Taxonomic and Morphological Notes on *Hypoxis angustifolia* (Hypoxidaceae) from Africa, Madagascar, and Mauritius

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ABSTRACT. Four varieties within *H. angustifolia* Lamarck, the most common species of the genus *Hypoxis* L. in Africa, are recognized, based in part on differences of seed testa features between populations in Mauritius, Madagascar, and continental Africa. SEM micrographs of seeds of *H. angustifolia* var. *angustifolia*, variety *luzuloides* (Robyns & Tournay) Wiland, and variety *madagascariensis* Wiland are included, and full descriptions of the above varieties as well as *H. angustifolia* var. *buchananii* Baker are given.

Key words: Africa, Hypoxidaceae, *Hypoxis*, Madagascar, Mauritius.

Hypoxis angustifolia is the most common and widely distributed species of *Hypoxis* (Hypoxidaceae) in Africa and on West Indian Ocean islands (Baker, 1877: 369, 1878a: 265, 1878b: 111, 1896: 180–181, 1898: 378; de Cordemoy, 1895: 188; Durand & Schinz, 1895: 231, 1896: 260; Engler, 1908: 352; Durand & Durand, 1909: 554; Nel, 1914b: 303; De Wildeman, 1921: 33; Bews, 1921: 64; Hutchinson & Dalziel, 1936: 394; Guinea López, 1945: 258; Williams, 1949: 302; Robyns & Tournay, 1955b: 388; Troupin, 1956: 207; Andrews, 1956: 306; Binns, 1968: 53; Hepper, 1968: 172; Morton, 1968: 31; Geerinck, 1971: 5–6; Jacot Guillarmod, 1971: 148; Troupin, 1971: VI.277; Ross, 1972: 132; Wickens, 1976: 160; Marais, 1978; Nordal et al., 1985: 24; Champluvier, 1987: 81; Nordal & Iversen, 1987: 34; Agnew & Agnew, 1994: 313; Thulin, 1995: 31; Zimudzi, 1996: 15; Nordal, 1997: 87). Throughout its range from Guinea-Conakry to Mauritius and to South Africa (for a map with general distribution see Wickens, 1976: 316) this species occurs from sea level to about 2000 m (Nordal et al., 1985, suggested even to 3000 m). It is common in a wide variety of open habitats, including secondary habitats such as road borders, grazed pastures, fields, and plantations.

Hypoxis angustifolia is regarded as a "good" species on the basis of cytological observations: its karyotype is established at the diploid (rarely tripoloid) level, with no indications of apomixis (Nordal et al., 1985). It is characterized by wide morphological variation but was usually treated as a single species without infraspecific taxa (e.g., Geerinck, 1971). Some authors (Nel, 1914b; Marais, 1978) facing the morphological variation within this species observed that it should probably be divided into microspecies. Until the present, however, only the variety *H. angustifolia* var. *buchananii* Baker had been described from the southeastern African coast.

For this paper a thorough study of morphology of *H. angustifolia* was conducted on specimens from Central Africa, Madagascar, and Mauritius and compared with specimens from other regions of the continent. Characters shared by almost all populations of the species include a membranous tunic, corymbose inflorescences with long pedicels, and two-branched trichomes on the leaves. Field observations in Tanzania show that the plant habit of *H. angustifolia* is highly influenced by its habitat. Plants growing in places exposed to sun and wind, on rocks, especially along disturbed areas like paths, tend to have rather rigid, narrow leaves. Plants occurring on the forest bottom tend to have wider leaves, which are soft in texture. Specimens in numerous herbaria (B, BR, BRLU, DAR, K, MO, NHT, P, POZG, TAN, UPS, WAG) often differ widely in dimensions and sometimes also shapes of tepals, anthers, pistils, and bracts; it seemed possible at first that this morphological variation might be as great within a single population as between widely separated populations.

