
Chlorophytum vespertinum (Asparagaceae, Anthericeae), a New Species from Zambia and Tanzania

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ABSTRACT. *Chlorophytum vespertinum* Vollesen from Zambia and Tanzania is described and illustrated. The species exhibits characters unique in *Chlorophytum* Ker Gawl.: pendulous flowers and fruits, flowers that open late in the afternoon and close before midnight, and leaves with a long-extended reflexed or recoiled tip. Its affinities are discussed in the context of recent taxonomic work on the genus. The species is distributed from central northern Zambia to southwestern Tanzania and usually grows on termite mounds in *Brachystegia* Benth. woodland or in surrounding areas. *Chlorophytum vespertinum* is assigned a preliminary IUCN Red List status of Vulnerable.

Key words: *Brachystegia* woodland, distribution, ecology, IUCN conservation status, morphology, taxonomy, termite mounds.

Chlorophytum Ker Gawl. (Asparagaceae: Agavoidae, Anthericeae) is a large genus containing approximately 150 species (Stevens, 2002). It is distributed throughout the Old World tropics but is particularly diverse in eastern and southern central Africa. Fifty-two species have been recorded from the Flora of Tropical East Africa area (Nordal et al., 1997), 56 in the Flora Zambesiaca area (Kativu et al., 2008), 49 in the Flore d'Afrique Centrale area (Meerts, 2015), and 46 from Angola (Figueiredo & Smith, 2008). Outside this core area, numbers fall away quickly with 31 species in South Africa (Germishuizen et al., 2006), 23 in Ethiopia and Eritrea (Nordal, 1997), and 35 in the whole of the Flora of West Tropical Africa area (Hepper, 1968). Meerts and BJORÅ (2012) point to Katanga

and northern Zambia as a center of diversity for *Chlorophytum*.

Since the publication of the Flora of Tropical East Africa and Flora Zambesiaca, two additional species have been described from Tanzania (BJORÅ, 2008; Meerts, 2011), one from Zambia (Osborne et al., 2022) and one from Namibia (Kativu & BJORÅ, 2016).

During fieldwork in the Mutinondo Wilderness Area in Zambia from 2010 to 2022, a *Chlorophytum* species with unusual morphological characters was found to be quite common on old established termite mounds in *Brachystegia* woodland and occasionally on edges of riverine forest. Searches in the herbaria at Meise (BR), Kew (K), and Missouri Botanical Garden (MO) found four earlier specimens of the same taxon from the Kalambo area in northernmost Zambia, one from near Kasama, and three from the Sumbawanga area in neighboring Tanzania. Where detailed ecology is recorded, these collections also indicated that the species grows on termite mounds in woodland or on the edges of riverine forest. Detailed examination of this material at Kew failed to reveal any match with known species of similar morphology and ecology or from the same geographical area (northern Zambia, southeastern Congo [Katanga], and southwestern Tanzania).

In Kativu et al. (2008: 77), the three Hoell & Nordal specimens cited below are mentioned in the discussion under *Chlorophytum amplexicaule* Baker as representing a taxon that “might deserve taxonomic recognition.” These specimens and the others mentioned herein represent a heretofore undescribed species here named *C. vespertinum*.

MATERIALS AND METHODS

Living plants were collected and studied by S. Bidgood, L. Merrett, and K. Vollesen at Mutinondo Wilderness Area and extensively photographed by L. Merrett. Preserved specimens from Mutinondo as well as older collections were studied in the herbaria of the Royal Botanic Gardens, Kew (K), Missouri Botanical Garden (MO) by Roy Gereau, and at Meise Botanic Garden (BR) by Pierre Meerts.

The conservation status of *Chlorophytum vespertinum* was assessed according to the IUCN Red List categories and criteria (IUCN, 2012). Georeferences were taken or estimated from the herbarium collections, and potential threats at each locality were assessed using the authors' knowledge of the locality or by using Google Earth imagery (Google Earth, 2022). Extent of occurrence (EOO) was calculated from a minimum convex polygon using the online GeoCAT tool (Bachman et al., 2011). Area of occupancy (AOO) was estimated using a 4 km² (2 × 2 km) cell, as required by the IUCN Red List guidelines (IUCN Standards and Petitions Committee, 2022).

TAXONOMIC TREATMENT

Chlorophytum vespertinum Vollesen, sp. nov.

TYPE: Zambia, Muchinga Prov., Mpika Distr., Mutinondo Wilderness Area, Chipundu Dambo [12°27'S 31°18'E], 7 Dec. 2019, *Bidgood, Merrett & Vollesen 9858* (holotype, K [barcode] K001328473!; isotypes, BR!, K!, MO!, UZL!).

Diagnosis. Haec species inter congeneros in eadem regione crescentes quoad capsulam longiorem quam latiore *Chlorophyto blepharophyllo* Schweinf. ex Baker simillima, sed ab eo foliis ad marginem semper glabris, inflorescentia pedicelloque papillosos atque seminibus minoribus distinguitur; ab omnibus congeneris apice foliari elongato recurvato, pedicellis per anthesin recurvatis et florescentia vespertina bene distincta.

