

MONIMIACEAE

TAXONOMIC AND NOMENCLATORIAL NOTES ON THE MONOTYPIC GENUS *XYMALOS* AND GENERAL INFORMATION ON THE FAMILY MONIMIACEAE

INTRODUCTION

Harvey (1863) originally described *Xylosma monospora* Harv., based on specimens from KwaZulu-Natal but without precise localities (*Cooper 1251* and *Cooper 1204*), as belonging to the Flacourtiaceae. In 1878, Bentham described *Toxicodendrum acutifolium* Benth. from the Eastern Cape for the same taxonomic entity but placed it in the Euphorbiaceae. Later Engler (1895, 1900) described the species yet again, this time from Tanzania, under the name *Paxiodendron usambarense* Engl. but placing it in the Lauraceae.

Baillon (1887) compared Harvey's *X. monospora* (which has a monocarpellate ovary with a solitary ovule, sessile stigma, and drupaceous, non-dehiscent fruit) with *Hyaenanche* Lamb., then in the Euphorbiaceae but now in Picrodendraceae (APG III 2009). Species of *Hyaenanche* have 4-locular ovaries with two ovules per locule, 3–5 styles connate in the lower half, and dehiscent capsules. Baillon (1887) concluded that the two entities placed respectively by Bentham (1878) in *Xylosma* G.Forst. and by Harvey (1863) in *Toxicodendrum* were in fact conspecific but did not belong in either *Toxicodendrum* or *Xylosma*. He therefore placed it in a new genus *Xymalos* Baill., which is an anagram of *Xylosma*, which means fragrant wood—referring to the leaves and wood that are lemon-scented when crushed. He placed *Xymalos* in the Bixaceae.

De Jussieu founded the family Monimiaceae in 1809 based on three genera, *Monimia* Thou., *Atherosperma* Labill. (a monotypic genus from Australia and Tasmania), and *Siparuna* Aubl. (a large neo-tropical genus with over 70 species). Oliver (1896) was the first to place *Xymalos* in the Monimiaceae and also emended the generic description. This familial transfer was followed by amongst others Baker & Wright (1909), Per-

kins & Gilg (1911), Wright (1912), Engler (1915), Verdcourt (1968), and Stannard (1997). Warburg (1893) recognized *Xymalos* as closely related to the Flacourtiaceae, but Gibbs (1917) and Hutchinson (1973) both placed *Xymalos* in the Trimeniaceae. Currently *Xymalos* is placed in Monimiaceae subfamily Mollinedioideae (Thorne 1974; Philipson 1987, 1993). Molecular data support this classification (Renner 1998, 1999). Monimiaceae is a pantropical family in the order Laurales and in a broad sense comprises 440 species and 34 genera (Philipson 1987, 1993). The small families Atherospermataceae and Siparunaceae have since been excluded from the Monimiaceae. Trimeniaceae is excluded from the order Laurales—a decision that is well supported by phylogenetic and morphological studies (Mooney *et al.* 1950; Renner 1999; Renner & Chanderbali 2000; Romanov *et al.* 2007; APG III 2009). Mabberley (2008) recorded 24 genera in the family but the new monotypic genus, *Grazilanthus*, from the Brazilian Atlantic Coastal Forest has since been described by Peixoto & Pereira-Moura (2008). The family currently comprises 150–220 species of shrubs and small trees in 25 genera (Renner *et al.* 2010). It has a highly disjunct, presumably Gondwanan distribution, mainly in the southern hemisphere (Renner *et al.* 2010). *Xymalos monospora* occurs in montane forests in east tropical and southern Africa, West Cameroon, and on Bioko, an island once connected to Africa (Figure 1).

Monimiaceae, together with the closely related families Lauraceae and Hernandiaceae (*Gyrocarpus* Jacq.), are characterized by having secretory cells containing so-called 'ethereal oil' (ethereal oil cells) and a unilacunar nodal anatomy (Mooney *et al.* 1950). Monimiaceae can be recognized by decussate to subopposite, exstipulate leaves; twigs that are often flattened below the somewhat swollen nodes; leaves that are pellucid-