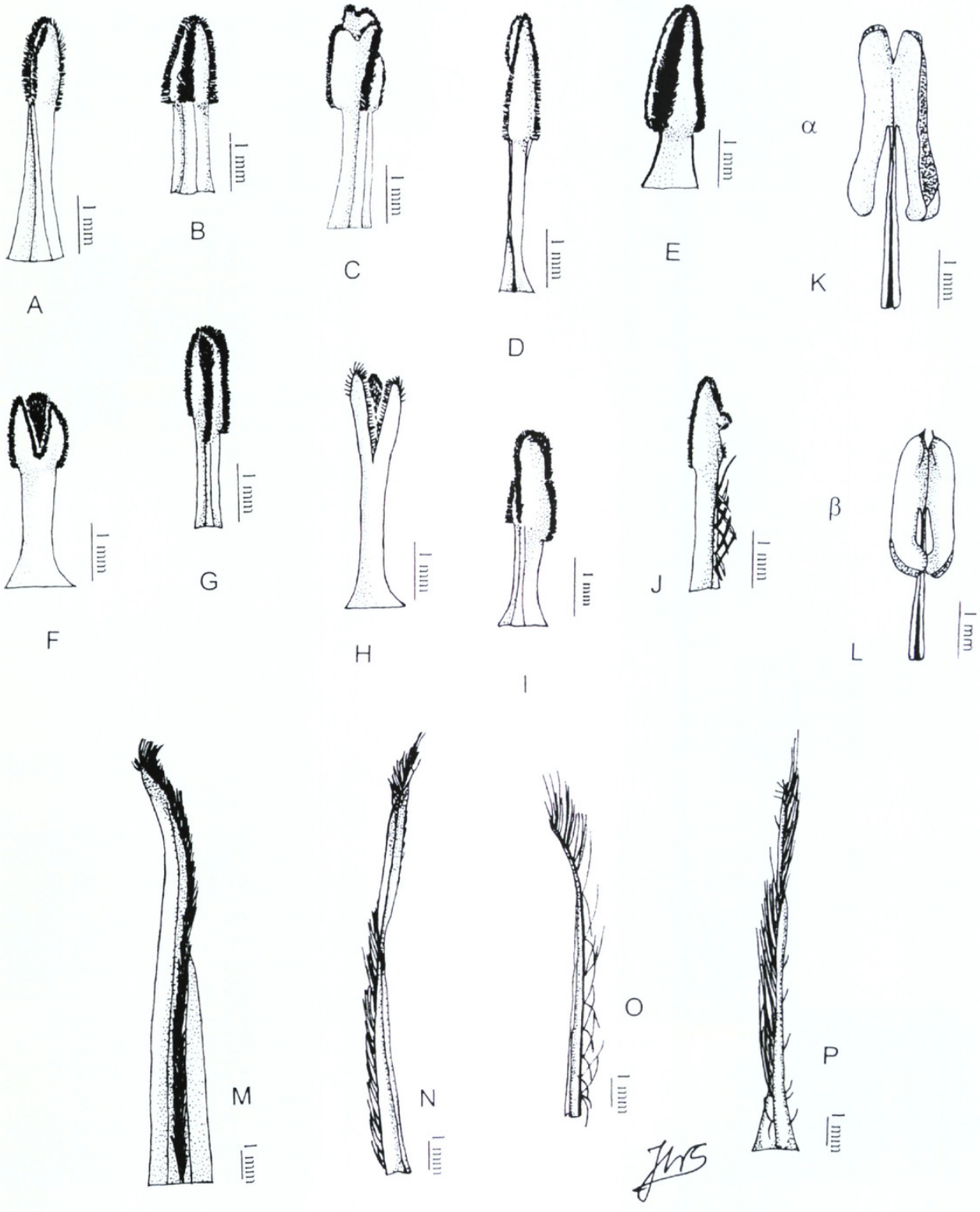

Figure 1. *Hypoxis angustifolia* var. *luzuloides* (Robyns & Tournay) Wiland. —A–I. Morphological forms of style with stigma. —J. Anomalous style and stigma. —K. Stamen, form α. —L. Stamen, form β. —M–P. Bracts. A & N from *Bamps & Malaisse 8052*, BR; B from *Quarre 5056*, BR; C from *Noirfalise 826*, BR; D from *Gillet s.n.*, BR; E from *Troupin 1243*, BR; F from *Lejoly 82/1013*, BRLU; G from *Liben 620*, BR; H from *Van Oosten 120*, BR; I from *Pauwels 6009*, BR; J from *Vanderyst s.n.*, BR; K & O from *Williams 18*, BR; L & M from *Lisowski 86119*, POZG; P from *Lewalle 5486*, BR.

Studies conducted on mature flowers from 51 herbarium sheets of *H. angustifolia* from Central Africa provided the observation that morphologies of style and stigma are the most variable characters in this species. Ten forms of gynoecium were observed, differing in a ratio of stigma to style length and stigma shape (Fig. 1A–I). They can be divided into two groups according to the ratio between style

and stigma: the first group, when the style is much longer than the stigma (Fig. 1A, C, D, F, H), and the second group when both are of equal size (Fig. 1B, G, I) or the stigma is longer than the style (Fig. 1E). The style can be trigonal in cross section (Fig. 1A, B, C, D, G, I) or terete (Fig. 1E, F, H), visibly tapering toward the apex (Fig. 1A, C, E) or wider only in the basal part and then of a constant width (Fig. 1D, F, H, I) or equal throughout its length (Fig. 1B, G). It can be massive in shape (Fig. 1B, E, F) or thin and delicate (Fig. 1D, H). The stigma is usually composed of three lobes except in one case where it is divided in four (Fig. 1C). The lobes can be totally fused, and in this case the papillae will be distributed in three stripes (Fig. 1A, B, D, E, G, I). All of these stripes can be of an equal length (Fig. 1A, B, D, E) or unequal (Fig. 1G, I). They might be of uniform width (Fig. 1A, D), tapering toward the stigma's apex (Fig. 1B, E) or tapering toward its base (Fig. 1G, I). Another variable feature is stigma shape. It tends to be more or less pyramidal in shape, tapering toward the apex (Fig. 1B, D, E), ovoid (Fig. 1A), or rather oblong (Fig. 1G, I). Sometimes the stigma consists of three free lobes (Fig. 1F, H) covered with papillae on their edges and adaxially. Lobes can be triangular in shape (Fig. 1F) or oblong (Fig. 1H). In several specimens the stigma was divided in the apical part into 4 obtuse lobes covered with stripes of papillae on margins (Fig. 1C). In one case an anomaly in the gynoecial structure was observed (Fig. 1J): one stripe of papillae on a stigma is much shorter and there is a spherical appendage covered with papillae below it, and 2-branched trichomes grow out of the style. The occurrence of trichomes on the style is extremely rare and may be considered a developmental anomaly. The most common forms of gynoecium are depicted in Figure 1A and 1D. Frequently plants with a different gynoecial type look alike otherwise. No correlation among gynoecial structure, other morphological features, or geographical range was observed. Palynological and molecular studies might provide insights into the origin of this natural infraspecific diversity.

The fact that the ratio of style to stigma length is not constant within *H. angustifolia* negates the taxonomic value of the sections proposed by Nel (1914a, 1914b), who emphasized this character as one of the most important in his subdivision of *Hypoxis*. It was already observed as a common situation in this genus (Nordal et al., 1985). In the description of section *Angustifoliae*, Nel (1914a) implied that species of this group posses a gynoecium with a stigma much shorter than the style, and only exceptionally equal. Although Nel gave *H. dinteri* Nel as an example for this section, the sectional epithet is taken from *H. angustifolia*, a species with a much greater variability in these characters. Nel's observations of variability within *H. angustifolia* were limited to dimensions of leaves.

The morphological variability of the reproductive organs in *H. angustifolia* involves stamens as well. The stamens are biseriate, with the inner cycle usually shorter than the outer, with a difference of about 0.5–1.0 mm, entirely due to the length of filaments. Equally long stamens were observed only in a few plants. Filaments are subulate, with one distinct vein and almost membranous edges. Rarely, they are linear and wider only in the basal part. There are two anther forms named here α and β (Fig. 1K, L). Both are emarginate at the apex, exactly as Nel (1914a, 1914b) observed, and sagittate at the base. Anthers α are usually relatively long in comparison to the filaments and reach 2–3 mm in length (exceptionally 1 mm). Thecae are oblong and obtuse on both ends (Fig. 1K). Raphides are often visible in the outer tissue. Anthers β are usually shorter, 1.2–2.5 mm long (exceptionally 3 mm long). Thecae are obtuse in the basal part. The connective is thickened in the apical part and often prolonged into tiny appendages, a phenomenon that is especially distinct after dehiscence (Fig. 1L). Anthers α are much more common than β and were observed in 60% of studied plants.

There is usually a difference between bracts subtending older and younger flowers in one inflorescence in most species of *Hypoxis*. Upper younger bracts in *H. angustifolia* are usually one-veined and similar to each other. Older bracts are more variable. All bracts are subulate, acute and more or less keeled, covered with trichomes along the midrib abaxially (Figs. 1M–P). The most common bracts are 5–15 mm long, usually less than 1 mm wide; lightly keeled or plane in the middle, flatly hooded at apex, single veined, villous along the midrib, hispid at apex, exceptionally with simple trichomes on edges near apex; sometimes with some raphide cells or red stripes on midrib (Fig. 1N, O). Less common are strongly keeled bracts with two smaller veins parallel to the midrib; 12–17 mm long and 1.5–2.0 mm wide; with appressed trichomes and occasionally with several simple trichomes on edges at apex, very often with raphide cells in tissue (Fig. 1M). The least common are bracts ca. 12.5 mm long and 0.5–1.7 wide, single-veined, pubescent with long (to 4 mm) trichomes, almost glabrous in basal part, sparsely ciliate on margins with short simple trichomes (Fig. 1P).

