

NEW DATA AND FIELD-OBSERVATIONS ON *TRICHILIA GRANDIFOLIA* OLIV. (MELIACEAE)

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SUMMARY

Recently the, hitherto unknown or incompletely described, female flowers and mature fruits of *T. grandifolia* Oliv., a local, endemic species from the island of São Tomé, were collected and subsequently studied for an emended description of this taxon. Notes on the distribution, ecology and chromosome number ($2n = 50$) are added.

1. INTRODUCTION

During the months of January and February, 1980, Arends, Groenendijk and De Wilde did botanical fieldwork in the island of São Tomé. Along a trail leading from Nova Moka towards Lagôa Amelia, flowering male specimens of *T. grandifolia* Oliv. were found, next to fallen fruits and seedlings of this species. Earlier, DE WILDE (1968) published a monograph dealing with the eighteen continental, African species of *Trichilia* recognized by him. At that time *T. grandifolia* was very poorly and incompletely represented in the various herbaria: female flowers, mature fruits and seedlings were lacking. Accordingly, during the fieldwork in 1980, great efforts were made to obtain these previously missing elements. However, flowering female specimens were not encountered. Mr. W. C. S. Heemskerk, at that time residing in the island, kindly offered to follow the flowering of a number of female trees after our departure. In late July, 1980, he succeeded in collecting female flowers and also mature fruits. Preserved and living material was sent to The Netherlands where, under greenhouse conditions at the Laboratory of Plant Taxonomy and Plant Geography of the University for Agriculture in Wageningen, some of the seeds germinated and developed into seedlings.

The first author analysed the newly acquired material as a part of the requirements for a graduate degree. In view of the complex ovule and seed-coat development encountered in the Meliaceae recently demonstrated by CORNER (1976), assistance was invited from Dr. F. D. Boesewinkel (Hugo de Vries Laboratory, University of Amsterdam) whose findings are published in the following paper (BOESEWINKEL 1981).

2. TAXONOMY

Trichilia grandifolia was validly published by OLIVER (1868). It is based on *Mann*

no. 1055 (São Tomé: sin. loc., holotype, K, 2 sheets). Full literature references are given by DE WILDE (1968). The last author accommodated *T. grandifolia* in the section *Trichilia* together with fourteen other species, all of which occur on the continent. Although the spermoderm in *T. grandifolia* is, to all appearances, strikingly different from the seed-coats found in the other species in the section, its ontogeny does not seem to be at variance. The partly free filaments terminated by 2 appendages and the intrastaminal disk fused to the base of the staminal tube are characteristic of this section. For the time being *T. grandifolia* is left in section *Trichilia*.

According to PENNINGTON & STYLES (1975), the genus *Trichilia* is distributed in tropical America, Africa and the Indo-Malayan region. It represents the type genus of the tribe Trichilieae in the subfamily Melioideae.

3. SUPPLEMENTED AND AMENDED DESCRIPTION *Fig. 1 and 2; Phot. 1*

Dioecious, medium-sized evergreen tree, 15–30 m tall and 28–40 cm d.b.h., in understorey of submontane evergreen forest at altitudes ranging between c. 900 and c. 1450 m; bole asymmetrical, somewhat fluted at the base, branching at or above the middle; the crown rather large and loosely branched. Bark smooth, pale brown; slash pinkish, turning pale brown, emitting a “cedar-wood” fragrance; sapwood cream-coloured, heartwood pale brown, rather soft.

Leaves imparipinnate, 20–50(–70) cm long; leaflets entire, (2–)3–4-jugate, (5–)10–25(–35) by (3–)5–10(–13) cm, acuminate at apex, obtuse, truncate or subcordate at the base.

Inflorescences lax, rather few-flowered, axillary or pseudo-terminal, (4–)10–15(–20) cm long; the female inflorescences usually shorter and less branched than the male ones.

