

Indigofereae (9.01–9.07)

Genus: *Phylloxylon* H.E. Baillon

Phylogenetic Number: 9.01.

Tribe: Indigofereae.

Species Studied—Species in Genus: 2 spp.—7 spp.

Fruit a legume; unilocular; $3\text{--}5 \times 1.3\text{--}1.5 \times 0.7\text{--}1.5$ cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; oblanceolate or ovate; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; compressed or terete; without or with beak; straight; with solid beak the same color and texture as fruit; long tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; reddish brown; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; slightly wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth (but shredding); nonseptate; chartaceous; not exfoliating (but in shreds and margins fibrous); remaining fused to epicarp; entire. Seeds 2 or 1; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

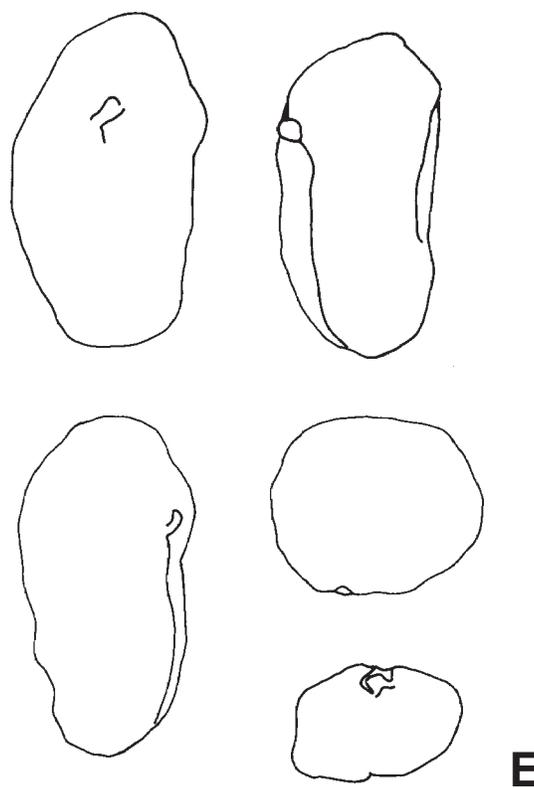
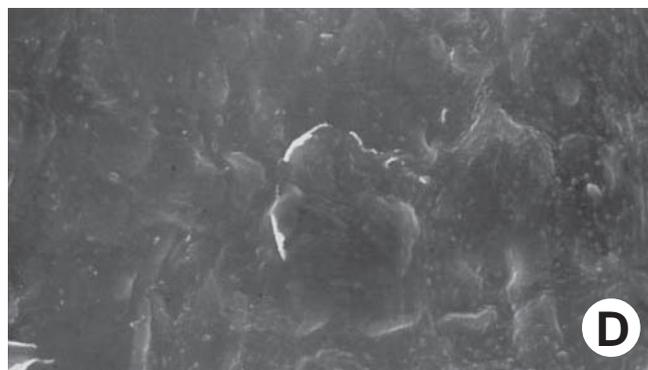
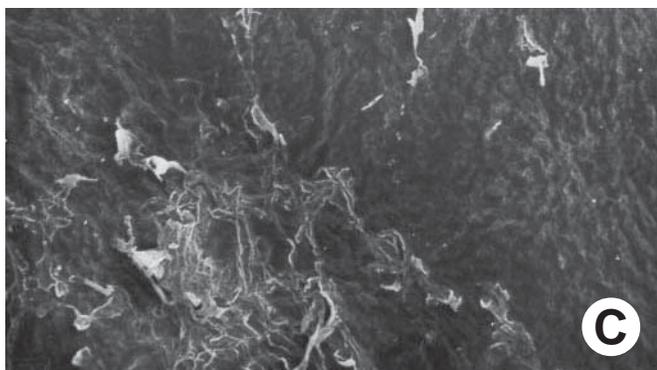
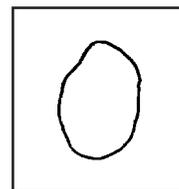
Seed $12\text{--}18 \times 10\text{--}13 \times 10\text{--}13$ mm; overgrown, 1 seed filling entire fruit cavity (or 2); not angular; asymmetrical; circular or oblong; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; slightly lighter than testa;

recessed. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; up to 2 mm long; with curved outline; circular or elliptic; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons completely fused forming a single, indivisible mass; not smooth; wrinkled; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; tan or brown; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; truncate; straight; deflexed and parallel to cotyledon width; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Madagascar.