During the study of Madagascar plants it was observed that in many specimens of *H. angustifolia*,

especially *H. angustifolia* var. *madagascariensis*, the apices of the inner tepals are covered with club-shaped one- or few-celled papillae (Fig. 3B). Such papillae sometimes also occur on the tepals of continental plants; however, they are usually not as visible as in Madagascar populations. This feature of inner tepals has so far not been observed in any other species of *Hypoxis*; in other species the inner tepals are usually apically flat and entire, although they are sometimes acute. The outer tepals are always somewhat hooded at the apex and possess a small appendage covered with papillae or short trichomes (see Wiland, 1997).

A sculptured seed testa has often been noted as a shared character in *H. angustifolia* (Nordal et al., 1985; Nordal & Iversen, 1987). It is usually brown in coloration, in some specimens showing a bit of iridescence, that makes it similar to the testa of some American species (Brackett, 1923). SEM micrographs from African populations show ovoid seeds to 2 mm long with a short papillose appendage at the apex, and the testa with pyramidal pointed projections covered with a wrinkled brown cuticle (Fig. 2A, B) (see also Nordal et al., 1985: 19; Nordal & Iversen, 1987: 45). Seeds of *H. angustifolia* var. *buchananii* are black (Y. Singh, pers. comm.), but unfortunately they were not available for a closer examination.

An examination of materials from Madagascar and Mauritius at MO revealed that numerous specimens of *H. angustifolia* possess seeds with a testa sculpture different from that described above. No other authors dealing with Hypoxidaceae from these islands (Baker, 1877; de Cordemoy, 1895; Perrier de la Bâthie, 1950) except Marais (1978) have noted the seed testa sculpture of *H. angustifolia*. Specimens from Mauritius, including the type specimen, have black seeds with colliculate testa and smooth cuticle (Fig. 2C). Semi-spherical papillae are minutely micropapillate on their surface (Fig. 2D). Such seeds were mentioned by Marais (1978) for the plants of Réunion and Mauritius and depicted on the plate in his paper. In plants from Madagascar two kinds of testa sculpture are present. A large proportion of specimens have testa with pyramidal papillae covered with a wrinkled brown cuticle, as is common in continental plants. Some specimens, however, possess black seeds with slightly longitudinally furrowed tuberculate papillae (Fig. 2E, F). The latter sculpture pebbling is different from that observed in Mauritius as well as on the African continent.

Because of the morphological variation of the seed testa sculpture in *H. angustifolia* from Mauritius, Madagascar, and continental Africa, recognition of four varieties is justified. *Hypoxis angustifolia* var. *buchananii* moreover is easily distinguishable because of its larger habit and because it grows in tufts versus the smaller and solitary-growing plants of other varieties. The island taxa are probably descendants of the continental populations. However, *H. angustifolia* was first described from Mauritius, so the type specimen possesses seeds with the least common type of testa sculpture.

Hypoxis angustifolia Lamarck, Encycl. 3: 182. 1789. TYPE: Mauritius. *Commerson s.n.* (holotype, P, computer image seen).

Perennial *herb*, 10–53 cm high; *rhizome* globose, 0.5–1.2 cm diam. (when dry), white inside, surmounted by inconspicuous membranous remains of old leaves, sometimes with some thin fibers; roots white, ± thick. Leaves grouped in a whitish pseudostem, *outer leaves* rarely present, if present not numerous, ovoid and spathe-like in basal part, linear in upper part, acute, to 10 cm long, ca. 0.7 cm wide, pilose along midrib and margins beneath with 2-branched white trichomes; nervation composed of 5 to 13 veins of unequal size; *inner leaves* 3 to 16, grass-like, linear or broadly linear, tapering toward apex, keeled, often recurved along two prominent lateral veins, acute at apex, 7–50 cm long, 0.2–1.0 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes 2(–3)-branched, 1.3–2.5 mm long, golden or white, soft; nervation composed of 5 to 29 veins of unequal size with 2 or 4 lateral veins prominently larger than the others. *Scapes* 1 to 7, 4–20 cm high, 0.5–1.1 mm wide, compressed, winged and glabrous in lower half, ciliate in upper half and pilose only beneath inflorescence; trichomes 2- or 3-branched; *flowers* single or in a lax 2- to 6-flowered corymbose cyme; *bracts* subulate or sword-shaped, acute, often two subtending a solitary flower, sometimes those subtending first two flowers much larger than upper ones, 3–17 mm long, 0.2–1.7 mm wide, keeled, 1-, 3-, or 5-veined, glabrous, villous or sparsely pilose on midrib abaxially, sometimes ciliate on margins; *pedicels* 5.5–35 mm long, pubescent or pilose. *Tepals* 6 (exceptionally 4), yellow, bright yellow, or outer tepals green and inner yellow, sometimes with a red or brownish stripe along midrib; *outer tepals* ovate, acute at apex, 3.5–10.0 mm long, 1.0–3.3 mm wide, adaxially with a clavate appendage below apex, 5- to 7-veined with irregular veins, villous or sparsely pilose abaxially; *inner tepals* ovate, obtuse, 3.5–9.0 mm long, 1.2–4.0 mm wide, 5- to 7-veined with irregular veins,