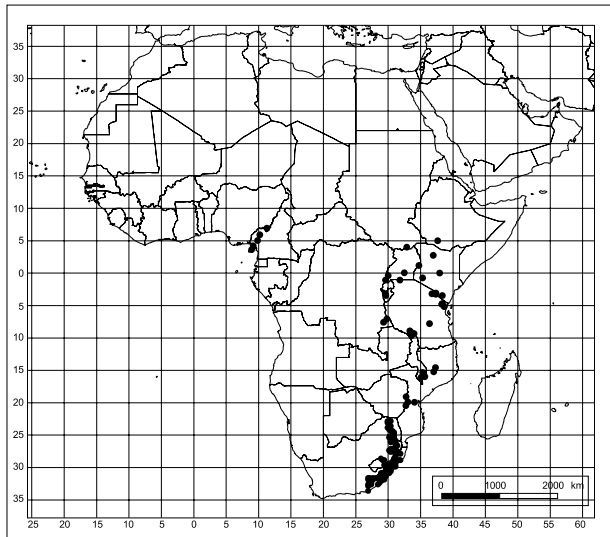


FIGURE 1.—Distribution of *Xymalos monospora* based on specimens housed in the National Herbarium, Pretoria, and on the literature (Verdcourt 1968; Stannard 1997).

dotted due to the presence of numerous glands or ‘ethereal oil cells’ (Lorence 1985), and are lemon-scented when crushed. The lack of stipules is considered by Hickey & Wolfe (1975) to be derived within the Laurales. *Xymalos* has leaves with margins that possess a ‘monimioid tooth’ with an undivided median vein and an indurated cap (Figure 4), another derived character in the Laurales (Lorence 1985), or the leaves are sometimes entire. Leaves are pinnately veined with prominent venation on the lower surface and the secondary veins originate at uniform angles to the costa (Lorence 1985), looping and joining well within the margin, sometimes leaving a bullate or puckered surface above. Plants are usually dioecious or monoecious and the yellow flowers are very small and mostly unisexual, except for *Hortonia* Wight ex Arn., which have bisexual flowers (Endress & Igersheim 1997). The latter is a Sri Lankan genus, sister to *Xymalos* (Renner *et al.* 2010), and possesses flowers with an elaborate perianth comprising spirally arranged petaloid and sepeloid series, 6–14 free, stalked carpels borne on a discoid receptacle, appendaged stamens and with staminodes present (Lorence 1985). The receptacle in Monimiaceae is deeply concave, cupuliform or urceolate (Mooney *et al.* 1950). The family is characterized by apocarpous gynoecia with uniovulate carpels (Endress & Igersheim 1997), surrounded by a flat or concave floral cup (Lorence 1985). The fruit(lets) are presented on the opened floral cup. Male flowers have a 4–8-lobed perianth with few to many stamens, with or without appendages and arranged in whorls or sometimes spirally or irregularly disposed, either without a pistillode or with remnants of one. The anthers are 2–4-sporangiate. Staminodes are absent or present in female flowers, carpels are few to many (only one in *Xymalos*) and sessile or stipitate, with a solitary, anatropous ovule. In the genera *Kibara* Endl. (Malaysia) and *Xymalos* (Africa) the discoid stigma is sessile on the turbinate ovary, but a style is present in all other genera, typically short and included, but exerted in *Monimia* (Philipson 1986, 1993). Ovules in *Xymalos* are crassinucellate and bitegmic (Leinfellner 1966) and the carpels are strongly ascidiate in the Mollinedioideae (Endress

& Igersheim 1997). The fruit are either separate drupelets with a \pm strongly developed putamen formed by the lignified endocarp, or apocarpous berrylets frequently enclosed in a persistent, well-developed fleshy hypanthium and/or receptacle (Philipson 1986; Romanov *et al.* 2007). Romanov *et al.* (2007) described these two fruit forms in the family and distinguished four different types of drupe(lets) differing in their endocarp structure.

Klopper *et al.* (2006) record *Xymalos mossambicensis* Cavaco as occurring in tropical Africa. Cavaco (1949) described this species from Mozambique but the name was not taken up by Verdcourt in his account of the *Flora of tropical East Africa* (1968), nor by Stannard in his account for *Flora zambesiaca* (1997), both of which only mention *Xymalos monospora*. Both of these authors and subsequent publications by Philipson (1993), Jordaan (2000, 2003), Da Silva *et al.* (2004) and Mabberley (2008) consider *Xymalos* a monotypic genus occurring in tropical and southern Africa. In Mozambique, *Xymalos* is recorded north of the Zambezi River at Ribáuè, Gurué (Stannard 1997) and Nampula (Da Silva *et al.* 2004) and south of the Zambezi at Tsetssera (Stannard 1997). Cavaco collected a specimen south of the Save River (southern Mozambique) and somewhere between Mapai and Pafuri (Kruger National Park area) (type specimen mentioned in the protologue). In this area between Save River and Mapai there is certainly no suitable habitat for *Xymalos monospora*, which usually grows in Afromontane forest, and the closest locality, Tsetssera, is roughly 400 km to the north of the Mapai-Pafuri record. Therefore, the locality is very doubtful as given in the protologue, namely: ‘Sul do Save, entre Mapai et Pafuri, in Moçambique’.