Notes: Schrire (1995) carried out extensive cladistic analyses with the Indigofereae genera and infrageneric taxa of *Indigofera* (9.07). Du Puy et al. (1995) revised the genus *Phylloxylon*. They changed the name of the most common and most widespread species from *P. decipiens* H.E. Baillon, also type of the genus, to *P. xylophyloides*. Peltier (1970) studied the seeds and sprouts of *P. xylophyloides*. After examining more than 200 seeds from different localities, he concluded that the cotyledons were completely fused without a trace of the line of fusion. Our observations agreed with Peltier's.

Phylloxylon: *P. xylophyloides* (J.G. Baker) D.J. Du Puy, J.-N. Labat & B.D. Schrire (A–E). A, Fruits ($\times 2.1$); B, damaged seed ($\times 4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Rhynchotropis* H.A.T. Harms

Phylogenetic Number: 9.03.

Tribe: Indigofereae.

Species Studied—Species in Genus: 2 spp.—2 spp.

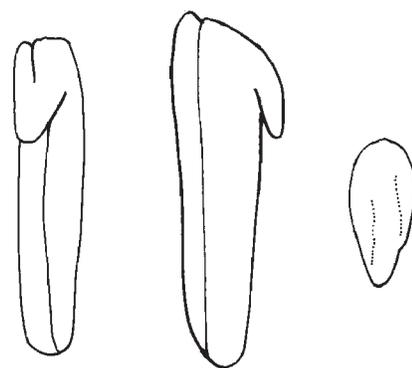
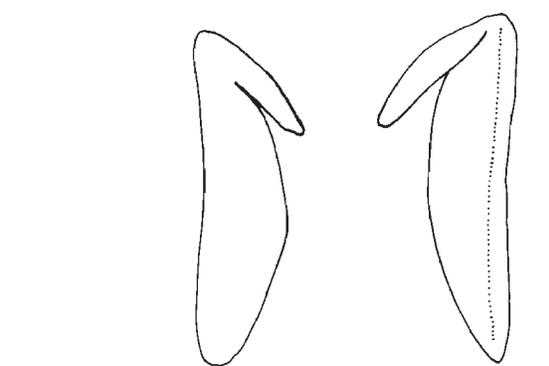
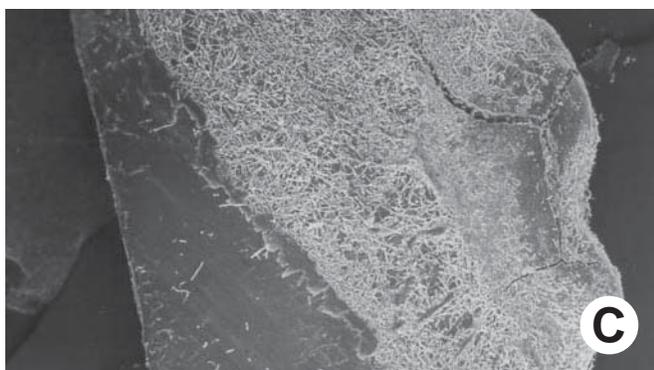
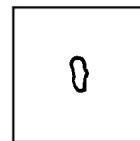
Fruit a legume; unilocular; $4.7 \times 0.4 \times 0.4$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; terete; without beak; long tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture (assumed); passive. Replum invisible. Epicarp dull; monochrome; brown; glabrous; eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; reddish brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp. Seeds 4–6; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

Seed $4.6 \times 2 \times 0.6$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; asymmetrical; reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with recessed features; finely grooved; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; punctiform; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7 mm long; with margins straight; oblong; not in groove of raphe;

adjacent to hilum; 0.7 mm from hilum; flush; same color as testa; dark brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; dark brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: South-central Africa.

Rhynchotropis: *R. poggei* (P.H.W. Taubert) H.A.T. Harms (A–E). A, Fruit ($\times 1.7$); B, seeds ($\times 6.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 15$).



