NAT. HIST. BULL. SIAM SOC. 45: 149–170, 1997

# UNMASKING THE REAL IDENTITY OF *SAPRIA POILANEI* GAGNEPAIN EMEND., AND DESCRIPTION OF *SAPRIA RAM* SP.N. (RAFFLESIACEAE)

*Hans Bänziger*[1] *and Bertel Hansen*[2]

ABSTRACT

Re-examination of the field notes of Poilane, used by Gagnepain to describe *Sapria poilanei* from W Cambodia, exposed a seriously misleading original description. New material from contiguous SE Thailand, perfectly matching Poilane's notes, is used to redescribe the species. *Sapria ram* sp. n. is described from Central West to South Thailand. It differs from *S. poilanei* in its multicoloured rather than whitish diaphragma, pan- rather than bowl-shaped female disk, and in its far more prominent and differently shaped tube ridges, among other characters. Distinction from the rather different *Sapria himalayana* Griffith is detailed. *Sapria ram* is very different biologically from the other two species: it is found at lower elevations, parasitizes other hosts and is pollinated by sarcophagid instead of calliphorid flies. Keys for the identification of fresh as well as long since dead flowers of the three known *Sapria spp.* are given.

## INTRODUCTION

The study of *Sapria* Griffith in Thailand has been obfuscated by taxonomic problems since its inception. The presence of the Rafflesiaceae in Thailand was first reported in a paper by HOSSEUS (1907) in which a new species and genus, *Richthofenia siamensis,* was described. This was synonymized by SOLMS-LAUBACH (1914) to *Sapria himalayana* Griffith, 1844. HOSSEUS'S (1907) study, while being detailed and having fine drawings, had certain problems (in prep.) among which were the description of the warts on the perigone lobes. These became the principal characters used for species distinction in *Sapria.* HOSSEUS'S specimens from Doi Suthep were stated as having white-dotted warts on red perigone lobes. The original description of *S. himalayana* mentioned yellow dots and as far as we have been able to establish, only yellow-dotted *S. himalayana* are otherwise known from Doi Suthep and other areas in North Thailand (e.g. photographic doc. No. 5937, Larsen & Hansen, 1958; Fig. IA in BÄNZIGER, 1988; S. Elliott, pers. comm.). It is generally assumed that Hosseus made a mistake. Yet yellow-dotted as well as white-dotted clusters which morphologically are *S. himalayana* were recently shown to one of us (H.B.) in an area in Northeast Thailand.

It appears that Kerr was the first botanist to collect what is described here as *S. ram* sp. n., in South Thailand in 1929 (No. 16738). It is surprising that Kerr did not note the striking difference between this species and *S. himalayana.* He had collected *S. himalayana* on Doi Suthep long before, in 1911. However, he, too, made a field note

[1] Department of Entomology, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Botanical Museum, University of Copenhagen, Copenhagen 1123, Denmark.
Received 9 July 1997; accepted 8 September 1997.

which has not been supported by subsequent findings. He reported No. 16738 to be yellow-dotted, while other collectors (see below), including H.B., mention *S. ram* sp. n., even near Kerr's site, as having white or sometimes faint pink dots. Nevertheless, Hosseus and Kerr might have been correct; the colour of certain structures may vary in exceptional cases in *Sapria,* or be aberrant, or they may have deteriorated in colour.

Subsequent collections of *S. ram* were made by Beusekom and others in 1971 (No. 3715) and Santisuk in 1976 (No. 842), both accompanied by colour photographs. Unfortunately, the material did not preserve well and deteriorated, so that without the knowledge we have today, it was not even possible to assess whether a new taxon was involved. It was not until new collections were made recently from several sites, and ample photographic documentation and ecological data were obtained, that a satisfactory picture of this species had emerged.

However, the biggest problem has been *S. poilanei* Gagnepain. Discovered in Cambodia's Cardamom Mountains and described from four collections in 1941 as being pink and destitute of dots and warts—unique features for a *Sapria*—the flower acquired a certain aura of mystery. No flower as described by Gagnepain has ever been seen again. It never will, even when access to its type locality, the last hideouts of the Khmer Rouge, is restored. The simple reason is that *S. poilanei* sensu Gagnepain does not exist. Re-examination of Poilane's field notes used by Gagnepain to describe this species, laid bare a seriously flawed original description which had hitherto completely obscured the real appearance of the species.