Erect *perennial herb* with single scape from a small, flattened discoid corm. *Corm* without fibrous remnants of old leaf bases. *Roots* numerous, to 15 cm, white, of 2 types: thinner (ca. 0.5 mm diam.), wiry ones without tubers and thicker (ca. 1 mm diam.), fleshy ones with terminal fusiform tubers to 2.7 × 1.5 cm. Leaf sheaths clasping stem, forming a basal "pseudostem" 4–10 cm. *Cataphylls* (basal leaves with reduced lamina) 4 to 6, green, reflexed at apex, to 4(–6) × 3 cm, base clasping "pseudostem," distinctly auriculate, glabrous, gradually larger upward, uppermost with small lamina. Upper *leaves* 2 to 5, spirally arranged (i.e., not distichous), narrowly ovate to elliptic, uniformly pale to bright green, erect when young, eventually spreading to reflexed, glabrous, 10–25 × 1.5–4 cm on flowering specimens, to 45 × 6.5 cm on fruiting specimens; apex drawn out

into a long filiform straight (when young) to recurved or recoiled tip; base of lower leaves auriculate, of upper hidden by sheathing bases of lower leaves; midrib and lateral veins inconspicuous, lateral veins to 20 per side, transverse veins present, inconspicuous; margin glabrous, straight (not undulate), narrowly membranous. *Inflorescences* appearing with young leaves, longer than leaves in flower, shorter in fruit, erect in flower, erect or eventually decumbent in fruit, unbranched or with 1 to 4 branches from near base; peduncle 10–25 cm, terete, glabrous, floriferous part 2–17 cm, rachis moderately to densely papillose; internodes 0.5–1.5(–2) cm; *bracts* supporting lateral branches glabrous, thinly membranous, 1–2.5 cm, with a broad ovate basal part 4–10 mm and a long filiform apical part 6–15 mm, not clasping stem; floral bracts similar, basal bracts to 12 mm with filiform part to 9 mm; apical bracts 3–5 mm with filiform part 2–3 mm. *Flowers* open and star-shaped at anthesis, 2 to 5 per bract at base of inflorescence, solitary upward; pedicel 1–4(–6) mm, not elongating in fruit, spreading in young bud but recurved at anthesis, with a distinct articulation at or slightly above middle, below articulation papillose-glandular, above articulation glabrous; *tepals* spreading or reflexed, glabrous, with pale green central part and white membranous lateral parts, with 3 inconspicuous longitudinal veins, ovate-elliptic, 3 outer ones 5–7 × 1.5–2 mm, 3 inner ones 4–6 × ca. 1.5 mm, extending to 9 and 8 mm, respectively, after flowering; *filaments* spreading, smooth, flattened, white, 3–6 mm; *anthers* bright yellow, linear-lanceolate, ca. 1.5 mm, papillose; *ovary* sessile, subglobose, dark green, 1–2 mm diam., glabrous; *style* soon deciduous, filiform, 2–3 mm at anthesis, extending to 5 mm; *stigma* truncate. *Capsule* pendulous, brown, 3-locular, oblong to slightly obovoid, triangular in lateral view with prominent angles, valves with faint transverse ribs, 6–8 × 4–6 mm, glabrous; apex retuse. *Seeds* 5 or more, black, glossy, irregularly cup-shaped, 1–1.5 mm diam.; intercellular furrows vertical, 10–15 µm deep, sharp-edged; periclinal walls of testa cells 10–30 µm diam., mostly flat, or occasionally with a tiny papilla in the middle. Figures 1–4.

Phenology. Flowering specimens of *Chlorophytum vespertinum* have been seen or collected at the beginning of the rainy season from late October to mid-December. Mature fruit and seeds have been collected during the main rainy season from late January to mid-March.

Distribution. *Chlorophytum vespertinum* is primarily known from two restricted areas: one in the extreme northeastern corner of Zambia (Mbala District) and neighboring southwestern Tanzania (Sumbawanga Rural District) and another in central northern Zambia (Mpika