Genus: *Cyamopsis* A.-P. de Candolle

Phylogenetic Number: 9.06.

Tribe: Indigofereae.

Species Studied—Species in Genus: 3 spp.—4 spp.

Fruit a legume; unilocular; $3.5\text{--}5 \times 0.4\text{--}1.8 \times 0.4\text{--}0.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight (or nearly so); not plicate; not twisted; symmetrical; linear (to somewhat falcate); not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome; light to dark brown to tan to black; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with complex hairs; with T-shaped hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated and recessed features; not veined; not tuberculate; wrinkled; longitudinally grooved; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp. Seeds up to 7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; thick; straight. Aril present or absent; dry; tongue-aril; tan.

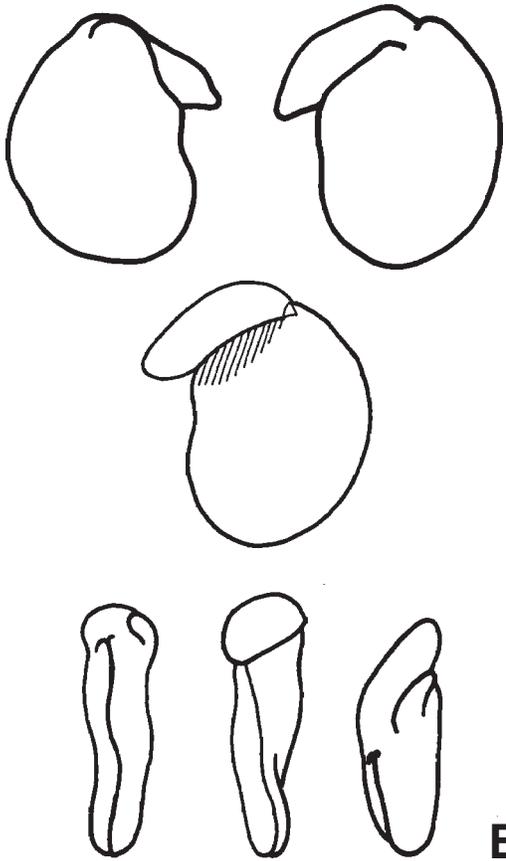
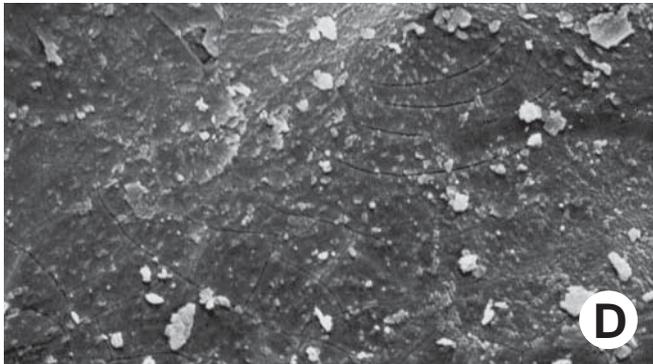
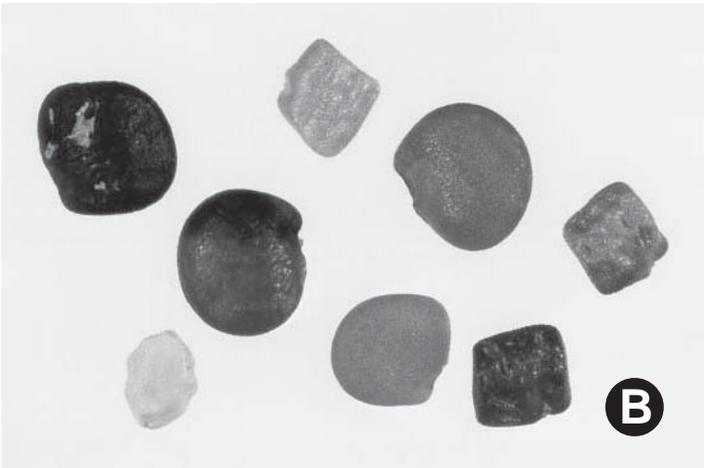
Seed $3\text{--}4 \times 3\text{--}3.4 \times 1.8\text{--}2.8$ mm; overgrown, 1 seed filling entire fruit cavity; angular to not angular; symmetrical or asymmetrical; circular, elliptic, or rectangular; compressed; with surface grooved; with grooves longitudinal and transverse (*C. senegalensis* J.B.A. Guillemin & G.S. Perrottet); with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored or clear (*C. tetragonoloba*); monochrome or bichrome (brown and dark brown); black, brown