Male flowers: pedicel 2–4(–6) mm long, pubescent; bracteoles 2, early deciduous, 1.1–1.6 by 1.0–2.0 mm, puberulous on both sides. Receptacle 1.3–3.0 mm long. Calyx cup-shaped 1.5–3(–4) mm high by (5.5–)7–9 mm wide, deeply 5-lobed, lobes (1.7–)2–3(–4) mm long by 2–4(–5) mm broad. Petals (4)5(6), free, (11–)12–15(–16.5) by (4–)5–6(–9) mm, rather thick and fleshy, densely puberulous, cream-coloured, suffused with pink near the apex, reflexed at anthesis. Staminal tube urceolate, yellowish, 9–10(–11.5) mm long (including the anthers), (9–)10(–11)-fid; free parts of the filaments 4–6 mm long, terminated by 2 appendages, glabrous outside, villous inside; connate part of the staminal tube (3–)4–5 mm long, inside partially thick, fleshy and hairy as the result of its fusion with the intrastaminal disk; anthers attached at the apex of the filaments in between the 2 appendages, 2.3–3.2 by 0.8–1.3 mm. Pistillode 7–9 mm long.

Female flowers: not essentially different from the male flowers, but the receptacle usually shorter, 1–1.5 mm long; the petals at the very base often slightly adnate to the staminal tube and somewhat shorter as compared to male flowers, (9–)11–12 mm long by 5–6 mm broad, the staminal tube also shorter (6–)7(–9) mm long, antherodes ca 2 by 1 mm, not opening and not producing pollen. Ovary globular to ovoid, (3–)4–5 mm in diameter, slightly longitudinally grov-