*S. poilanei* was first reported from Thailand by SMITINAND (1980) who discovered it on Khao Soi Dao Tai in the Southeast (Smitinand, pers. comm.). His identification must have been tentative since Gagnepain's description is so inaccurate, probably based on the geographic vicinity of his site to the type locality. HANSEN (1972a) had already hinted at the possible presence of the species in this area based on its proximity to the Cambodian localities.

Before our studies, the species seems to have been sighted only twice more, by laymen, on the nearby Khao Soi Dao Nua. One of them (Mr. P. Yaopirom) published a colour photograph in a Thai language magazine. When H.B. visited both mountains early in 1997, nobody at the offices and ranger quarters of the Wildlife Sanctuary encompassing the two mountains had ever seen the flower or knew where it grew. H. B. was fortunate to find three clusters during four solo ascents of Khao Soi Dao Nua. The specimens perfectly matched Poilane's field notes, in utter contrast to Gagnepain's description.

Before the unmasking of the true circumscription of *S. poilanei* and the unravelling of the discrepancies between the other species, various authors (e.g. HANSEN, 1972a, b, 1973; BAIN & HUMPHREY, 1980; ELLIOTT, 1990) were inevitably misled into inaccurate descriptions, identifications and geographical distributions of *Sapria* species.

## TERMINOLOGY AND EXPLANATORY NOTES ON MORPHOLOGY (FIGS. 1–9)

The extent by which the perigone lobes spread and recurve ('opening degree') can be very different from flower to flower, even at full anthesis. This distorts the real size of

the flower (measured as diameter and height). To minimize this, flowers with lobe inclination higher than 75 degrees on all sides are not considered in regard to their diameter and height.

For simplifying the description, the collar (i) of the diaphragma is divided into three concentric, basally more or less decagonal, bands: A basal one (ib) attached to the tube somewhat below the intersection of the lobes with the latter; a median one (im) bearing the ramenta (though sometimes these transgress into the third band); and a distal one (id) surrounding the aperture. While the last is membraneous the others are fleshy.

In the three known species of *Sapria* the tube (l) is intersected by 20 radially arranged ridges (m). Distally they completely or nearly reach the diaphragma where they flatten out and disappear or, in some cases, especially in males, they broaden out in a wide, increasingly flat arch which merges with that of adjacent ridges. In some individuals there is, below the diaphragma, an additional short low ridge between the normal ridges. At the other end, at some distance from the tube bottom, the ridges mutually merge and more or less disappear. In males (rarely visible in females) fine ridges reappear at the base of the column which they follow up until they reach the disk where they disappear between (not below) each anther, before re-emerging once more as a swelling at the base of the outer wall of the disk, between and above each anther. The main ridges on the tube wall are "T" shaped in cross section (Figs. 4, 7–9), i.e. they are topped by a flange. The shape of the flange and the ratio of its width to the ridge's height, are characteristic of the species.

The anthers (z) number 20 in all *Sapria* species. Each anther has two superimposed duct-like chambers which merge distally into a slit-like dehiscence pore.

There are 20 nodules (y) found in the female column, somewhat below the stigmatic fascia. We join those who interpret them as being reduced anthers.

By 'cluster', we mean the buds and flowers of *Sapria* parasitizing a single host plant (liana). It is not yet known whether all flowers in a cluster belong to a single plant or to several, but the former is more likely.

## DESCRIPTIONS

### *Sapria poilanei* Gagnepain emend. Bänziger & Hansen

Not. Syst. Paris 9: 144 (1941); B. Hansen, Bot. Tidsskr. 67: 149 (1972); Fl. Camb., Laos, Viet-Nam 14: 61, tab. 9 (1973).