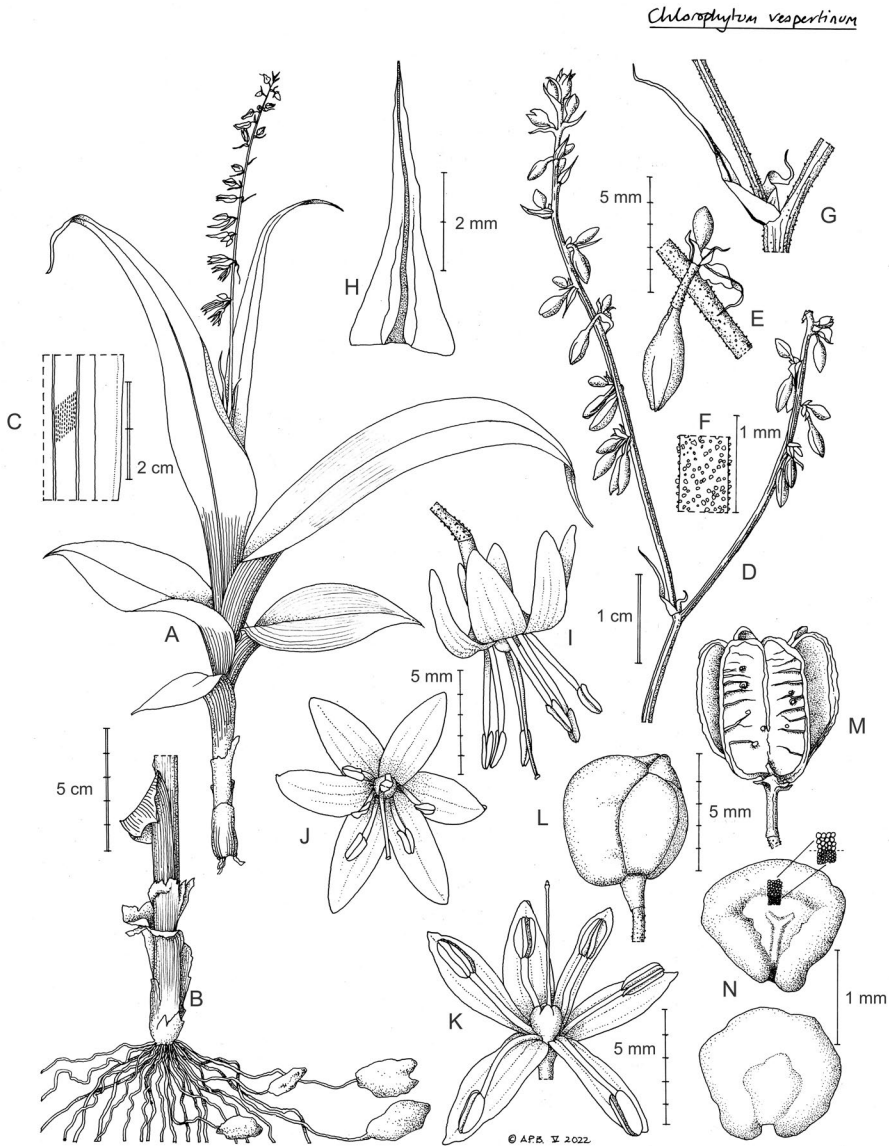


Figure 1. *Chlorophytum vespertinum* Vollesen. —A. Habit. —B. Stem base with roots and tubers. —C. Part of upper leaf surface. —D. Inflorescence. —E. Inflorescence axis, pedicel, and flower bud. —F. Enlarged part of inflorescence axis. —G. Inflorescence node with bracts. —H. Bract. —I, J, K. Open flowers. —L. Ovary. —M. Mature capsule. —N. Mature seed, upper with detail of surface ornamentation. A–C, K–L. Bidgood et al. 9858. D–H Gereau et al. 7074. I, J photos by Lari Merrett. M, N Merrett 2507. Drawn by Andrew Brown.

District). There is also one collection from near Kasama, about equidistant between these two areas. The habitat (termite mounds) of *C. vespertinum* is widespread throughout central Africa. It is therefore very likely that the species also occurs in neighboring areas of southern Congo (Katanga), and it will probably also have a wider distribution in northern Zambia and southwestern Tanzania. Figure 5.

Habitat. *Chlorophytum vespertinum* has been collected at elevations from 1150 to 1800 m. At Mutinondo, *C. vespertinum* commonly grows on mature, settled *Macrotermes* termite mounds in *Brachystegia* woodland or in the border zones between termite mounds and woodland or seasonally wet grassland or riverine forest. These mounds can be substantial in size, when fully developed usually 5–10 m in diameter