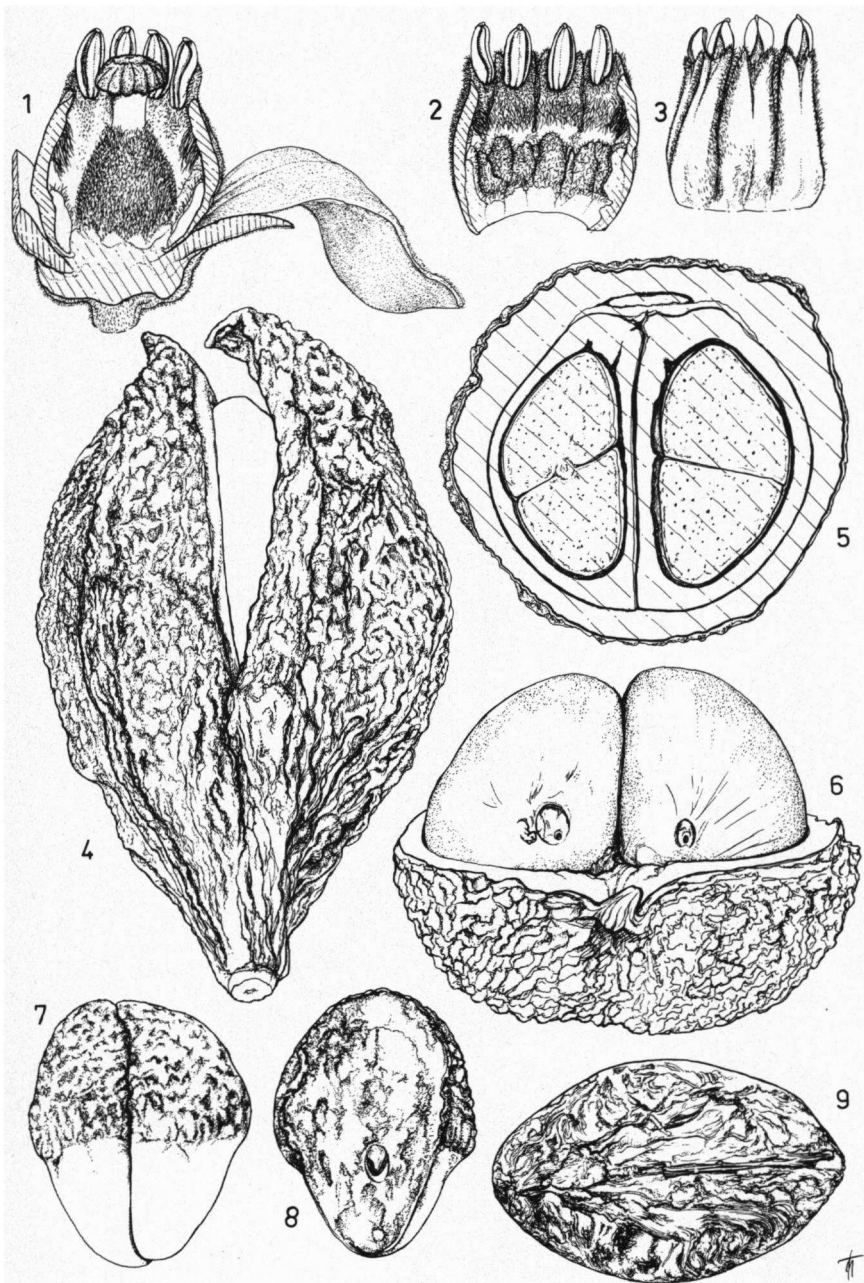


Fig. 1. *Trichilia grandifolia* Oliv. – 1: section of ♀ fl. ($\times 4$); 2: part of staminal tube, inside, ♀ ($\times 4$); 3: id., outside ($\times 4$); 4: mature, dehiscent fruit ($\times \frac{2}{3}$); 5: transverse section of fr., one locule showing 2 seeds, the other locule aborted ($\times \frac{2}{3}$); 6: fruit seen from the apex, one valve removed, showing two seeds, each with a micropylar spot at the top ($\times \frac{2}{3}$); 7: cotyledons, seed coat removed ($\times \frac{2}{3}$); 8: one cotyledon, inner side, showing the radicle ($\times \frac{2}{3}$); 9: seed, the sarcotesta removed but the vascularized leathery inner side still adhering to the cotyledons ($\times \frac{2}{3}$). – 1–3: Heemskerk in Herb. Groenendijk 141; 4–9: Heemskerk in Herb. Groenendijk 139.