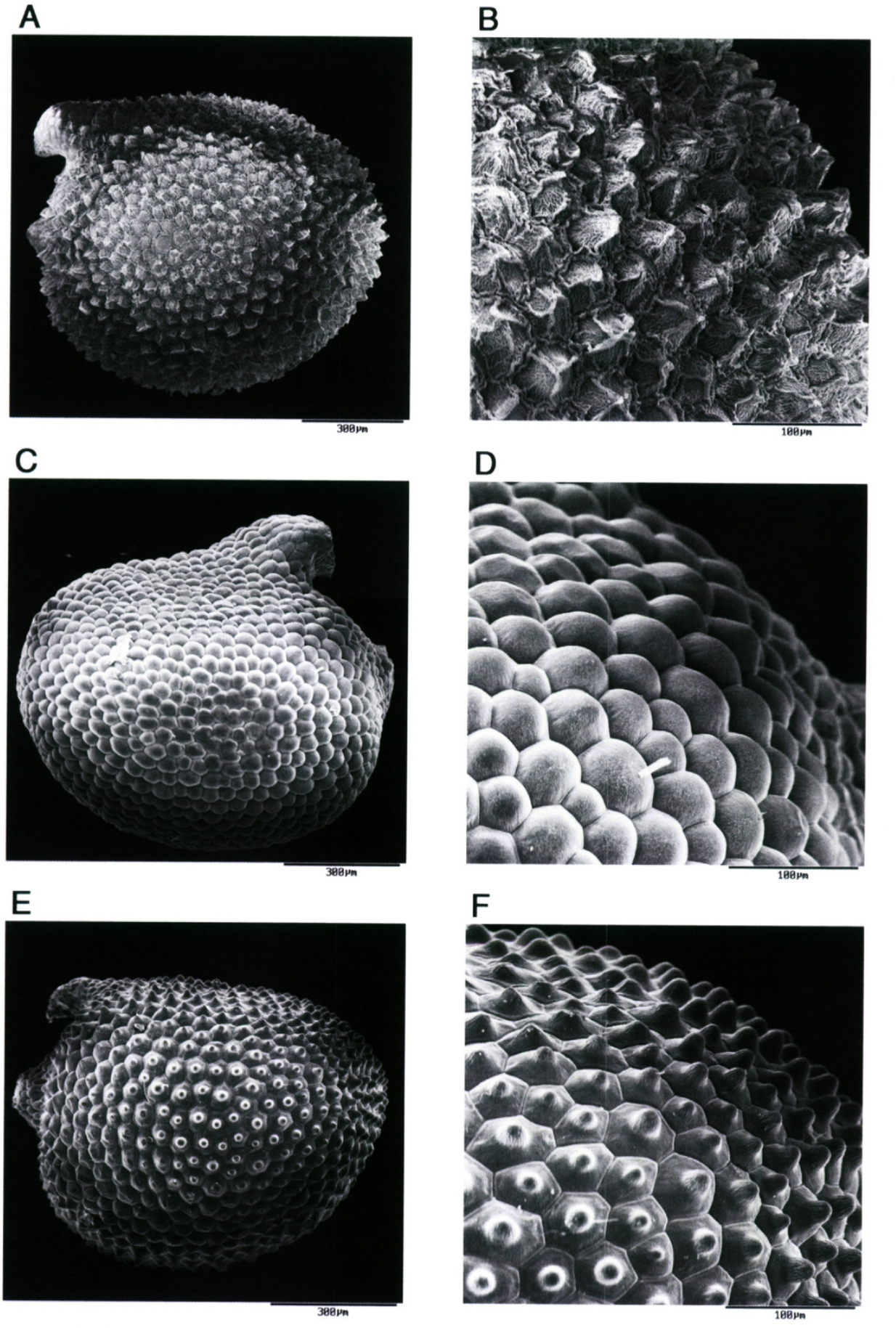

Figure 2. A, B. *Hypoxis angustifolia* var. *luzuloides*.—A. Seed. —B. Seed testa sculpture. C, D. *H. angustifolia* var. *angustifolia*.—C. Seed. —D. Seed testa sculpture. E, F. *H. angustifolia* var. *madagascariensis*.—E. Seed. —F. Seed

glabrous or pilose along midrib abaxially; *stamens* usually unequal, outer longer than inner or rarely equal; *filaments* subulate; outer stamens 2.2–4.0 mm long with filaments 1.3–3.0 mm long; inner stamens 1.7–3.5 mm long with filaments 1–2 mm long; *anthers* linear, deeply sagittate at base, retuse at apex, 1.0–3.2 mm long; *ovary* obconical, 2–5 mm long, 1–3 mm wide, almost glabrous or villous; *style* 0.5–3.0 mm long; *stigma* 0.6–2.5 mm long, both variable in shape. *Capsule* turbinate, 3.5–14.0 mm long, 2.5–4.0 mm diam., glabrous or pubescent, surmounted by persistent perigon, often splitting in three lobes; *seeds* numerous, ovoid, 0.8–2.0 mm long, 0.65–0.80 mm wide, with short papillose appendage at apex, black or brown; for cuticle and testa features, see varietal descriptions.

KEY TO THE VARIETIES OF *HYPOXIS ANGUSTIFOLIA*

1a. Plants growing in tufts; inner leaves 9–10 mm wide, flat, with at least 4 prominent lateral veins . . . . . *H. angustifolia* var. *buchananii*
1b. Plants growing solitary; inner leaves 3–8 mm wide, with 2 prominent lateral veins.
  2a. Seeds brown; papillae pyramidal; cuticle wrinkled . . . . . *H. angustifolia* var. *luzuloides*
  2b. Seeds black; papillae semi-spherical or tuberculate; cuticle smooth.
    3a. Papillae semi-spherical . . . . . *H. angustifolia* var. *angustifolia*
    3b. Papillae tuberculate . . . . . *H. angustifolia* var. *madagascariensis*

Hypoxis angustifolia var. **angustifolia**

Herb to 5–15 cm high; *rhizome* 0.8–1.2 cm diam. (when dry). *Inner leaves* 3 to 10, linear, 7–15 cm long, ca. 0.2 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes golden; nervation composed of 7 to 11 veins with two lateral veins prominently larger than the others. *Scapes* 2 to 7, 4.0–7.5 cm high, 0.5–0.8 mm wide, ciliate in lower half, pilose in upper half; *flowers* single or in a lax 2-flowered cyme; *bracts* subulate, usually two subtending a solitary flower, 3–7 mm long, ca. 0.2 mm wide, 1-veined, villous on midrib abaxially; *pedicels* 7–11 mm long, pubescent. *Tepals* 6, yellow or bright yellow; *outer tepals* 4–5 mm long, ca. 2 mm wide, 5-veined, villous abaxially; *inner tepals* 3.7–4.5 mm long, 1.2–1.4 mm wide, 5-veined, pilose along midrib abaxially; *stamens* unequal; outer stamens 2.4–2.8 mm long with filaments 2.0–2.1 mm long; inner stamens 1.7–2.5 mm long with filaments 1.8–2.0 mm long; *anthers* ca. 1 mm long; *ovary* ca. 2.5 mm long, ca. 2 mm wide, villous; *style* subulate, 1.5–2.0 mm long; *stigma* 0.6–0.7 mm long, composed of three fused lobes. *Capsule* 3.5–4.5 mm long, ca. 3 mm diam., pubescent; *seeds* ca. 1 mm long, ca. 0.8 mm wide, black; testa covered with smooth cuticle; semi-spherical papillae minutely micropapillate on their surface (Fig. 2C, D).

Habitat. Gravelly soil, along path and roadside in sun with grasses; in open, humid places (Marais, 1978); 660–770 m altitude.

Observations. This typical subspecies occurs on Mauritius and probably also on Réunion.

Flowering January and September.

Specimens examined. MAURITIUS. Montane Cocotte nature reserve, *Lorence 2248* (MO); Macambe forest, *Lorence 660* (MO).