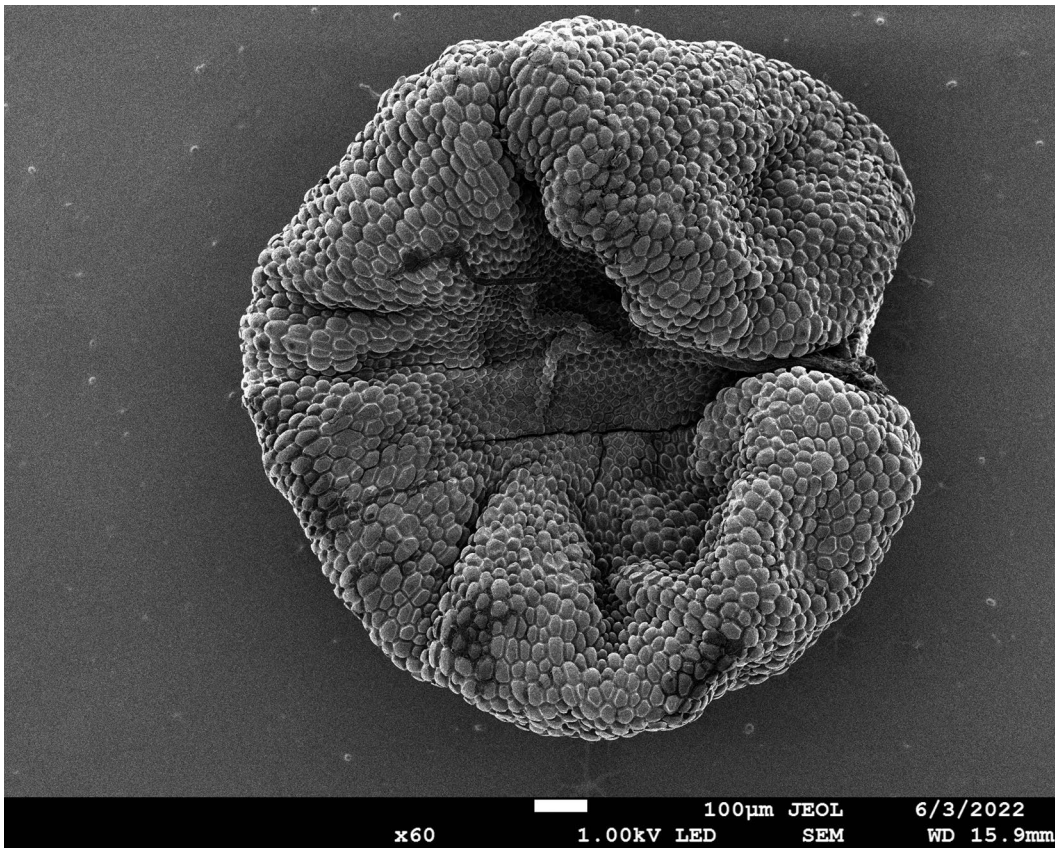


Figure 2. Surface structure of mature seeds of *Chlorophytum vespertinum* Vollesen. (SEM photographs by Iris van der Beeten, Botanic Garden, Meise.) Whole seed, ventral view.

and up to 3 m in height. The soil is a heavy, gray clay loam that is considerably richer in base cations than the soil of the surrounding vegetation. The vegetation on the mounds is therefore usually quite different from and denser than the surrounding woodland. Trees and shrubs characteristically or exclusively growing on the termite mounds at Mutinondo include *Allophylus africanus* P. Beauv., *Apodytes dimidiata* E. Mey. ex Arn., *Bersama abyssinica* Fresen., *Combretum platypetalum* Welw. ex M. A. Lawson, *Diospyros mespiliformis* Hochst. ex A. DC., *Ficus thonningii* Blume, *F. glumosa* Delile, *Grewia pachycalyx* K. Schum., *Grewia schinzii* K. Schum., *Gymnosporia putterlickioides* Loes., *Hibiscus ovalifolius* (Forssk.) Vahl, *Maerua triphylla* A. Rich., *Oncoba spinosa* Forssk., *Searsia quartiniana* (A. Rich.) A. J. Mill., *Shirakiopsis elliptica* (Hochst.) Esser, *Gymnanthemum amygdalinum* (Delile) Sch. Bip. ex Walp., and *Ziziphus mucronata* Willd. The herb layer is usually sparse with no, or very little, grass cover. Characteristic common species in the herb layer include *Costus*

spectabilis (Fenzl) K. Schum., *Kniphofia reynoldsii* Codd, and the present new species. A number of these species are quite fire tender and would not be able to survive the annual bushfires if growing in the woodland proper, but the large, well-established termite mounds with their denser tree and shrub cover, sparse herb layer, and no or hardly any grass cover often avoid destructive burning.

While some of the older collections of *Chlorophytum vespertinum* were also recorded as growing on termite mounds (Gereau *et al.* 7074, Harder *et al.* 1288, Hoell & Nordal 135), others (Bredo 6185, Harder *et al.* 1225, Hoell & Nordal 131, Hoell & Nordal 142, E. A. Robinson 4103) give the habitat as base of rocky hills, edges of riverine forest, or woodland. All these collections only have broad, generalized vegetation descriptions. It is thus impossible to ascertain whether the actual habitats for some of these were forest or woodland floor proper and not in border zones toward or on old, decayed termite mounds.