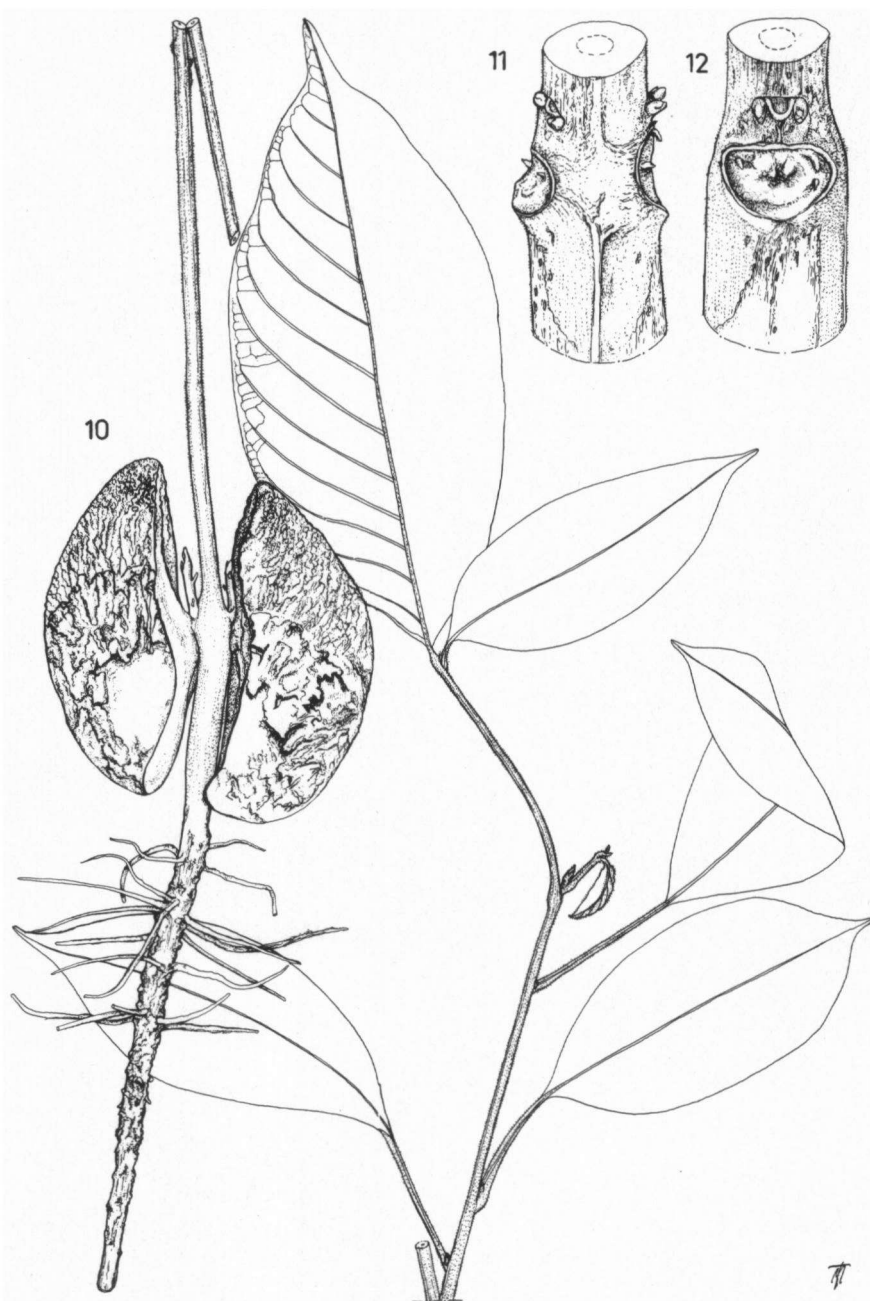


Fig. 2. *Trichilia grandifolia* Oliv. – 10: seedling, about three months after germination ($\times \frac{2}{3}$); 11 and 12: details of axillary buds above the scars left by fallen cotyledons, side-view and frontal one ($\times 2$). – 10: Van Veldhuizen 686: 11–12: from living plant in cultivation.

