum with faboid split; epicarp muricate or wrinkled, not exfoliating; funiculus flattened or thick ..... *Erythrina*, 10.01

41. Testa osseous or coriaceous 42
Testa chartaceous 46

42. Testa smooth 43
Testa not smooth 44

43. Seed compressed; fruit a legume or nutlet, compressed or terete, long tapered, tapered, or short tapered at apex, coriaceous, fleshy, leathery, or ligneous ..... *Erythrina*, 10.01
Seed flattened; fruit a loment (or a loment segment), flattened, rounded at apex, membranous ..... *Cranocarpus*, 11.02

44. Seed with surface grooved; cotyledons not smooth ..... *Dipteryx*, 3.01
Seed with surface ridged or smooth; cotyledons smooth 45

45. Hilum with curved outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; lens discernible ..... *Erythrina*, 10.01
Hilum with angular outline, subapical to radicle tip; lens not discernible ..... *Lecointea*, 1.08

46. Testa tan; seed oblong; hilum punctiform ..... *Euchresta*, 28.01
Testa brown; seed D-shaped, elliptic, irregular, ovate, samaroid, or reniform; hilum larger than punctiform 47

47. Cotyledons margin not entire 180 degrees from base of radicle; fruit with all layers dehiscing ..... *Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of radicle; fruit indehiscent 48

48. Seed with deep hilar sinus; fruit with deciduous calyx ..... *Leptoderris,* Millettieae
Seed without hilar sinus; fruit with persistent calyx 49

49. Seed angular, irregular or samaroid ..... *Sweetia*, 2.02
Seed not angular, elliptic, ovate, or reniform 50

50. Fruit a loment (or a loment segment); fruit apex right-angled with longitudinal axis of fruit, membranous; fruit wings absent; seed length parallel with fruit length ..... *Cranocarpus*, 11.02
Fruit a legume; fruit apex aligned or oblique with longitudinal axis of fruit, chartaceous or coriaceous; fruit wings present; seed length oblique or transverse to fruit length ..... *Derris,* Millettieae

51. Seed flattened; hilum without faboid split, 0.5 mm long; cotyledons with lobes; plumule rudimentary ..... *Grazielodendron,* 4.09
Seed terete or compressed; hilum with faboid split, 2–10.5 mm long; cotyledons without lobes; plumule moderately or well developed ..... *Erythrina,* 10.01

Seed Key 16: Aril absent. Cotyledons split over radicle. Hilum recessed.

1. Seed with umbo on seed faces 2
Seed without umbo on seed faces 3

2. Seed 2.7–5 mm long; hilum partially concealed, larger than punctiform, within halo or rim; cotyledons tan; radicle equaling or exceeding length of cotyledons ..... *Chamaecytisus*, 30.15A
Seed 12–13 mm long; hilum visible, punctiform, not within halo or rim; cotyledons white; radicle less than 1/2 length of cotyledons ..... *Ramorinoa*, 4.11

3. Seed with visible radicle and cotyledon lobes 4
Seed without visible radicle and cotyledon lobes 33

4. Hilum larger than punctiform 5
Hilum punctiform 18

5. Cotyledons completely or partially concealing radicle 6
Cotyledons not concealing radicle 11

6. Seed rim present; fruit a loment (or a loment segment) ..... *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet 7

7. Endosperm absent ..... *Erythrina*, 10.01
Endosperm present 8

8. Seed with surface grooved; cotyledons white ..... *Cicer*, 20.01
Seed with surface smooth; cotyledons brown, green, tan, or yellow 9

9. Seed 12–35 mm long, with shallow hilar sinus; testa not smooth, chartaceous; hilum elliptic; endosperm trace ..... *Pongamia,* Millettieae
Seed 3–7 mm long, without hilar sinus; testa smooth, coriaceous; hilum circular; endosperm thick or thin 10

10. Testa color modified by a bloom; embryonic axis right angled, perpendicular to length of seed ..... *Diphysa*, 14.03
Testa color not modified by a bloom; embryonic axis deflexed, oblique to length of seed ..... *Poitea*, 8.05

11. Seed rim present; fruit a loment (or a loment segment), moniliform, indehiscent; endocarp septate ..... *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume, circular, elliptic, linear, oblong, obovate, or ovate, with all layers dehiscing or epicarp and mesocarp dehiscing and endocarp not dehiscing; endocarp subseptate or nonseptate 12