Hypoxis angustifolia var. **buchananii** Baker, J. Linn. Soc., Bot. 17: 111. 1878b. TYPE: South Africa. Natal: Nov. 1875, *Buchanan s.n.* (holotype, K).

Herb to 35 cm high; *rhizome* not seen. *Inner leaves* 4 to 6, broadly linear, 16–35 cm long, 0.9–1.0 cm wide, sparsely ciliate on margins and midrib beneath; trichomes golden; nervation composed of 25–29 veins with 4 lateral veins prominently larger than others. *Scapes* 4 to 5, 13.0–19.5 cm high, ca. 1 mm wide, winged and glabrous in lower half, ciliate in upper half, sparsely pilose on the whole surface below inflorescence; *flowers* in a very lax 2- to 3-flowered cyme; *bracts* subulate, 6–9 mm long, ca. 1 mm wide, 1-veined, pilose on midrib abaxially; *pedicels* 20–35 mm long, sparsely pilose. *Tepals* 6, yellow; *outer tepals* ovate, acute at apex, ca. 10 mm long, ca. 3.3 mm wide, with an oblong appendage, 7-veined, sparsely villous abaxially with 2- or 3-branched trichomes; *inner tepals* ca. 9 mm long, ca. 3 mm wide, 7-veined, pilose along midrib abaxially to half of its length; *stamens* unequal; outer stamens ca. 4 mm long with filaments ca. 2.5 mm long; inner stamens ca. 3.5 mm long with filaments 2.0 mm long; *anthers* ca. 3.2 mm long; *ovary* 4.0–4.5 mm long, ca. 1.2 mm wide, villous; *style* ca. 0.5 mm long; *stigma* ca. 2 mm long, pyramidal, obtuse at apex, wider than style, with three wide stripes of papillae. Fruits and seeds not seen.

Observations. On the sheet with the type specimen three plants are present. Two of them corre-

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testa sculpture. A and B from *Lewalle 5486*, MO; C and D from *Lorence 1421*, MO; E and F from *Lowry, Rakotozafy & Nicoll 4208*, MO.

spond to the description above, whereas one has much narrower leaves with fewer veins and belongs to the widespread continental variety. So far, *H. angustifolia* var. *buchananii* was cited from only two other collections: from Inanda *Wood 426, 771* (Baker, 1896: 180–181). Whereas *H. angustifolia* var. *luzuloides* occurs mainly in open places with sunlight, Baker (1896: 180) observed that this is "a large shade grown variety, with longer leaves of very thin texture; pedicels longer, very slender." Pedicels of this taxon are indeed usually longer than in the other varieties; however, this feature overlaps somewhat between *H. angustifolia* var. *buchananii* and *H. angustifolia* var. *luzuloides*. This variety, which occurs on the very edge of the range of *H. angustifolia*, certainly deserves further study.

Specimen examined. REPUBLIC OF SOUTH AFRICA. **Natal:** Umzinto, Rynie Park, *Strey 5974* (BR).

Hypoxis angustifolia var. **luzuloides** (Robyns & Tournay) Wiland, comb. et stat. nov. Basionym: *Hypoxis luzuloides* Robyns & Tournay, Bull. Jard. Bot. État 25: 254. 1955. TYPE: Congo-Kinshasa. Kivu, Tschambi, *G. F. de Witte 1130* (holotype, BR).

Herb 10–53 cm high; *rhizome* 0.8–1.2 cm diam. (when dry). *Inner leaves* 3 to 12, grass-like, linear, tapering toward apex, usually keeled, often recurved along two prominent lateral veins, acute at apex, 10–50 cm long, 0.3–0.8 cm wide, ciliate on margins and midrib beneath or very sparsely pilose on entire surface; trichomes golden or white; nervation composed of 5 to 13(23) veins with 2 thicker than others. *Scapes* 1 to 6, 5–20 cm high, ca. 1 mm wide, ciliate in lower half, pilose in upper half; *flowers* single or in a lax 2- to 6-flowered cyme; *bracts* subulate, 12–17 mm long, (0.5–)1.0–1.7 mm wide, 1- or 3-veined, villous on midrib abaxially, sometimes ciliate on margins; *pedicels* 12–25 mm long, pubescent. *Tepals* 6 (exceptionally 4), yellow, bright yellow, or outer tepals green and inner yellow, sometimes with a red stripe along midrib; *outer tepals* 5–8 mm long, 2–3 mm wide, 5- to 7-veined, villous abaxially; *inner tepals* 4–7 mm long, 3–4 mm wide, 5- to 7-veined, pilose along midrib abaxially to ¾ of its length; *stamens* usually unequal; outer stamens 3–4 mm long with filaments 2.5–3.0 mm long; inner stamens 2–3 mm long with filaments 1.5–2.0 mm long; *anthers* 1.5–3.0 mm long; *ovary* 2–5 mm long, 1–3 mm wide, villous; *style* 1–3 mm long, *stigma* 0.7–2.5 mm long, both variable in shape. *Capsule* 7–14 mm long, ca. 3 mm diam., pubescent; *seeds* ca. 2 mm long, 0.65–0.80 mm wide, brown; papillae pyramidal, testa covered with wrinkled cuticle (Fig. 2A, B).

General distribution. Intertropical and southern Africa, Madagascar, Mascarenes.

Habitat. Miombo; dry forest; bush; various grasslands; wooded grassland in river valleys; river banks; lakeshores, moist depressions; dunes; on base of termite mounds; pastured grassland on rocky soil; granite slabs on slopes; secondary grassland on laterite; fallow fields in grassland, shrubby fallow fields on sand; moist roadsides, roadside ditches, along trails and roads in the forest, disturbed forest, rocky gorge on steep grade; cultivation of manioc; loamy soil, with kaolin, rocky soil. Altitude 0–2800 m.

Observations. Flowering from January to May. Medicinal plant; pulp from the rhizome is useful for healing pustules and infected wounds (Gillet & Pâque, 1910). Its chemical compounds were studied by Sibanda et al. (1990). *Hypoxis luzuloides* Robyns & Tournay (1955a) was described from Central Africa as a separate species in Nel's section *Argenteae* based on the fact that in the type specimen the stigma was longer than the style. This is, however, weak support as discussed above. Various authors included this name in the synonymy of *H. angustifolia* (Geerinck, 1971; Nordal et al., 1985; Zimudzi, 1996; Nordal, 1997; Wiland-Szymańska, 2001). The type specimen of *H. luzuloides* possesses all features common in *H. angustifolia* and seeds with the testa sculpture and wrinkled cuticle typical of continental populations. I have therefore transferred this specific epithet to the varietal rank rather than choosing a new epithet and type specimen.