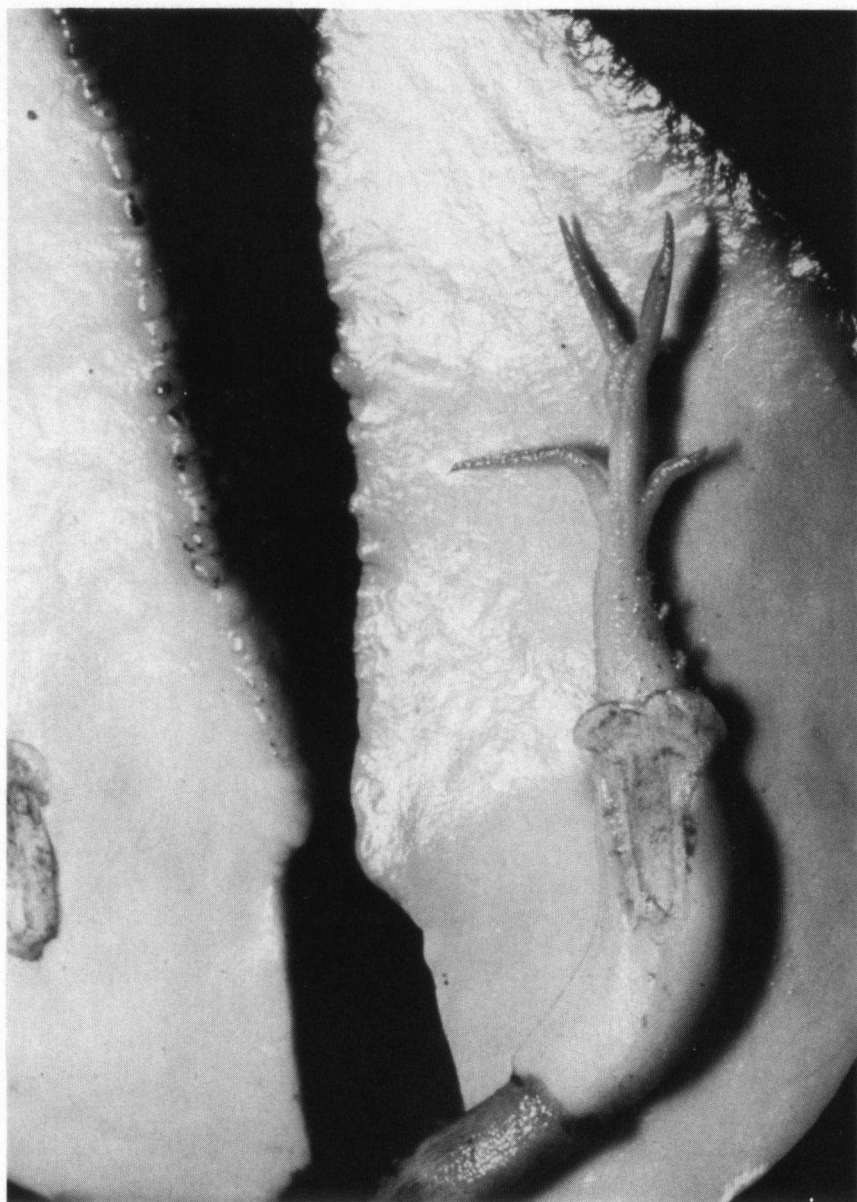
ed, densely villous, 2-celled; ovules 2 in each cell, axile, collateral, anatropous, bitegmic; style shorter than in male flowers, 1.5–2 mm long, slightly broadening towards the apex, glabrous or at most rough with very minute trichomes and often villous at the base; stigma capitate, 1.5 mm high by (2–)3(–4) mm wide, furrowed by the in bud closely appressed antherodes, densely covered with short and rather stiff trichomes, flattened at the apex and with a depression in the centre.

Infructescence usually bearing only one developed fruit, rarely two.

Mature fruit a 2-chambered, shortly stipitate capsule, brown or with a brownish-red gloss, ovoid, ellipsoid, obovoid or almost globose, circular or broadly elliptic in transverse section, 8.5–15 cm long by 6–10 cm wide, distinctly beaked at the top; the beak firm, tapering towards the apex, often curved sideways, up to 1.5 cm long; its outside strongly verrucose and provided with c. 8 more or less distinct sinuous ribs which start from the base to disappear above the middle, very densely covered with an often mealy indumentum of extremely short trichomes; loculicidally dehiscent with 2 valves; the valves very thick and fleshy to somewhat lignescent, 5–10 mm thick, smooth and glabrous inside. The fruits normally containing two seeds, occasionally only one, the other ovules aborted or very backward in development; sometimes the two seeds are found in one chamber, sometimes one in each of both chambers. The fresh pericarp when cut producing a sticky whitish exudate.

Mature seeds 7–10 cm long by 5–7 cm broad, more or less ovoid or plano-convex when two seeds are present and, if so, flat on the adjacent sides; without endosperm; testa (the product of the outer integument sensu CORNER 1976) almost completely developed into a thick, firm, fleshy sarcotesta, only leaving a very small spot near the apex of the seed (the foramen) uncovered; the sarcotesta smooth on the outside, in vivo cream-coloured, with a scent reminiscent of orange or pine-apple, at some parts up to 10 mm thick (mostly 2–3 mm), at the inner side leathery and highly vascularized and partly of chalazal origin; cotyledons very firm, hard fleshy, yellowish-brown, 6–9.5 by 3–6 cm, collateral, plano-convex, the outer surface on the micropylar side smooth in contrast to the verrucose chalazal side, inside dotted with glandular dark brown or blackish resinous pits; radicle superior, lying between the cotyledons.