(greenish), cream, green, tan, or yellow; glabrous; not smooth; with elevated or recessed features; shagreen; grooved (4 parallel grooves on each face of *C. senegalensis*); coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; with both folded; sufficiently or not sufficiently (just base) folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; differing at apex (1 concealed by overarched radicle and other auriculate and concealing radicle); partially concealing (depending on the cotyledon) or not concealing radicle (depending on the cotyledon); entire over radicle or split over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon width; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Arabia and drier parts of Africa. *Cyamopsis tetragonoloba* is known only from cultivation and was possibly of Indian origin.

Notes: Unlike most faboid seeds soaked in pohlstoffe for less than 24 hours, the testa of *Cyamopsis* species fragments as in *Tripodion* (13.03).

Cyamopsis: *C. tetragonoloba* (C. Linnaeus) P.H.W. Taubert (*C-E*), *C. spp.* (*A-B*). *A*, Fruits ($\times 1.2$); *B*, seeds ($\times 4.2$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Indigofera* C. Linnaeus

Phylogenetic Number: 9.07.

Tribe: Indigofereae.

Species Studied—Species in Genus: 87 spp.—ca. 730 spp.

Fruit a legume (see Notes) or loment (but not a true loment); 0.2–7.5 × 0.2–0.5 × 0.2–0.6 cm; with deciduous corolla; with deciduous calyx; without (more frequently) or with (occasionally) orifice formed by curving of fruit or fruit segments; straight to curved to 1-coiled; not plicate; not twisted; asymmetrical or symmetrical; circular, linear, moniliform, or falcate; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures nearly straight; widest near middle or D-shaped; not inflated; flattened, subtriangular, terete, or quadrangular; without beak; long to short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; long to short tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; constricted along both margins; without sulcus; plain or embellished; with prickles or wings. Fruit wings present (in *I. trifoliata* C. Linnaeus fruit are slightly winged along sutures, and in *I. glandulosa* J.C. Wendland wings are broader and fringed) or absent; 4; 0.1–0.2 mm wide; valvular; on both valves. Fruit nonstipitate. Fruit with all layers dehiscing or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome (some densely minutely pubescent, giving epicarp a silver appearance or silvery patches on a dark color); reddish brown or red (brownish); glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs or glandular hairs (*I. colutea* (N.L. Burman) E.D. Merrill); with T-shaped hairs (biramous); stiff; with hair bases plain; glandular or eglandular; with glandular hairs, dots, or glandular disks (in *Trifoliata* group); with spines (curved) or without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; exfoliating in part or not exfoliating; with or without cracks; cracking transverse to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; mottled, streaked, or

bichrome; brown or tan; with dark spotted mottling; with black, brown, or red (to dark reddish black) overlay; smooth; septate to subseptate to nonseptate; with septa thin (tissue paper-like), flexible to thicker than paper, firm; with septa glandular or eglandular; coriaceous or chartaceous; not exfoliating or exfoliating in part; remaining fused to epicarp; entire. Seeds 1–18; length parallel with fruit length or transverse to fruit length (*I. luzonensis* I. de Kort & G. Thijsse and *I. zollingeriana* F.A.W. Miquel); touching or neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; thick; straight. Aril absent.