Cavaco compared the holotype of *X. mossambicensis* with specimens of *X. monospora* from southern and tropical Africa housed in the Paris Herbarium (e.g. *Rudatis 1418*, *Stolz 2063*, *Holst 4249*) and concluded that his specimen constituted a new species. We have not seen the type but Cavaco’s (1949) protologue and accompanying illustration indicate that *X. mossambicensis* differs essentially from *X. monospora* in having larger leaves with entire margins and fasciculate rather than racemose inflorescences. Throughout the distribution range of *X. monospora*, the leaf margins vary from entire (Figure 2) to coarsely serrate with widely spaced gland-tipped teeth (Figure 3). Inflorescences are always axillary and vary from cymose to racemose. There are no significant differences between *X. mossambicensis* and *X. monospora*, and they are therefore considered as conspecific.

TAXONOMY

***Xymalos monospora* (Harv.) Baill.** in Bulletin Mensuel de la Société Linnéenne de Paris 1: 650 (1887); Warb.: 53 (1893); Oliv.: t. 2444 (1896); Sim: 288, t. 121 (1907); Baker & C.H.Wright: 170 (1909); Perkins & Gilg: 10, t. 5 (1911); C.H.Wright: 493 (1912); F.W.Andrews: 7 (1950); J.Léonard: 402, t. 39 (1951); Keay: 55 (1954); Verdc.: 1, t. 1 (1968); Fouilloy: 109 (1974); R.B.Drumm.: 237 (1975); Pooley: 96 (1993); A.E.van Wyk & P.van Wyk: 302 (1997); Stannard: 43 (1997); Lötter: 114 (2002); M.Coates Palgrave: (2002);



FIGURE 2.—*Xymalos monospora* showing entire leaves. Photographer: M. Lötter.



FIGURE 3.—*Xymalos monospora* showing toothed leaves and some leaf damage. Photographer: M. Lötter.

Boon: 104 (2010). *Xylosma monospora* Harv.: 52, t. 181 (1863). Type: South Africa, Natal [KwaZulu-Natal], without precise locality, *Cooper 1251* (TCD—digital image!, lecto., designated here; K—digital image!, PRE!, isolecto.). [Note: Of the two collections cited in Harvey's protologue of *Xylosma monospora*, *Cooper 1251* is chosen as the lectotype because there are more duplicates of this collection than of *Cooper 1204*.]

Toxicodendrum acutifolium Benth.: 214 (1878). Type: South Africa, Eastern Cape, 'British Caffraria', *Barber & Barber 10* (K—digital image!, holo.).

Paxiodendron usambarense Engl.: 182 (1895). *Xymalos usambarense* (Engl.) Engl.: 310 (1901). Type: Tanganyika [Tanzania], E Usambara Mountains, Gonja, Bulwa, *Holst 4249* (B, holo.†; P—digital image!, lecto., designated here; COI—digital image!, JE—digital image!, K—digital image!, isolecto.).

P. usambarense var. *serratifolia* Engl.: 182 (1895). Type: Tanganyika [Tanzania], Kilimanjaro, Marangu, *Volkens 2264* (B, holo.†; JE—digital image!, lecto., designated here).

P. ulugurense Engl.: 389 (1900). *Xymalos ulugurense* (Engl.) Engl.: 310 (1901); Baker & C.H.Wright: 170 (1909). Type: Tanganyika [Tanzania], Uluguru Mountains, Lukwangule Plateau, *Goetze 274* (B, holo.†; K—digital image!, lecto., designated here).

Xymalos mossambicensis Cavaco: 45 (1949). Type: 'Moçambique [Mozambique], Sul do Save, entre Mapai et Pafuri', *Cavaco 89* (P, holo.).