Seedling: germination epigeal, the cotyledons emergent (phanerocotyl). Tap-root with more or less horizontal, lateral roots. Hypocotyl (2.5–)4(–5) cm long, somewhat swollen, puberulous. Cotyledons opposite, sessile, ultimately becoming dark green, often with remnants of the vascularized testa on the micropylar side, shed about 4 months after germination and leaving conspicuous scars on the stem; each cotyledon at or somewhat above the axil with up to 4 axillary buds, these accessory buds either collateral or serial (one or more of these buds may develop into accessory epicotyls even without any visible damage to the main epicotyl). Epicotyl 4–15(–20) cm long, puberulous. First two leaves scale-like (cataphylls), opposite or sub-opposite, c. 10–15 mm long by 1–2 mm broad, falling off soon after germination. The following foliage leaves (eophylls) spirally arranged, simple, entire, petiolate; the leaves gradually becoming larger, the



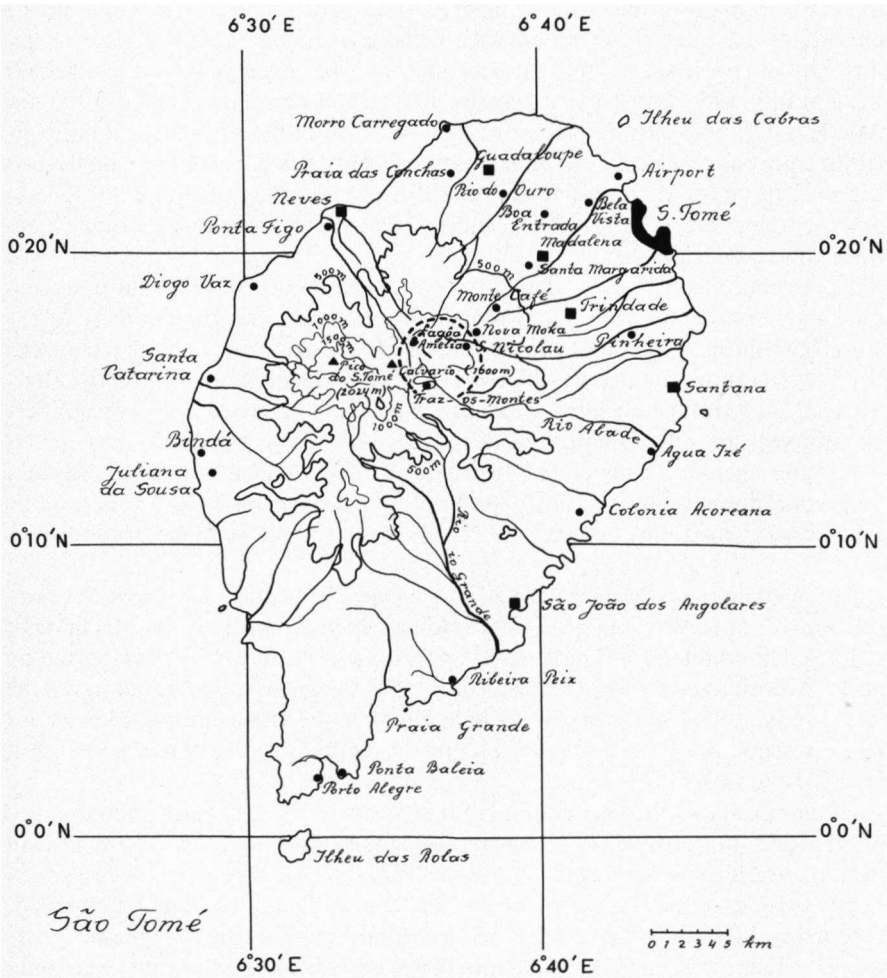
Phot. 1. Germinating seed of *Trichilia grandifolia* Oliv., one cotyledon removed (*Van der Laan 174*; phot. J. W. Mugge).

third – but often the fourth to sixth or seventh leaf – becoming compound (two – but more often three – foliolate) at an average seedling age of about 3 months.