Seed 1–6 × 0.9–3.5 × 0.6–3.5 mm; not overgrown; angular to not angular; symmetrical (except hilum) or asymmetrical; circular, irregular, linear, quadrangular, or rectangular; terete, quadrangular, or compressed; with surface grooved; with grooves transverse; with or without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with frequent or infrequent mottles; brown, orange, red (dish-brown), tan, or yellow; with black or red overlay; glabrous; not smooth; with elevated or recessed features; reticulate (*I. australis* C.L. von Willdenow with interesting reticulation), shagreen, tuberculate, or tessoid; pitted with small separate pits or large concatenated pits (with large single pits); coriaceous. Fracture lines absent. Rim absent. Raphe visible or not visible; from hilum to lens; darker than testa; black; recessed. Hilum visible or fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; to 5 mm long; with curved outline; elliptic; apical at apex of radicle tip (*I. linifolia* (C. Linnaeus) A.J. Retzius), marginal according to radicle tip, or between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length; with margins straight or curved; irregular, wedge-shaped, hourglass, or dumbbell-shaped; not in groove of raphe; adjacent to hilum; less than 1 mm from hilum; mounded; dissimilar color from testa; darker than testa; brownish black, brown, or red (brownish); not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; differing (1 concealed by overarched radicle and other auriculate and concealing radicle) or similar at apex;

partially concealing or not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white or yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; perpendicular to length of seed. Radicle linear; deflexed and parallel to cotyledon length or width; centered or not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); less than 1/2 length of cotyledons to 1/2 to nearly length of cotyledons. Plumule rudimentary to moderately developed to well developed; glabrous.

Distribution: Pantropic and pansubtropic.

Notes: Gillett (1958) monographed *Indigofera* (including *Microcharis* G. Bentham (9.04)) in tropical Africa and recognized five subgenera. Kort and Thijsse (1984) noted that Polhill (1981f) treated *Indigofera* with its two satellite genera, *Cyamopsis* (9.06) and *Rhynchotropis* (9.03), together with the rather anomalous Madagascan genus *Phylloxylon* (9.01) (hitherto of unknown affinity) in tribe Indigofereae. Schrire (1995) performed extensive cladistic analyses with the Indigofereae genera and *Indigofera* infrageneric taxa. He concluded that *I.* subgen. *Indigastrum* (H.F. Jaubert & É. Spach) J.B. Gillett, *I.* subgen. *Microcharis* (G. Bentham) J.B. Gillett, *Cyamopsis*, and *Rhynchotropis* formed a sister clade to the remainder of *Indigofera*, so he reinstated the aforementioned *Indigofera* subgenera as genera, *Indigastrum* H.F. Jaubert & É. Spach (9.05) and *Microcharis*. Pending a general expression of opinion by the botanical community concerning Schrire's changes, we have chosen to present *Indigofera* with its traditional circumscription (Gillett 1958, 1971; Polhill 1981f). Choi and Kim (1997) sequenced the ITS region of six *Indigofera* species, and concluded that the ITS sequence will be useful for understanding *Indigofera* classification and evolution. We had seeds available for study of only of three species of *I.* subgen. *Indigastrum*: (1) *Indigofera argyraea* C.F. Ecklon & C.L.P. Zeyher (*Indigastrum argyraeum* (C.F. Ecklon & C.L.P. Zeyher) B.D. Schrire), (2) *Indigofera fastigiata* E.H.F. Meyer (*Indigastrum fastigiatum* (E.H.F. Meyer) B.D. Schrire), and (3) *Indigofera parvifolia* B. Heyne ex R. Wright & G.A.W. Arnott (*Indigastrum parvifolium* (B. Heyne ex R. Wright & G.A.W. Arnott) B.D. Schrire); and of only one species of *I.* subgen. *Microcharis*, *Indigofera disjuncta* J.B. Gillett (*Microcharis disjuncta* (J.B. Gillett) B.D. Schrire). The seed characteristics of these four species were congruent with those of the other 83 *Indigofera* species

studied. The dark spots on the outer endocarp surface are "groups of swollen coloured cells rich in tannin" (Gillett 1958, p. 2), and they can form pits in the seeds. The fruits of species such as *I. cryptantha* G. Bentham ex W.H. Harvey appear to be loment, but this is not true. These fruits are dehiscent legumes and not loment separating into articles.

Indigofera: I. kirilowii C.J.M. Maximowicz & I.V. Palibin
(*D-F*), *I. spp.* (*A-C*). *A*, Narrow fruits ($\times 1.2$); *B*, wide
fruits ($\times 5.3$); *C*, seeds ($\times 2.2$); *D-E*, testa ($\times 50$,
 $\times 1000$); *F*, embryos ($\times 6$).