Selected examined specimens. SIERRA LEONE. *Haswell 37* (K), *Morton SL3532* (K). NIGERIA. **Kaduna:** Igabi Dist., Anara, *Keay 25779* (K). **Plateau:** Jos Plateau, Naraguta, *Lawlor & Hall 101* (K). **Taraba:** Mambila Plateau, *Chapman 66* (K). **Adamawa:** Chappal Hendu, *Chapman 4424* (K). CAMEROON. **North-West:** Bamenoa, Bafut-Ngemba, *Richards 5308* (K). CHAD. **Chari-Baguirmi:** Region du Lac Fitri entre Boullai et Djannaw, *Chevalier 9485* (K). CENTRAL AFRICAN REPUBLIC. **Bamingui-Bangoran:** 8°28′N, 20°53′E, *Fay 3105* (K). SUDAN. **Darfur:** Jabel Marra, *Wickens 1945* (K). ETHIOPIA. *Thulin, Hynde & Tadesse 3369* (UPS). **Amhara:** Blue Nile Gorge, *Gilbert 2162* (K). **Oromiya:** 5 km N of Neghelle, *Vollesen 2640* (K). **Southern:** 11 km S of Dilla, *Friis, Tadesse & Jefford 4274* (K). CONGO-KINSHASA. **Bas-Zaïre:** Lutete, *Hens 221* (BR, K, P). **Kinshasa:** Kimuenza, *Lejoly 82/1013* (BR, BRLU). **Bandundu:** Chutes Tembo, *Breyne 2590* (BR). **Haut-Zaïre:** Abok, *Scops 168* (BR); Nioka, *Lejoly 3338* (BRLU), *Lisowski 48484* (POZG). **Kasai Oriental:** Lomami, *Dandoy 206* (BRLU). **Kivu:** Kikanga, *Bequaert 4211* (BR). **Shaba:** Tshibonde, *Mullenders 2346* (BR); Kapolowe, *Lisowski B-7276* (POZG). RWANDA. Parc National de L'Akagera, *Bouxin*

& *Radoux 434* (BR); Gabiro, *Burgeon 17 & 34* (BR); Kibugabuga, *Liben 620* (BR); Nemba, *Bouxin & Radoux 1415* (BR); Bugesera, *Augier 2898* (BR); Matinza, *Bouxin & Radoux 1008* (BR); Lulama, *Bouxin & Radoux 418* (BR); Mimuli, *Troupin 4230* (BR); Lukionji, *Troupin 6776* (BR); Kakitumba, *Christiaensen 736* (BR). BURUNDI. Route Bubanza–Musigati, *Lewalle 4189* (BR); Bujumbura, *Lewalle 5486* (BR, MO); plaine de la Ruzizi, *Reekmans 2906* (BR, MO), *Lambinon 75/44* (WAG); Bulamata, *Germain 7191* (BR); Rumonge, *Lewalle 5029* (BR). UGANDA. **Bushenyi:** Kasharara, *Rwaburindore 1872* (MO). **Mbarara:** Mbarara, *Purseglove 602* (K); Kilaro, *Rwaburindore 2064* (MO). **Masaka:** 1–2 km E of Kikoma, *Lye 4440* (K, UPS). **Mpigi:** Entebbe, *Brown 293* (K). **Mukono:** Busana, Bugerere, *Eggeling 527* (K). **Inanga:** on lower NW slopes of Bugiri hill, *Wood 702* (K). **Kumi:** Bukedea, *Katende K226* (K). **Moroto:** base of Mt. Debasien, near Mornita, *Eggeling 5798* (K). **Kapchorwa:** NE Mt. Elgon, *Tweedie 1110* (K). **Mbale:** N Bugisu, Muyembe escarpment, *Norman 256* (K). KENYA. **Western:** Kakamega, *Carrall 429* (K). **Nyanza:** Oyugis–Kendu Road, *Hanid & Kiniaruh 651* (MO); Tinderet Forest Res., *Maas Geesteranus 5220* (BR). **Rift Valley:** Kipkarren, *Brodhurst-Hill 173* (K); 8 km S of Nandi Hills, *Davidse 7121* (MO); Menengai, *Maas Geesteranus 4573* (BR). **Central:** Vlei near 14 Falls, Thika–Donyo Sabuk Road, *Verdcourt 1965* (K). **Eastern:** Moyale, *Gillet 12799* (BR, K). **Coast:** Maji ya Chumvi, *Kässner 453* (K); Shimba Hills, Longo Mwagandi area, *Magogo & Glover 311* (MO); Shimba Hills, Pengo Hill, *Bamps 6331* (BR). TANZANIA. **Kagera:** Kabogo, near Shanga, *Tanner 5857* (K). **Mara:** Wogakuria Hill, *Greenway & Turner 12007* (K). **Shinyanga:** Shinyanga, *Bax s.n.* (K). **Arusha:** Essimingori Mountain, *Wiland & Mboya 174* (MO); Mt. Meru, *Bjørnstad 233* (K, DAR); between Magugu & Babati, *Polhill & Paulo 2373* (BR). **Kilimanjaro:** road to Horombo, *McCusker 98* (K); Moshi–Arusha road, *Polhill & Paulo 984* (BR). **Tanga:** 12 km E of Old Korogwe *Eriksson, Kalema & Leliyo 572* (NHT); Machui, Tanga–Pangani road, *Faulkner 1844* (B, BR, K); Mandundu, *Archbold 1007* (DAR). **Dodoma:** Mpwapwa, Kiboriani Mountains, *Hornby & Hornby 2096* (K). **Morogoro:** Uluguru Gebirge, *Schlieben 3245* (B, BR, K, MO); Mgeta, *Wigfield 2313* (DAR). **Pwani:** 59 mi. from Dar es Salaam on main road to Morogoro, *Welch 296* (BR, K); about 15 mi. S of Dar es Saalam, between Kambiji and Mjimwema, *Batty 1347* (MO); Mafia Island, Rufiji, *Wallace 811* (K); Dar es Salaam, *Harris 244 & 1234* (DAR); Kibaha Research Station, *Banda 314* (NHT). **Zanzibar:** Zanzibar Island, *Faulkner 2940* (BR, K); Pemba Island, *Williams 18* (BR, K). **Iringa:** near Isele village, *Wiland & Mboya 73* (MO); Chimala escarpment, *Richards 7513* (K); Kidatu, *Mhoro 424* (DAR). **Lindi:** Nachingwea, *Anderson 947* (NHT). ZAMBIA. *van Rensburg 1317* (P). MOZAMBIQUE. *de Koning 7406* (BR), *Quintas 157* (BR), *Bates 520* (BR), *Pope & Miller 588* (BR). REPUBLIC OF SOUTH AFRICA. *Schlieben 7345* (BR), *Ackock 10832* (BR). MADAGASCAR. **Fianarantsoa:** 10 km W of Ivato, *Croat 29634* (MO, TAN); Ranomafana Res., NE of Fianarantsoa, *Leeuwenberg et al. 14147* (MO, TAN). **Tananarive:** Forest Station of Manjakatiompo, *Croat 28950* (MO, TAN). **Toamasina:** swamp of Torotonsifotsy, *Rakotomalaza, Andrianasolo, Rasolomanana & Andraintsiferana 1340* (MO, TAN); 7 km E of Anjozorobe, *Schatz, Stevens & Lowry 3483* (MO, TAN). **Toliara:** 5 km S of Manambaro, 23 km W of Fort Dauphin, *Miller & Randrianasolo 6218* (MO, TAN). **Tulear:** Chain Anosyennes from Fort Dauphin to Ranamafona, *Croat 31840* (MO).