4. DISTRIBUTIONAL AND ECOLOGICAL NOTES

Map 1

Trichilia grandifolia is not only an endemic in São Tomé, but even in this island it seems to be of very restricted distribution. Up to now the species has only been collected along a track leading from Bon Successo (SW. of Nova Moka) towards Lagôa Amelia, and nearby Traz-os-Montes. The altitudes of these places range between 900 m and 1450 m. Our own observations and collections along the track to Lagôa Amelia were made between 1150 m and 1300 m alt. and it seems doubtful whether the species is distributed much beyond this altitudinal range. The mean annual precipitation in this particular area varies from 2500–3500 m; the mean annual temperature fluctuates between 13.5 and 18.0°C. The relative



Map 1. São Tomé. The interrupted circle demarcates the distribution of *Trichilia grandifolia* Oliv.

humidity of the air remains high throughout the year. Although it is possible that *T. grandifolia* may be found elsewhere in the mountainous interior of the island, this is rather unlikely. At the present stage of our knowledge the species occurs in small forest remnants on rather steep slopes in an area totalling less than 20 km². Here the tree appears to be quite common. However, even on these slopes man-made small-scale forest clearings for arable land were seen in many places. The species was never observed to grow in true secondary vegetation. Evidently it is in danger of extinction due to habitat destruction.

As stated in the description, *T. grandifolia* is strictly dioecious, which is in conformity with the condition in the *Trichilia* species found on the African continent. During our stay in the island in January and February 1980, many male individuals were found in flower. In that same period not a single female tree was seen flowering. Flowering male trees are often conspicuous by the abundance of fallen flowers underneath these trees. Female trees were recognized by the presence of fruits. It was observed that some female trees showed both young and almost mature fruits simultaneously. This suggests that the female individuals flower at least twice a year, probably at the bi-annual transition from the dry to the wet season, since Heemskerk collected female flowers in July. The male individuals most probably flower all the year round and at least several times. DE WILDE (1968) observed the same phenomena among continental *Trichilia* species.

Dehiscence of the large and heavy fruits always proceeds from the apex and may start already on the tree. However, we gathered that the majority of the fruits open as the result of hitting the forest floor. Also mature but still indehiscent fruits were found underneath the trees, probably opening on the ground afterwards. Many fruits, and some seeds also, were found gnawed upon, most likely by monkeys or other mammals. Although nowadays mammals may act as dispersing agents, it was stated by EXELL (1956: 3) that the island was not inhabited by mammals (except bats) until its discovery in 1470. Barochory or even achory sensu VAN DER PIJL (1972) appears to be the main means of dispersal.

The seed-coat of the large seeds of *T. grandifolia* does not show the conspicuously contrasting black and red colours which are so characteristic of most of its mainland relatives. The seeds are probably too heavy to be transported by birds. According to CORNER (1976, Vol. 1: 185) the massive construction fits the forest-requirement and appears to be a character of the primitive Meliaceae seed. BOESEWINKEL (1981, this issue), however, comes to a different conclusion for *T. grandifolia*.

Under forest conditions we found that the seed-coat decays easily and that this process does not necessarily affect the cotyledons. Germination experiments in the glasshouse at Wageningen, to the contrary, proved that it was necessary to remove the seed-coat. If this was omitted, the seeds, the cotyledons included, decayed within a short time. The same was found to hold true for "peeled" seeds which were buried at about 5 cm depth in a sandy soil. Positive results were only obtained with "peeled" seeds which were placed on the surface of the soil. Light

conditions also appear to be important for a successful germination. Seeds placed under normal August-September day-light conditions in the glasshouse (temp. ca 25°C) showed a rapid greening of the cotyledons, but no other indications of development. Other seeds in the same glasshouse placed in rather deep shade developed into seedlings after about two months.