12. Endosperm thick 13
Endosperm thin 14

13. Seed without external groove between radicle and cotyledon lobes; hilum circular, within rim; radicle 1/2 to nearly length of cotyledons or equaling length of cotyledons; lens oblong or wedge-shaped ..... *Calicotome*, 30.17
Seed with external groove between radicle and cotyledon lobes; hilum elliptic, not within rim or within halo; radicle less than 1/2 length of cotyledons; lens circular or triangular ..... *Aotus*, 24.21

14. Seed terete; testa osseous; hilum with straight outline ..... *Glottidium*, 8.01A
Seed compressed; testa coriaceous; hilum with curved outline 15

15. Hilum elliptic or oval 16
Hilum circular 17

16. Hilum partially concealed, within rim; lens similar color as testa; cotyledons brown or tan; radicle linear ..... *Gastrolobium*, 24.13
Hilum visible, within halo; lens dissimilar color from testa; cotyledons green; radicle bulbose ..... *Phyllota*, 24.19

17. Hilum within rim; lens elliptic or wedge-shaped; cotyledons red ..... *Laburnum*, 30.09
Hilum not within rim; lens irregular, linear, or oblong; cotyledons brown, green, or tan ..... *Poitea*, 8.05

18. Seed with external groove between radicle and cotyledon lobes 19
Seed without external groove between radicle and cotyledon lobes 21

19. Testa color modified by a bloom; embryonic axis right angled, perpendicular to length of seed ..... *Diphysa*, 14.03
Testa color not modified by a bloom; embryonic axis deflexed, oblique to length of seed 20

20. Testa not smooth; hilum elliptic; lens circular or triangular; endosperm thick ..... *Aotus*, 24.21
Testa smooth; hilum circular; lens irregular, linear, or oblong; endosperm thin ..... *Poitea*, 8.05

21. Endosperm thick 22
Endosperm thin or trace 26

22. Hilum partially or fully concealed 23
Hilum visible 24

23. Seed 5.5–6 mm long, ovate; hilum within rim; lens equal to or greater than 0.5 mm in length, oblong; radicle lobe tip straight .... *Hesperolaburnum*, 30.10
Seed 2–3.5 mm long, oblong or reniform; hilum not within rim; lens less than 0.5 mm in length, circular; radicle lobe tip hooked ..... *Jacksonia*, 24.08

24. Seed reniform; hilum not within rim ..... *Cascaronia*, 4.16
Seed circular, D-shaped, elliptic, oblong, or rectangular; hilum within rim 25

25. Lens oblong or wedge-shaped; cotyledons not concealing radicle; radicle lobe tip straight, deflexed and parallel to cotyledon length, 1/2 to nearly length of or equaling length of cotyledons ..... *Calicotome*, 30.17
Lens circular or elliptic; cotyledons partially concealing radicle; radicle lobe tip curved, deflexed and parallel to cotyledon width, less than 1/2 length of cotyledons ..... *Amorpha*, 6.04

26. Hilum within halo or rim 27
Hilum not within halo or rim 30

27. Seed terete; lens oblong .....*Spartidium*, 27.04
Seed compressed; lens circular, elliptic, linear, triangular, or wedge-shaped 28

28. Seed circular, D-shaped, ovate, quadrangular, or rectangular; seed rim present; radicle deflexed and parallel to cotyledon length .....*Coursetia*, 8.08
Seed elliptic, mitaform, or reniform; seed rim absent; radicle deflexed and parallel to cotyledon width or oblique to cotyledons 29

29. Testa osseous; hilum rim color of testa; cotyledons with lobes touching (auriculate), yellow; radicle oblique to cotyledons ..... *Geissaspis*, 14.13
Testa coriaceous; hilum rim color lighter than testa; cotyledons with lobes not touching, tan; radicle deflexed and parallel to cotyledon width .....*Dalea*, 6.08

30. Seed D-shaped; testa red ..... *Psorothamnus*, 6.06
Seed circular, oblong, obovate, ovate, rectangular, or reniform; testa brown 31

31. Lens irregular, linear, or oblong .....*Poitea*, 8.05
Lens circular..... 32

32. Seed 2.2–2.8 mm long; testa osseous; lens equal to or greater than 0.5 mm in length, not in groove of raphe, dissimilar color from testa, black ..... *Geissaspis*, 14.13
Seed 5–6 mm long; testa coriaceous; lens less than 0.5 mm in length, in groove of raphe, similar color as testa, brown .....*Cascaronia*, 4.16