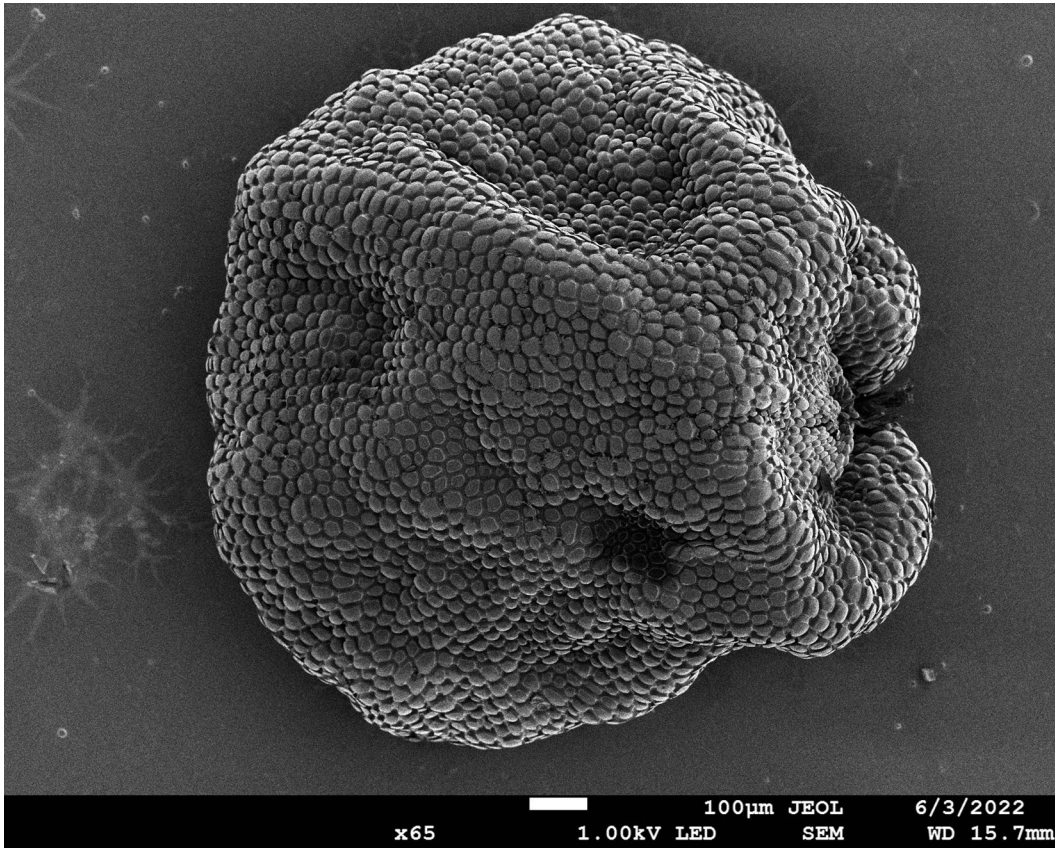


Figure 3. Surface structure of mature seeds of *Chlorophytum vespertinum* Vollesen. (SEM photographs by Iris van der Beeten, Botanic Garden, Meise.) Whole seed, dorsal view.

Pollination and seed dispersal. Two questions immediately arise from the general description of *Chlorophytum vespertinum*. Firstly, what type of insect pollinates the flowers? Evening-flowering species (e.g., in Acanthaceae) usually have long-tubed, strongly scented flowers and are pollinated by large moths. *Chlorophytum vespertinum* has an open flower with a spreading to reflexed perianth and has no discernible scent. This type of flower is normally pollinated during the day by bees, flies, or beetles. This of course also may be the case here, but we have not noticed any insect activity around the opened flowers in the evening. Another more interesting possibility—also considering the habitat—would be termite pollination. Secondly, how are the seeds dispersed? The capsule is large, nodding, and contains numerous seeds that are small in comparison with the seeds of other species of *Chlorophytum*. The glossy black seeds are strongly water repellent. This may indicate that the seeds are long lived and adapted to prolonged storage.

IUCN Red List category. *Chlorophytum vespertinum* is known from 12 collections representing seven distinct localities in Tanzania and Zambia. Three of the seven collecting sites appear to benefit from some level of protection.

From Tanzania, *Harder et al. 1288* (MO) is within the boundaries of the Kalambo River Nature Forest Reserve, which was declared in 2019 comprising an area of 465 km² previously occupied by the Kalambo River and Kalambo Fall Territorial Forest Reserves, both declared in 1957 (Government of Tanzania, 2019). Although the species was recorded as “rare” at the time of collection (October 1992), the area has been under continuous protection for 65 years and now enjoys the highest level of protection afforded by the Tanzanian government, so the species may be considered well protected there. The northernmost Zambian collection, *Bredo 6185* (BR), was recorded as coming from “Ulungu, Sizye Village,” and maps within the boundaries of the Lungu Forest Reserve, which was desig-