Hypoxis angustifolia var. **madagascariensis** Wiland, var. nov. TYPE: Madagascar. Toamasina: Ambanizana, Masoala Peninsula, along Androka River S of MBG house, 15°39′30″S, 49°57′30″E, June 1993, *Zjhra & Hutcheon 273* (holotype, MO). Figures 2E, F, 3.

Haec varietas a *H. angustifolia* var. *angustifolia* et *H. angustifolia* var. *luzuloides* seminis testa tuberculato-aculeata differt.

Herb to 10–15 cm high; *rhizome* 0.5–1.2 cm diam. (when dry), surmounted by inconspicuous membranous remains of old leaves to 1 cm high. *Inner leaves* 5 to 16, not grouped in a distinctive pseudostem, linear, tapering toward apex, keeled, acute at apex, 9–38 cm long, 0.2–0.4 cm wide, almost glabrous or sparsely ciliate on margins and midrib beneath; trichomes white; nervation composed of 5 to 15 veins. *Scapes* 1 to 6, 2.5–13.0 cm high, 0.5–1.1 mm wide, elongate with age, ciliate in lower half, sparsely pilose in upper half; *flowers* single or in a lax 2- or 3-flowered cyme (Fig. 3C); *bracts* sword-shaped, with membranous edges, those subtending the first two flowers much larger than the third, often two subtending a solitary flower, the lowest 12–17 mm long, 1.0–1.7 mm wide, 3- or 5-veined, the uppermost 5–7 mm long, sparsely pilose abaxially or glabrous; *pedicels* 5.5–12.0 mm long, glabrous or sparsely pilose. *Tepals* 6 (exceptionally 4), yellow; *outer tepals* 3.5–4.3 mm long, 1.0–1.5 mm wide, 5-veined, sparsely pilose abaxially; *inner tepals* 3.5–4.2 mm long, 1.2–1.6 mm wide, with numerous papillae around apex (Fig. 3B), 5-veined, glabrous; *stamens* equal, ca. 2 mm long with filaments 1.4–1.6 mm long, or unequal with outer stamens ca. 2.2 mm long with filaments 1.3–1.4 mm long, and inner stamens ca. 1.8 mm long with filaments 1.0–1.1 mm long; *anthers* 1.2–1.4 mm long; *ovary* 3–4 mm long, 1.0–1.7 mm wide, almost glabrous; *style* 1.2–1.3 mm long, trigonous; *stigma* 0.7–0.8 mm long, composed of three oblong, partially fused lobes. *Capsule* 4.5–8.0 mm long, ca. 2.5–4.0 mm diam., glabrous; *seeds* 0.8–0.9 mm long, 0.65–0.7 mm wide; testa black with slightly longitudinally furrowed tuberculate papillae, cuticle smooth (Fig. 2E, F).

Habitat. Wet rocks; on trail in primary forest; 475–850 m altitude.

Vernacular name. Mangitrampango (*Miller & Lowry 3905*).

Observations. Flowering in February, April, June, and October. From *H. angustifolia* var. *luzuloides* it differs in the seed testa sculpture, larger bracts, smaller flowers, and more distinctive papillation on the apex of the inner tepals. In Mada-

Figure 3. *Hypoxis angustifolia* var. *madagascariensis* Wiland. —A. Habit. —B. Papillae on apex of inner tepal. —C. Inflorescence. A & B from *Rakoto & Turk 83*, MO; C from *Zjhra & Hutcheon 273* (MO).

gascar there is no distinct difference in geographical distribution or habitat preference between these two taxa. Field studies are needed to evaluate the relationship between them.

Paratypes. MADAGASCAR. **Toamasina:** Maroantsetra, mountains NE of village Ambanizana, *Lowry, Rakotofazy & Nicoll 4208* (MO). **Fianarantsoa:** National Park of Ranomafana, *Rakoto & Turk 83* (MO, TAN). **Antsiranana:** Nature Reserve of Marojejy, NW of Mandena, *Miller & Lowry 3906* (MO). **Tamatave:** ca. 50 km NW of Tanatave, trail from Fotsimavo to Nature Reserve of Betampona, *Gentry 11311* (MO, TAN).

Acknowledgments. We thank the curators and workers of all above-mentioned herbaria for their help and hospitality. Our special thanks are addressed to Petra de Block and Yashica Singh for their contributions, to Roy Gereau for his comments and suggestions during preparation of the manuscript, to Porter P. Lowry II and the MBG employees in TAN, and to the editors of the MBG Press for their help. Fieldwork was possible thanks to National Geographic Society grant number 6891–00. Administrative divisions used in the text were mainly based on maps available on http://www.fao.org.

Literature Cited

Agnew, A. D. Q. & S. Agnew. 1994. Upland Kenya Wild Flowers, 2nd ed. East Africa Natural History Society, Nairobi.

Andrews, F. W. 1956. The Flowering Plants of the Sudan, Vol. 3. Buncle, Arbroath.

Baker, J. G. 1877. Flora of Mauritius and the Seychelles. Reeve, London.

———. 1878a. Report on the Liliaceæ, Iridaceæ, Hypoxidaceæ, and Haemodoraceæ of Welwitsch's Angolan Herbarium. Trans. Linn. Soc. London, Bot. 1: 245–273.

———. 1878b. A synopsis of Hypoxidaceae. J. Linn. Soc., Bot. 17: 93–126.

———. 1896. Amaryllideae. Pp. 171–246 *in* W. T. Thiselton-Dyer (editor), Flora Capensis, Vol. 6. Reeve, London.

———. 1898. Amaryllideae. Pp. 376–413 + 577 *in* W. T. Thiselton-Dyer (editor), Flora of Tropical Africa, Vol. 7. L. Reeve, Ashford.

Bews, J. W. 1921. An Introduction to the Flora of Natal and Zululand. City Printing Works, Pietermaritzburg.

Binns, B. 1968. A First Check List of the Herbaceous Flora of Malawi. The Government Printer, Zomba.