Note: Most type specimens were seen as digital images on websites. Where the holotypes have been destroyed during World War II in the Berlin Herbarium, as in the case of *Holst* and *Goetze* specimens, lectotypification is covered by article 9.15 of the Code (McNeill *et al.* 2006), which provides for narrowing the lectotype to a single specimen. There are records of duplicates of *Holst 4249* verified by Engler, isotypes of *Paxiodendron usambarense*, in K, COI, JE and P, all of them flowering material, and all specimens show entire leaves. The Paris specimen is selected because it is the only one which gives the exact type locality in Tanzania. All the syntypes of *Paxiodendron usambarense* Engl. var. *ser-*

ratifolia Engl. (three Volkens specimens) were destroyed in Berlin, but one extant isosytype, *Volkens 2264*, is seen on ALUKA [<http://plants.jstor.org/>], housed at JE, and is therefore selected as the lectotype. This specimen has leaves with widely-spaced teeth in contrast with all the isotypes of the typical *P. usambarense* with entire leaves. There is only a fragment of the duplicate of *Goetze 274* at K, which is selected as the lectotype for *Xymalos ulugurense*.

Evergreen tree up to 8(–20) m, mostly single-stemmed, with dense, rounded, spreading crown. *Bark* silvery grey or grey-brown, rough, slightly fissured, with prominent lenticels, flaking in large scales to leave concentric, ridged markings; inner wood lemon-yellow; sap reddish. *Leaves* simple, opposite, glabrous, lemon-scented when crushed, pellucid-dotted; lamina narrowly elliptic to obovate, 40–200 × 15–100 mm, apex acute, rounded or shortly acuminate, base cuneate, margin usually irregularly and coarsely glandular-serrate, sometimes entire; midrib sunken above, prominent beneath, lateral veins 6–9, looping well within margin, reticulate venation prominent on both surfaces; petiole up to 30 mm long, glabrous. *Inflorescences* racemose or paniculate, solitary or paired in leaf axils, 10–35(–70) mm long; peduncles 5–10 mm long; bracts triangular, 1.0–2.5 mm long. *Flowers* unisexual, small, yellowish or greenish; pedicels 1–3 mm long, velvety. *Perianth* 1–2 mm long, hairy. *Petals* absent. *Male flowers*: perianth 4–6-lobed; lobes rounded to ovate; stamens 6–15 or more; anthers subsessile. *Female flowers*: perianth 3–5-lobed; lobes ovate, rounded to triangular, velvety, margins ciliate; ovary obovoid, cylindrical or turbinate, glabrous; stigmas sessile, discoid, thick, glabrous. *Fruit* an ovoid to ellipsoid drupe, (5–)10–25 × 3–15 mm, slightly asymmetrical, glabrous, orange or reddish, fleshy, crowned with persistent stigma. *Seed* solitary, ellipsoid, compressed, 10 × 8 mm, white (Figure 4). *Flowering time*: June–Oct.

Diagnostic characters: leaves of *Xymalos monospora* are opposite and translucent gland-dotted, with a lemon smell when crushed. The bark is very distinctive, flaking to reveal circular or worm-like markings, and when cut has a lemon-like smell (Lötter 2002). Small, fragrant yellow flowers, the sexes on separate trees, appear from June to October (Lötter 2002), arranged in racemes and