33. Seed rim present..... 34
Seed rim absent 37

34. Cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon length 35
Cotyledons completely or partially concealing radicle; radicle deflexed and parallel to cotyledon width, oblique to cotyledons, or straight with embryonic axis 36

35. Testa osseous; hilum larger than punctiform, marginal according to radicle tip; endosperm thick ..... *Retama*, 30.21
Testa coriaceous; hilum punctiform, apical at apex of or subapical to radicle tip; endosperm thin .....*Coursetia*, 8.08

36. Seed 4–4.5 mm long, terete; testa coriaceous; rim winglike along 1 side of seed; wings present; hilum not within halo ..... *Inocarpus*, 2.10
Seed 9–16.5 mm long, compressed; testa chartaceous; rim winglike around seed; wings absent; hilum within halo..... *Pericopsis*, 2.17

37. Testa chartaceous 38
Testa osseous or coriaceous 50

38. Hilum apical at apex of radicle tip, subapical to radicle tip, or between cotyledon and radicle lobe 39
Hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip..... 42

39. Seed reniform, flattened; hilum not within halo or rim ..... *Cranocarpus*, 11.02
Seed elliptic, irregular, oblong, or ovate, terete or compressed; hilum within halo or rim 40

40. Seed ca. 38 mm long; hilum fusiform; cotyledons pubescent around base of radicle; radicle triangular; plumule well developed, pubescent ..... *Haplormosia*, 2.16
Seed 3.5–16.5 mm long; hilum circular or elliptic; cotyledons glabrous around base of radicle; radicle bulbose or linear; plumule rudimentary, glabrous 41

41. Seed 3.5–8.2 mm long; hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, within rim; lens linear, flush; cotyledons without basal groin formed by lobes .....*Ammodendron*, 2.46
Seed 9–16.5 mm long; hilum with the lips of the faboid split the same color as the rest of the hilum, within halo; lens diamond-shaped, mounded; cotyledons with basal groin formed by lobes ..... *Pericopsis*, 2.17

42. Seed terete 43
Seed compressed or flattened..... 45

43. Seed asymmetrical; raphe not visible; hilum fully concealed ..... *Strongylodon*, 10.02
Seed symmetrical; raphe visible; hilum visible or partially concealed 44

44. Cotyledons without margins recessed; fruit linear, rounded at base, with epicarp and mesocarp dehiscing and endocarp not dehiscing; endocarp separating into 1-seeded winged segments ..... *Endosamara,* Millettieae
Cotyledons with margins recessed; fruit coiled or moniliform, long tapered at base, with all layers dehiscing, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscing along suture; endocarp entire ..... *Sophora*, 2.45

45. Seed circular, elliptic, ovate, or rhombic 46
Seed reniform 47

46. Testa wrinkled; cotyledons without margins recessed ..... *Derris,* Millettieae
Testa bearing endocarp remnants; cotyledons with margins recessed ..... *Sophora*, 2.45

47. Hilum elliptic, fusiform, heart-shaped, or oval 48
Hilum circular 49

48. Fruit a loment (or a loment segment), apex right-angled with longitudinal axis of fruit, membranous; fruit wings absent; seed length parallel with fruit length ..... *Cranocarpus*, 11.02
Fruit a legume, apex aligned or oblique with longitudinal axis of fruit, chartaceous or coriaceous; fruit wings present; seed length oblique or transverse to fruit length ..... *Derris,* Millettieae

49. Seed flattened; fruit a loment (or a loment segment), without beak; fruit apex right-angled with longitudinal axis of fruit; epicarp villous, glandular ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume, with beak; fruit apex aligned or oblique with longitudinal axis of fruit; epicarp sericeous, eglandular ..... *Austrosteenisia,* Millettieae

50. Cotyledons without lobes 51
Cotyledons with lobes 55

51. Seed terete 52
Seed compressed or flattened 53

52. Hilum without faboid split; epicarp rugose, exfoliating in part; funiculus partially filiform and partially thick ..... *Strongylodon*, 10.02
Hilum with faboid split; epicarp muricate or wrinkled, not exfoliating; funiculus flattened or thick ..... *Erythrina*, 10.01