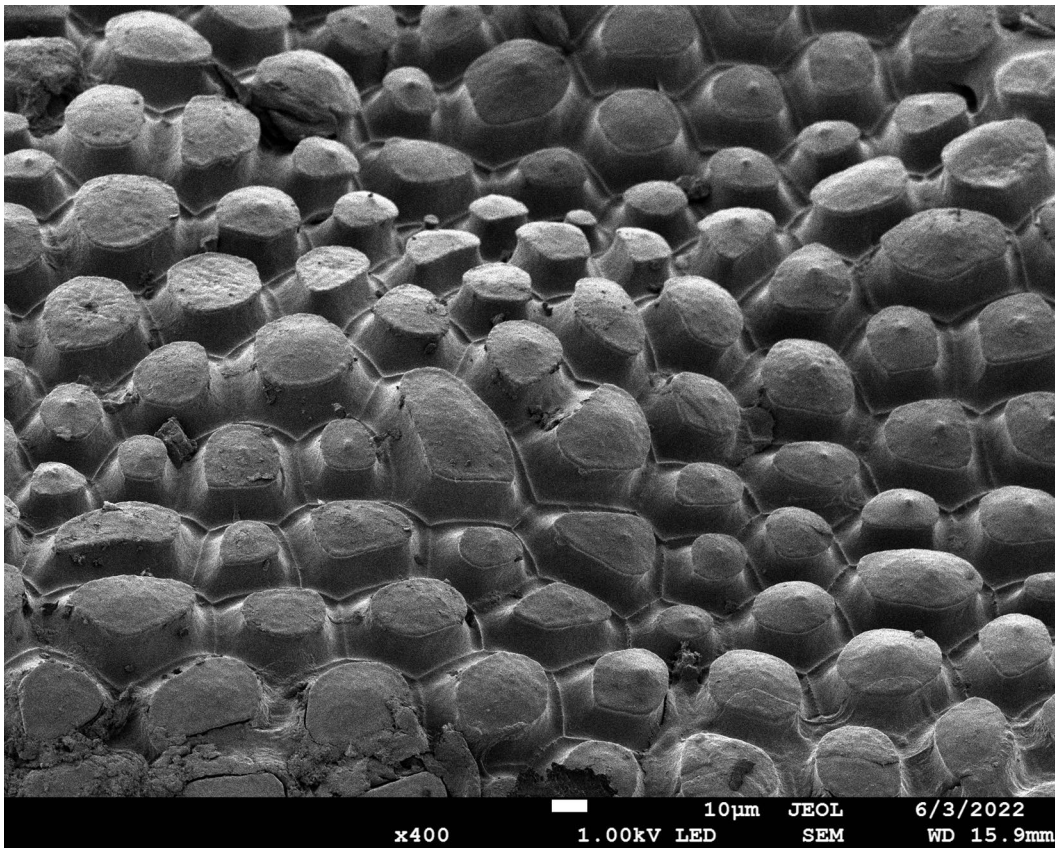


Figure 4. Surface structure of mature seeds of *Chlorophytum vespertinum* Vollesen. (SEM photographs by Iris van der Becten, Botanic Garden, Meise.) Detail of surface ornamentation.

nated in 1964 and has an area of 189 km² (<<https://www.protectedplanet.net/26957>>). Little other information is available about this protected area. From the Mutinondo Wilderness Area in central northern Zambia there are four recent collections from 2017 to 2020. At Mutinondo, *C. vespertinum* has been observed and counted on a number of termite mounds (Vollesen, pers. obs. 2017–2019). Extrapolating from the sampled termite mounds to the total area of ca. 250 km², the total Mutinondo subpopulation would almost certainly amount to several hundred individuals. The Mutinondo Wilderness Area is a privately owned reserve that is managed solely for ecotourism and conservation purposes, and no agriculture or harvesting of woodland products takes place within the area. There are no known current or future threats to the species at this locality. The species does not have a local name at Mutinondo, and none have been recorded at any of the other localities. It is therefore unlikely that it is used for medicinal or any other purposes.

The other four collecting sites lack any known gov-

ernmental or private protection. The northernmost Tanzanian collection, *Gereau et al. 7074* (K, MO), was collected at a Wildlife Conservation Society research camp on village land, with no formal protection but in relatively intact vegetation, which still looks intact in Google Earth imagery from 2017; the species was reported as “abundant” there. The other unprotected Tanzanian site, “11.0 km SSW of Moravian mission at Tatanda (Livingstone Memorial Mission) on Sumbawanga - Mbala (Zambia) highway,” *Harder et al. 1225* (MO), is in an intense agricultural area adjacent to a main highway and can be assumed to be subject to at least some decline in the quality of its habitat. In Zambia, the site of the three collections from Kalombo Farm in 2006 appears to have intact woodland vegetation in Google Earth imagery from 2022, but the site at 28 km southeast of Kasama, *E. A. Robinson 4103* (K), is in an area that is highly impacted and partially denuded by agriculture and settlements and must certainly have lost much of the species’ habitat since the collection in 1960. Therefore, at least two of the seven