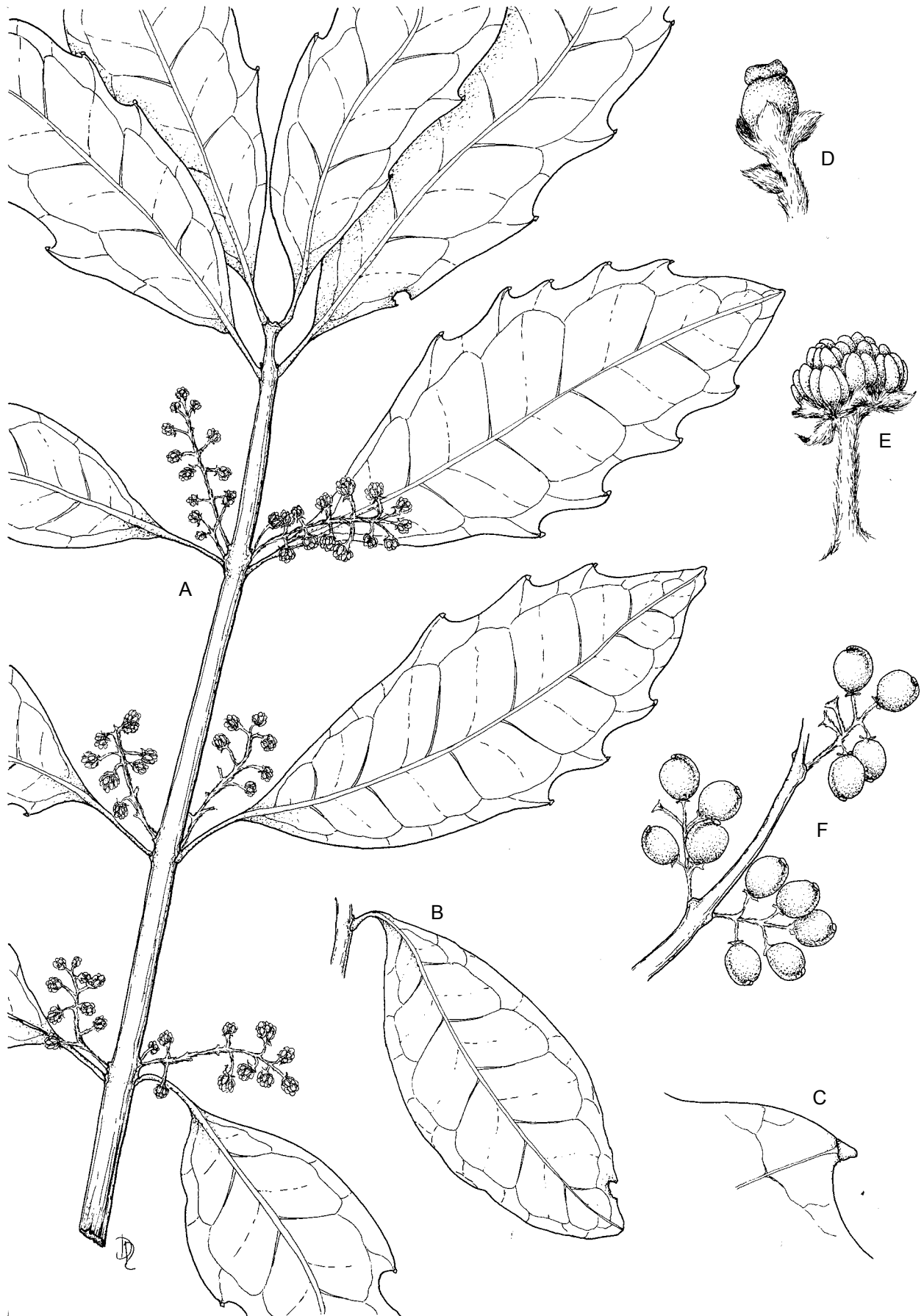


FIGURE 4.—*Xymalos monospora*, A, C & E, Mohle 389 (PRE); B, Van der Schijff 5630 (PRE); D, Compton s.n. (PRE53940); F, De Winter & Killick 8954 (PRE). A, flowering twig $\times 1$; B, leaf with entire margin $\times 1$; C, tip of tooth on leaf margin $\times 2$; D, female flower $\times 8$; E, male flower $\times 4$; F, fruiting branch $\times 1$. Artist: Daleen Roodt.