In the natural habitat seedlings of *T. grandifolia* were often numerous underneath the seed-trees. Usually these seedlings showed 1–3 (usually 2) accessory epicotyls. This quality might have survival value in species growing in a forest environment where it often takes a long time before seedlings get an opportunity to develop further and where destruction of the terminal shoot in this stage is of frequent occurrence. Saplings and mature trees always show only one stem, however.

Although many tree-species in its habitat were densely covered with epiphytes, these were not or rarely found growing on *T. grandifolia*.

5. VERNACULAR NAME AND USE

Our local guide Pedro was acquainted with *T. grandifolia* and called it: “Cacao do mato”, Portuguese for: “the Cocoa of the forest”. He explained that this name refers to the shape and dimensions of the fruits which, quite often, resemble those of the Cocoa tree, by far the most important crop on the island. The wood, he said, is rather soft and only used as a firewood, and according to him no other parts of the tree were used.

6. SOMATIC CHROMOSOME NUMBER

Tips from lateral roots of the seedlings (voucher *Heemskerk in Herb. Groenendijk no. 140*), as mentioned in paragraph 4, were pre-treated in 0.001 M 8-hydroxyquinolin solution (4 hours) and fixed in acetic-alcohol. After maceration in 1 N HCl (2 min. at 60°C) and squashing, the cover slips were removed by

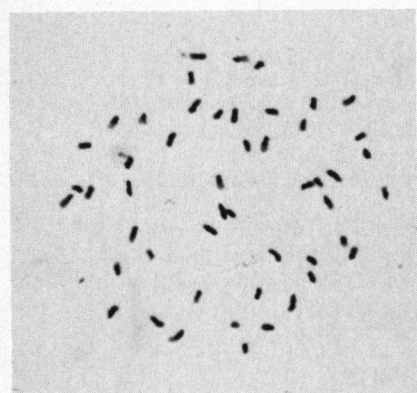


Fig. 3. Karyotype ($2n = 50$) in root tip of *Trichilia grandifolia* Oliv. Magn. appr. 1000 ×.

freezing. The slides were hydrolised in 1 N HCl (6 min. at 60°C) and stained in 1.5% Giemsa solution, dried and embedded in DPX. One of the resulting permanent slides is retained as voucher 6-9 in WAG.

The somatic chromosome number of *T. grandifolia* is $2n = 50$; the karyotype is shown in *fig. 3*. The chromosomes are submetacentric, and range in length from c. 1.5 μm to c. 3 μm . This number had already been recorded in some continental African species of both the sections *Moschoxylum* (A. Juss.) C.DC. and *Trichilia* (STYLES & VOSA 1971).

Specimens examined, additional to the material cited by DE WILDE (1968): São Tomé: along a trail leading from Nova Moka towards Lagôa Amelia (♂ fl., young and mature fr. and seedlings, Jan.) *De Wilde, Arends and Groenendijk 104* (WAG, 3 sheets, fl. and fr. in spirit coll.); *ibid.* (mature fr. and seedling, Jan.) *De Wilde, Arends and Groenendijk 308* (WAG, 4 sheets); *ibid.* (veget. and ♂ fl., Febr.) *De Wilde, Arends and Groenendijk 326* (WAG, 3 sheets, fl. in spirit coll.); *ibid.* (young and mature fr., April) *Heemskerk in Herb. Groenendijk 139* (WAG, spirit coll. only); *ibid.* (mature fr., May) *do. 140* (WAG, spirit coll. only); *ibid.* (♀ fl., July) *do. 141, 142* (WAG, spirit coll. only); *ibid.* (young fr., July) *do. 143, 144 and 145* (WAG, spirit coll. only); *ibid.* (veget. and young fr., Sept.) *Van de Have 1* (WAG, 3 sheets).

Culta: Agricultural University, Wageningen, the Netherlands, *Van der Laan 174* (WAG, seedling from seeds collected on São Tomé and forwarded by Heemskerk, spirit coll. only); *ibid.*, *Van Veldhuizen 686* (WAG, *idem*, spirit coll. only).

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