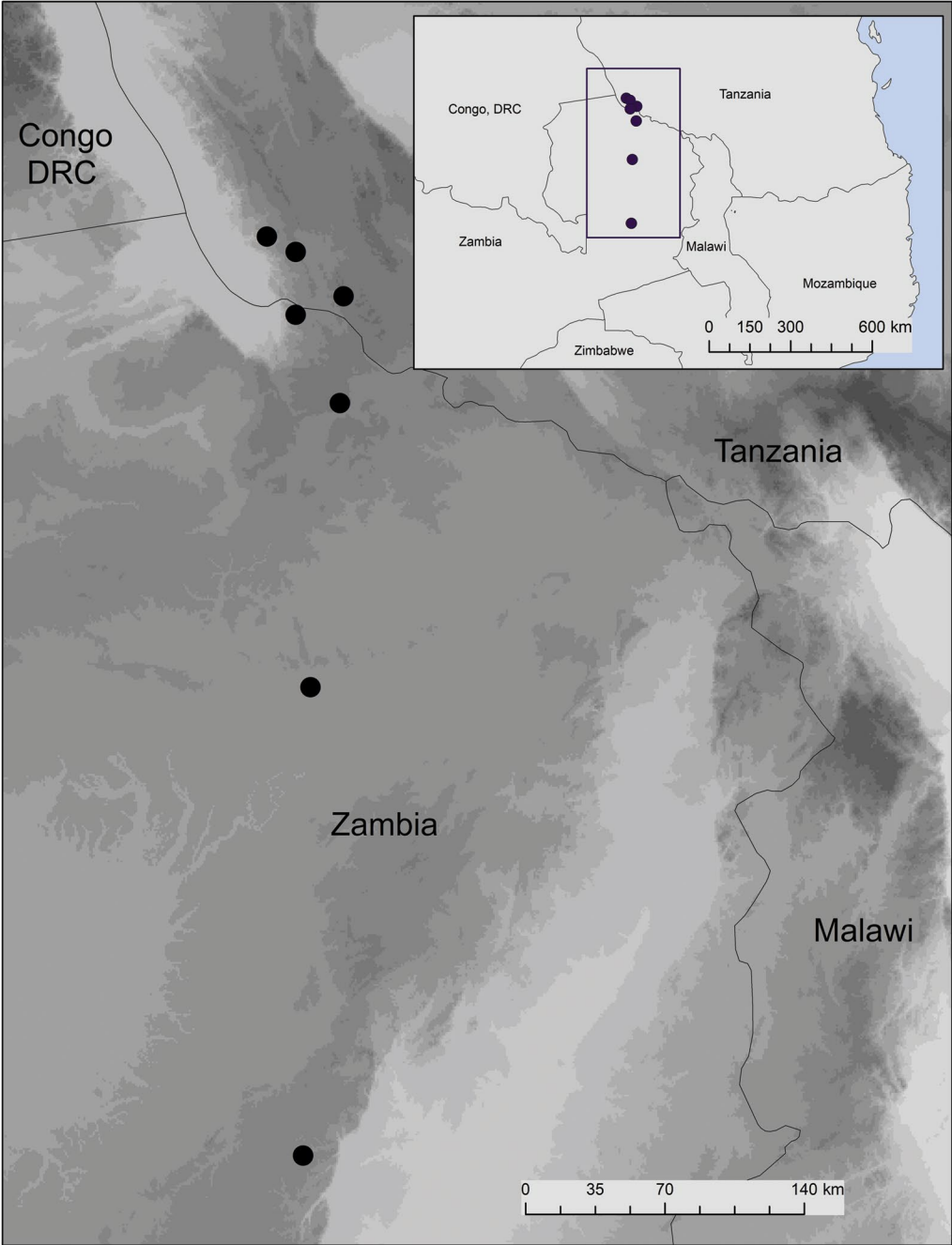


Figure 5. Distribution of *Chlorophytum vespertinum* Vollesen (black dots) in Tanzania and Zambia.

collecting sites are subject to the threat of agricultural land conversion.

Information on population size is not precise enough to permit the application of IUCN Red List criterion C or D, and no information on population reduction that would enable the use of criterion A is available, leav-

ing only criterion B (Geographic range) available for the preliminary conservation assessment of this species. From the specimen coordinates, the EOO is 8846 km², within the limits for Vulnerable (VU) under criterion B1; the AOO is 28 km², within the limits for Endangered under criterion B2 (IUCN, 2012). Given the scale

Table 1. Matrix of taxonomically important characters comparing *Chlorophytum vespertinum* Vollesen with closely related species in the same region and similar habitats.

	<i>C. blepharophyllum</i> var. <i>amplexicaule</i>	<i>C. blepharophyllum</i> var. <i>blepharophyllum</i>	<i>C. brachystachyum</i>	<i>C. gallabatense</i> var. <i>floribundum</i>	<i>C. gallabatense</i> var. <i>gallabatense</i>	<i>C. vespertinum</i>
Flower and fruit orientation	erect	erect	erect	erect	erect	pendulous
Inflorescence axis and pedicel	glabrous	glabrous	glabrous	papillose	glabrous	papillose
Pedicel, articulation	near middle	near middle to apical	near apex	near apex	near middle to apical	near middle
Capsule	ca. 8 × 6 mm, longer than wide, erect	8–12(–15) × 6–12 mm, longer than wide, erect	3–5 × 4–6 mm, wider than long, erect	6–8 × 5–7 mm, longer than wide, erect	3–5 × 6–7 mm, wider than long, erect	6–8 × 4–6 mm, longer than wide, pendulous
Seeds, number per locule, size	not seen	discoid, 5 or more, 2.5–3 mm diam.	cup-shaped, 1 or 2, ca. 2 mm diam.	irregularly cup-shaped, 5 or more, ca. 2 mm diam.	discoid, 1 or 2, 2–3 mm diam.	irregularly cup-shaped, 5 or more, 1–1.5 mm diam.
Leaf margin	ciliate	ciliate (rarely glabrous)	ciliate	glabrous	glabrous	glabrous

of the principal threat, each of the three protected sites and each of the four unprotected sites may be considered a “location” (sensu IUCN, 2012 and IUCN Standards and Petitions Committee, 2022). Given the EOO and AOO, the existence of seven threat-defined locations, and a continuing decline of at least the quality of habitat at two locations, the Red List status of *Chlorophytum vespertinum* is here assessed as Vulnerable [VU B1ab(iii)+2ab(iii)].