53. Seed flattened; fruit a loment (or a loment segment), rounded at apex, membranous; epicarp glandular ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume or nutlet, long tapered, tapered, or short tapered at apex, coriaceous, fleshy, leathery, or ligneous; epicarp eglandular 54

54. Hilum elliptic or oval; endosperm absent; embryonic axis oblique; radicle oblique to cotyledons or with 180-degree turn ..... *Erythrina*, 10.01
Hilum circular; endosperm present; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length or width ..... *Poitea*, 8.05

55. Seed symmetrical 56
Seed asymmetrical 59

56. Hilum punctiform; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) ..... *Errazurizia*, 6.05
Hilum larger than punctiform; radicle centered between cotyledons... 57

57. Hilum with straight outline, apical at apex of radicle tip; radicle deflexed and parallel to cotyledon width ..... *Gliricidia*, 8.06
Hilum with curved outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; radicle deflexed and parallel to cotyledon length, oblique to cotyledons, or with 90-degree turn 58

58. Testa glossy; hilum oval, marginal according to radicle tip; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length *Gastrolobium*, 24.13
Testa dull; hilum elliptic, apical according to radicle tip but marginal according to seed length; embryonic axis oblique or right angled; radicle oblique to cotyledons or with 90-degree turn .... *Sophora*, 2.45

59. Endosperm absent 60
Endosperm present 63

60. Hilum larger than punctiform 61
Hilum punctiform 62

61. Fruit a loment (or a loment segment), irregular or reniform, short tapered at base, membranous, nonstipitate ..... *Cranocarpus*, 11.02
Fruit a legume, C-shaped, circular, coiled, falcate, or samaroid, rounded at base, coriaceous or ligneous, stipitate or substipitate ..... *Machaerium*, 4.06

62. Hilum partially or fully concealed, between cotyledon and radicle lobe; embryonic axis deflexed; radicle deflexed and parallel to cotyledon width ..... *Machaerium*, 4.06
Hilum visible, subapical or marginal according to radicle tip; embryonic axis straight; radicle oblique to cotyledons ..... *Taralea*, 3.02

63. Seed with surface grooved ..... *Cicer*, 20.01
Seed with surface smooth 64

64. Testa color modified by a bloom 65
Testa color not modified by a bloom 66

65. Seed oblong, terete or compressed; raphe visible ..... *Diphysa*, 14.03
Seed reniform, flattened; raphe not visible ..... *Cranocarpus*, 11.02

66. Hilum within halo or rim 67
Hilum not within halo or rim 70

67. Radicle linear or triangular 68
Radicle bulbose 69

68. Fruit 2–9 times longer than wide, short tapered at apex; dehiscence of valves active; endocarp spongy; funiculus less than 0.5 mm long ..... *Lupinus*, 30.08
Fruit length less than twice as long as width, rounded at apex; dehiscence of valves passive; endocarp scurfy or smooth; funiculus measured ..... *Gastrolobium*, 24.13

69. Seed 1.6–3 mm long; hilum with curved outline, marginal according to radicle tip; radicle deflexed and parallel to cotyledon length; lens circular ..... *Gompholobium*, 24.01
Seed 5.5–12 mm long; hilum with straight outline, apical at apex of radicle tip; radicle deflexed and parallel to cotyledon width; lens rhombic ..... *Gliricidia*, 8.06

70. Seed reniform 71
Seed circular, oblong, obovate, ovate, quadrangular, or rectangular 72

71. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, rounded at apex, indehiscent; fruit apex right-angled with longitudinal axis of fruit ..... *Cranocarpus*, 11.02
Seed compressed; fruit a legume, linear or oblong, short tapered at apex, with all layers dehiscing; fruit apex aligned with longitudinal axis of fruit ..... *Poitea*, 8.05

72. Lens circular or elliptic; seeds in 2 or more series ..... *Lupinus*, 30.08
Lens irregular, linear, oblong, or rhombic; seeds in 1 series 73

73. Seed 5.5–12 mm long; lens rhombic; mesocarp thick, 2-layered, ligneous; endocarp spongy ..... *Gliricidia*, 8.06
Seed 3–5 mm long; lens irregular, linear, or oblong; mesocarp thin, 1-layered, coriaceous; endocarp scurfy or smooth ..... *Poitea*, 8.05