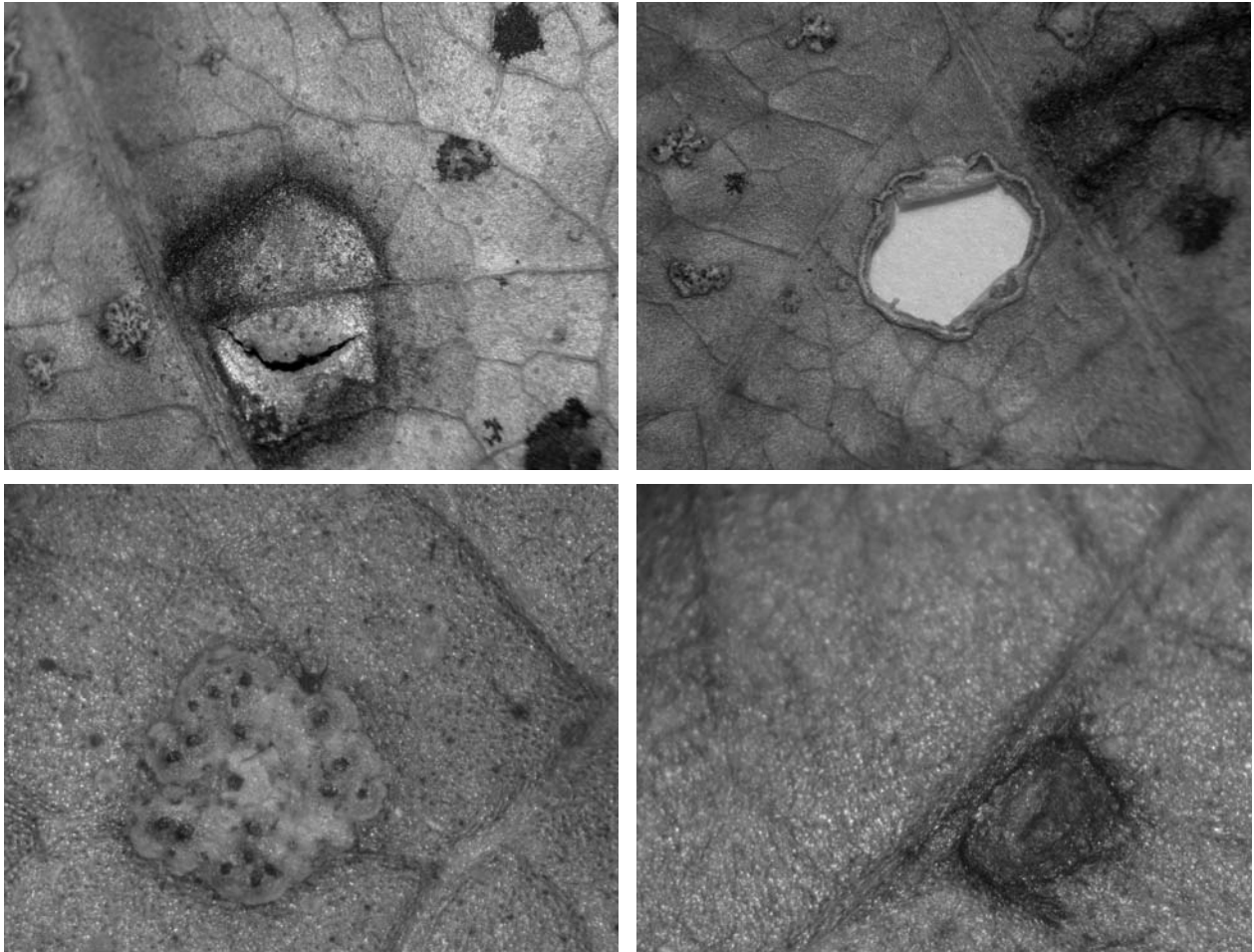


FIGURE 5.— *Xymalos monospora* showing leaf damage. Photographer: M. Jordaan.

often produced in clusters from old leafless wood (Sim 1907). The fruits are ovoid, smooth, 1-seeded drupes, often enclosed by a perianth or a fleshy receptacle, with a persistent stigma.

Distribution and habitat: *Xymalos monospora* grows in Afromontane, scarp or coastal forests, or in grasslands associated with forests, in moist areas near watercourses, from near sea level to above 2 000 m. It occurs in eastern tropical and southern Africa, from southern Sudan as far south as the Eastern Cape. Tadesse (2000) suggests that the species could also occur in Ethiopia but has not yet been recorded there. Distinctive disjunct populations occur in the highland forests of Nigeria on the Gofel Mountains (Aluka Library [<http://plants.jstor.org/>]), Cameroon Mountains (Cable & Cheek 1998) and on the Island of Bioko, formerly Fernando Pó (Keay 1954) (Figure 1). The range of *Xymalos monospora* falls well within the archipelago-like Afromontane Region of Endemism (White 1978, 1983). This African phytochorion is of special biogeographical and evolutionary significance because of its putatively ancient status.

Pollination: *Xymalos monospora* is wind- or insect pollinated, but this needs further investigation (Philipson 1993). Quantities of pollen are produced by the male flowers, and most specimens collected possess male flowers, with very few of the ± 50 specimens in the National Herbarium, Pretoria, with female flowers.

Leaf damage: there is some damage to the leaves on ± 100 specimens examined, usually in the form of black patches or holes in the leaf blade (Figure 5). *Xymalos monospora* is the host for an unusually large number of fungal pathogens (Doidge 1950), which are probably the cause of the damage to the leaves. The leaf edges are also sometimes eaten away (Figure 3) and the species is a host for the larva of the butterfly *Papilio dardanus* Brown (mockerswallowtail) (Papilionidae) (Picker *et al.* 2004; butterflycorner website [en.butterflycorner.net]).

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