Notes. *Chlorophytum vespertinum* exhibits some unique characters in *Chlorophytum*. The evening flowering habit, the long, recurved to recoiled leaf apex, and the recurved pedicels and pendulous fruits have not been observed in any other species. Recurved pedicels are occasionally seen in other species in the bud stage but never in open flowers. Other similar taxa with leaf bases forming a conspicuous “pseudostem” are *C. blepharophyllum* Schweinf. ex Baker var. *amplexicaule* (Baker) Meerts, *C. blepharophyllum* var. *blepharophyllum*, *C. gallabatense* Schweinf. ex Baker var. *floribundum* (Baker) Meerts, and *C. brachystachyum* Baker. Apart from these, *C. gallabatense* var. *gallabatense* and *C. pauper* Poelln. occasionally develop an indistinct “pseudostem.”

Table 1 summarizes key features that distinguish these taxa. *Chlorophytum blepharophyllum* (both varieties) and *C. brachystachyum* have a ciliate leaf margin, while *C. gallabatense* (both varieties) has a glabrous leaf margin. In the flowering state, *C. gallabatense* var. *floribundum* has a papillose inflorescence axis, while *C. blepharophyllum*, *C. brachystachyum*, and *C. gallabatense* var. *gallabatense* all have a glabrous inflorescence axis. The pedicel is articulated near the apex in *C. brachystachyum* and *C. gallabatense* var. *floribundum*, but near the middle in *C. blepharophyllum* and *C. gallabatense* var. *gallabatense*. In fruit, *C. blepharophyllum* and *C. gallabatense* var. *floribundum* have a capsule that is longer than wide (6–12[–15] × 5–7[–12] mm) with many-seeded locules, while *C. brachystachyum* and *C. gallabatense* var. *gallabatense* have a smaller capsule that is slightly wider than long (3–6 × 4–7 mm) with 1- or 2-seeded locules. In *C. pauper*, the rhizome and leaf bases are covered with fibrous remains of old leaves, a character not seen in any of the other related species.

Of these, *Chlorophytum vespertinum* is most similar to *C. gallabatense* var. *floribundum* in having a papillate inflorescence axis and pedicels. In addition to its long, recurved to coiled leaf apices, it differs from that taxon in its pendulous flowers and fruits, the pedicels articulated near the middle, and smaller seeds.

Paratypes. TANZANIA. **Rukwa Region:** Sumbawanga Rural Distr., 11 km SW of Tatanda Mission, 8°34'S 31°29'E,

24 Oct. 1992, *Harder et al.* 1225 (MO); 35 km W of Matai on Matai–Kasanga rd., Lwasu Hills, 8°22'S 31°16'E, 28 Oct. 1992, *Harder et al.* 1288 (MO); Loasi River Valley, Navinga Stream, Kafukaka Village, 8°17'S 31°08'E, 12 Nov. 2009, *Gereau et al.* 7074 (K, MO). ZAMBIA. **Northern Province:** Mbala Distr., Ulungu, Sizye Village, 8°39'S 31°16'E, 6 Nov. 1948, *Bredo* 6185 (BR); Kalombo Farm, 9°03'S 31°28'E, 4 Dec. 2006, *Hoell & Nordal* 131 (K!, O); Kalombo Farm, 9°03'S 31°28'E, 4 Dec. 2006, *Hoell & Nordal* 135 (K, O not seen); Kalombo Farm, 9°03'S 31°28'E, 5 Dec. 2006, *Hoell & Nordal* 142 (K, O not seen); Kasama Distr., 28 km SE of Kasama, 10°20'S 31°20'E, 22 Nov. 1960, *E. A. Robinson* 4103 (K). **Muchinga Province:** Mpika Distr., Mutinondo Wilderness Area, Chipundu Dambo, 12°27'S 31°18'E, 20 Feb. 2017, *Bidgood et al.* 9377 (K); Mpika Distr., Mutinondo Wilderness Area, Chipundu Dambo, 12°27'S 31°18'E, 7 Dec. 2019, *Merrett & Vollesen* in *Bidgood* 9858 (K); Mpika Distr., Mutinondo Wilderness Area, Chipundu Dambo, 12°27'S 31°18'E, 23 Jan. 2020, *Merrett* 2507 (K); Mpika Distr., Mutinondo Wilderness Area, Chipundu Dambo, 12°27'S 31°18'E, 13 Mar. 2020, *Merrett* 2527 (K).

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