Brackett, A. 1923. Revision of the American species of *Hypoxis*. Contr. Gray Herb. 69: 120–147.

Champluvier, D. 1987. Hypoxidaceae. Pp. 81–84 *in* G. Troupin (editor), Flore du Rwanda Spermatophytes, Vol. 4. Ann. Mus. Roy. Afrique Centr., Sci. Econ., Vol. 16.

Cordemoy, E. J. de. 1895. Flore de l'Ile de la Réunion. *In* J. Cramer & H. K. Swann (editors) [1972], Historiae Naturalis Classica, Vol. 94. Cramer Ver., Lehre.

Durand, T. & H. Durand. 1909. Sylloge Florae Congolanae (Phanerogamae). Maison A. de Boeck, Bruxelles.

——— & H. Schinz. 1895. Conspectus Florae Africae, Vol. 5. Jardin botanique de l'État, Bruxelles.

——— & ———. 1896. Études sur la Flore de l'État Indépendant du Congo. Hayez, Bruxelles.

Engler, H. G. A. 1908. Die Pflanzenwelt Afrikas insbesondere seiner tropischen Gebiete, Grundzüge der Pflanzeverbreitung in Afrika und die Charakterpflanzen Afrikas, Vol. 2. Wilhelm Engelmann, Leipzig.

Geerinck, D. J. L. 1971. Hypoxidaceae. *In* P. Bamps (editor), Flore du Congo du Rwanda et du Burundi, Spermatophytes. Jardin botanique national de Belgique, Bruxelles.

Gillet, J. & E. Pâque. 1910. Plantes principales de la Région de Kisantu: leur nom indigène, leur nom scientifique, leur usages. *In* Notes botaniques sur la région du Bas- et Moyen-Congo, fasc. I. Ann. Mus. Congo Belge, Bot., sér. 5.

Guinea López, E. 1945. Ensayo Geobotánico de la Guinea Continental Española. Dirección de Agricultura de los Territorios Españoles del Golfo de Guinea, Madrid.

Hepper, F. N. 1968. Hypoxidaceae. Pp. 170–172 *in* F. N. Hepper (editor), Flora of West Tropical Africa, 2nd ed., Vol. 3(1). Crown Agents for Oversea Governments and Administrations, London.

Hutchinson, J. & J. Dalziel Mc Ewen. 1936. Flora of West Tropical Africa, the British West African Colonies, British Cameroons, the French and Portuguese Colonies South of the Tropic of Cancer to Lake Chad, and Fernando Po. 2(2). Crown Agents for the Colonies, London.

Jacot Guillarmod, A. 1971. Flora of Lesotho. *In* R. Tüxen (editor), Flora et Vegetatio Mundi Vol. 3. J. Cramer Ver., Lehre.

Marais, W. 1978. Hypoxidacées. *In* J. Bosser, Th. Cadet et al. (editors), Flore des Mascareignes. Royal Botanic Gardens, Kew.

Morton, J. K. 1968. West African Lilies and Orchids. Longmans, London.

Nel, G. 1914a. Studien über die Amaryllidaceae–Hypoxideae unter besonderer Berücksichtigung der afrikanischen Arten. *In* A. Engler (editor), Beiträge zur Flora von Afrika. 43. Bot. Jahrb. Syst. 51: 234–286.

———. 1914b. Die Afrikanischen Arten der Amaryllidaceae–Hypoxideae *in* A. Engler (editor), Beiträge zur Flora von Afrika. 43. Bot. Jahrb. Syst. 51: 287–290.

Nordal, I. 1997. Hypoxidaceae. Pp. 86–89 *in* S. Edwards, S. Demissew & I. Hedberg (editors), Flora of Ethiopia and Eritrea, Vol. 6. The National Herbarium, Addis Ababa University, Addis Ababa. The Department of Systematic Botany, Uppsala University, Uppsala.

——— & J. Iversen. 1987. Hypoxidaceae. Pp. 33–47 *in* B. Satabié & P. Morat (editors), Flore du Cameroun 30. Ministère de l'Enseignement supérieur et de la Recherche Scientifique, Yaoundé.

———, M. M. Laane, E. Holt & I. Staubo. 1985. Taxonomic studies of the genus *Hypoxis* in East Africa. Nordic J. Bot. 5: 15–30.

Perrier de la Bâthie, H. 1950. Amaryllidaceae. *In* H. Humbert (editor), Flore de Madagascar et des Comores, F. 41. Firmin-Didot, Paris.

Robyns, W. & R. Tournay. 1955a. Amaryllidaceae. Bull. Jard. Bot. État 25: 254–255.

——— & ———. 1955b. Monocotylées. *In* Flore de Spermatophytes du Parc National Albert, 3. Institution des Parcs Nationaux du Congo Belge, Bruxelles.

Ross, J. H. 1972. The Flora of Natal. Botanical Survey Memoir, 39. Botanical Research Institute, Pretoria.

Sibanda, S., O. Ntabeni, M. Nicoletti & C. Galeffi. 1990. Nyasol and 1,3(5)-diphenyl-1-pentene related glycosides from *Hypoxis angustifolia*. Bot. Syst. Ecol. 18: 481–483.

Thulin, M. (editor). 1995. Hypoxidaceae. P. 31 *in* Flora of Somalia, 4. Royal Botanic Gardens, Kew.

Troupin, G. (editor). 1956. Flore des Spermatophytes du Parc National de la Garamba. I. Gymnospermes et Monocotyledones. *In* Exploration du Parc National de la Garamba. Mission H. de Saeger. 1. Institut des Parcs Nationaux du Congo Belge, Bruxelles.

———. 1971. Syllabus de la Flore du Rwanda Spermatophytes. Ann. Mus. Roy. Afrique Centr., Sci. Econ., Vol. 7.

Wickens, G. E. 1976. The Flora of Jebel Marra (Sudan Republic) and its Geographical Affinities. Her Majesty's Stationery Office, London.

Wiland, J. 1997. *Hypoxis bampsiana* (Hypoxidaceae) a new species from Central Africa. Bull. Jard. Bot. Belg. 66: 207–211.

Wiland-Szymańska, J. 2001. The genus *Hypoxis* (Hypoxidaceae) in Central Africa. Ann. Missouri Bot. Gard. 88: 302–350.

Wildeman, E. De. 1921. Contribution à l'étude de la Flore du Katanga. Typo-Litho. D. Reynaert, Bruxelles.

Williams, R. O. 1949. The Useful and Ornamental Plants in Zanzibar and Pemba. Zanzibar Protectorate, Zanzibar.

Zimudzi, C. 1996. A synopsis of the Hypoxidaceae in the Flora Zambesiaca area. Kirkia 16: 11–19.