GAGNEPAIN (1941) asserted that his description of the colours of *S. poilanei* was based on Poilane's field notes of 1939, reproduced here in Fig. 10. Critical re-examination of the field notes shows that Gagnepain interpreted them very carelessly. He incorrectly stated that the perianth and the diaphragma were pink and, most important of all, that the lobes were not dotted. These are some of the most salient characters for species distinction. Furthermore, in the sketch (reproduced in HANSEN, 1973, Table 9, Fig. 3) of the flower drawn by Gagnepain after Poilane's notes, there are no warts on the lobes, although such are visible as corrugations and faint warts in the dry type material. In addition, the inner

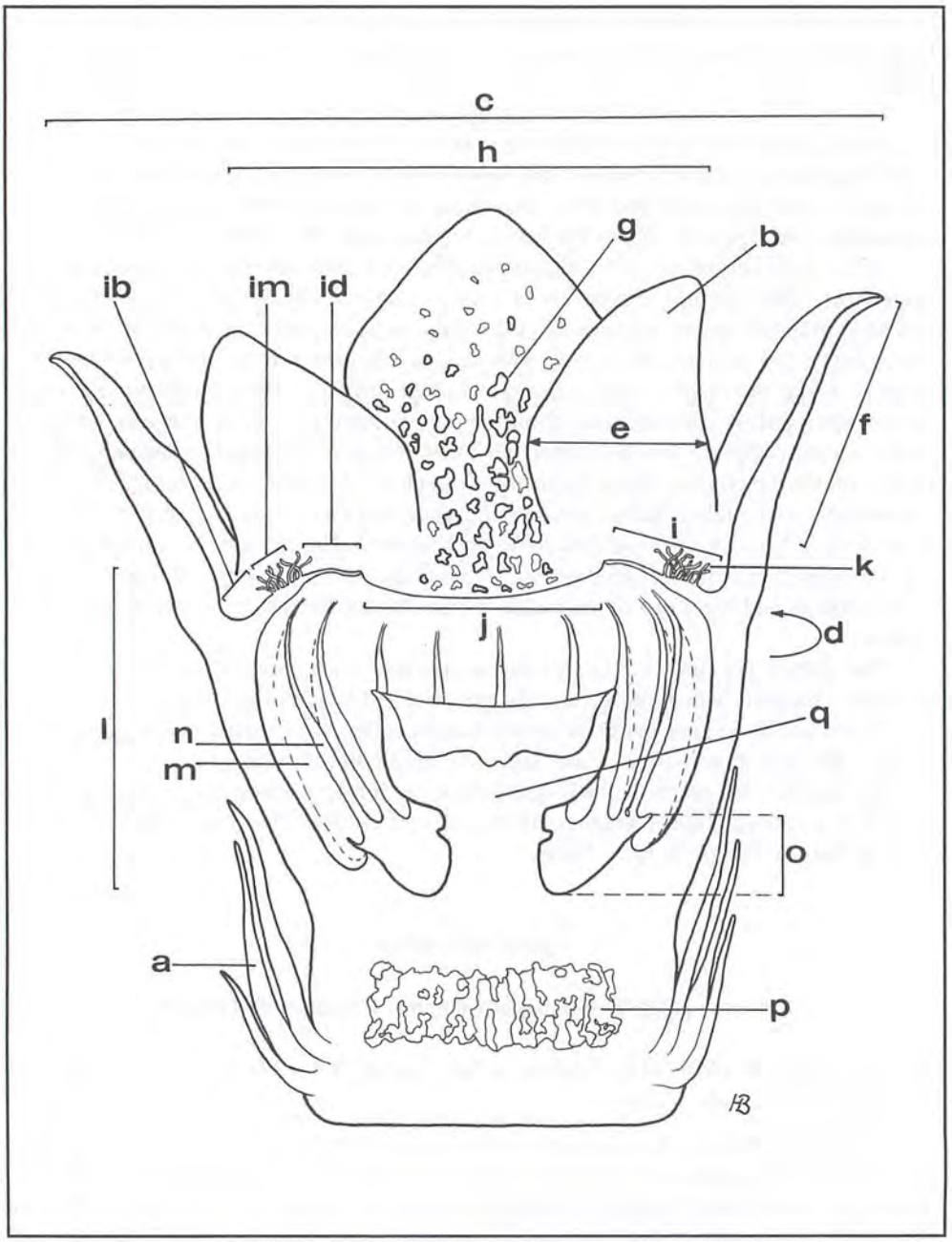
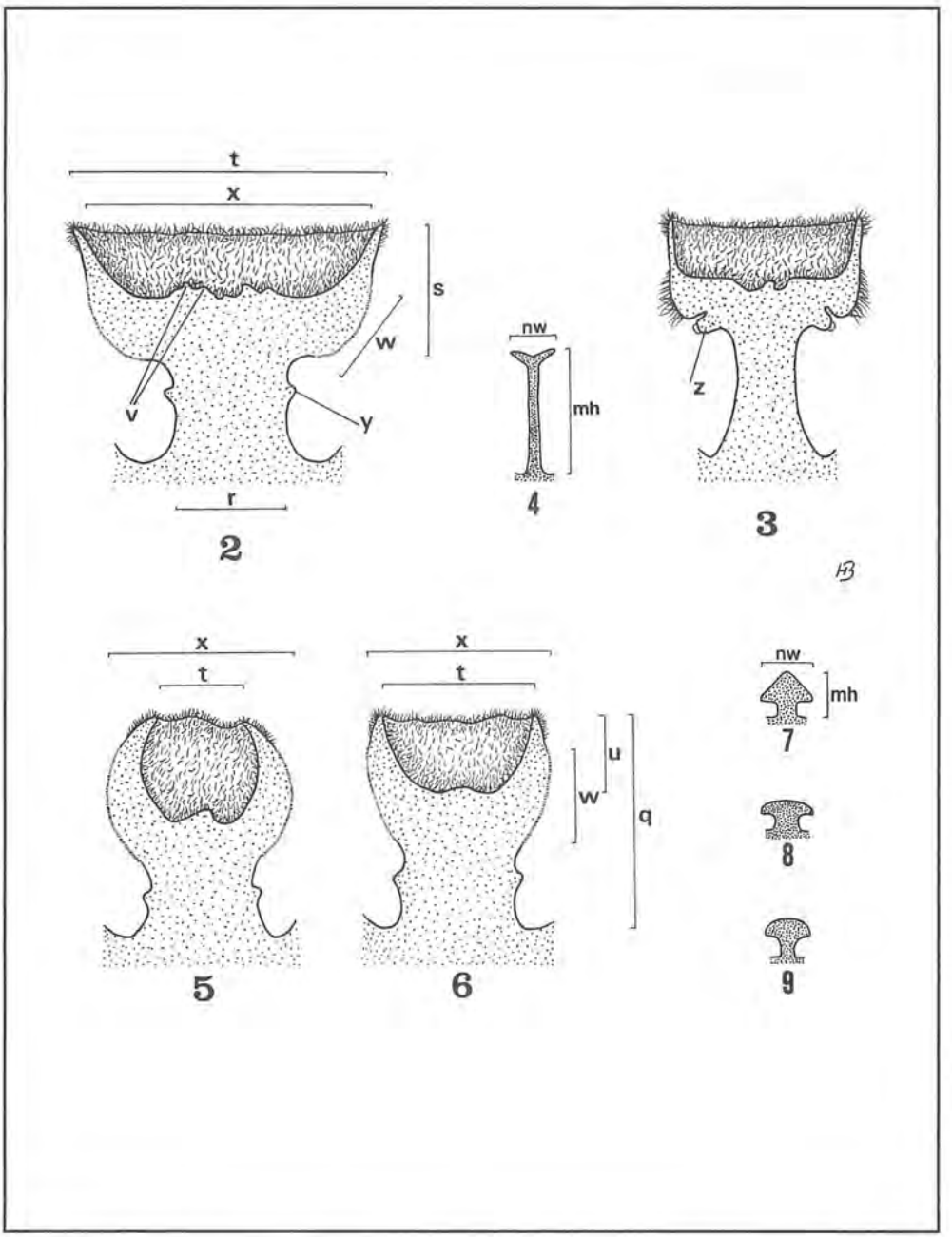
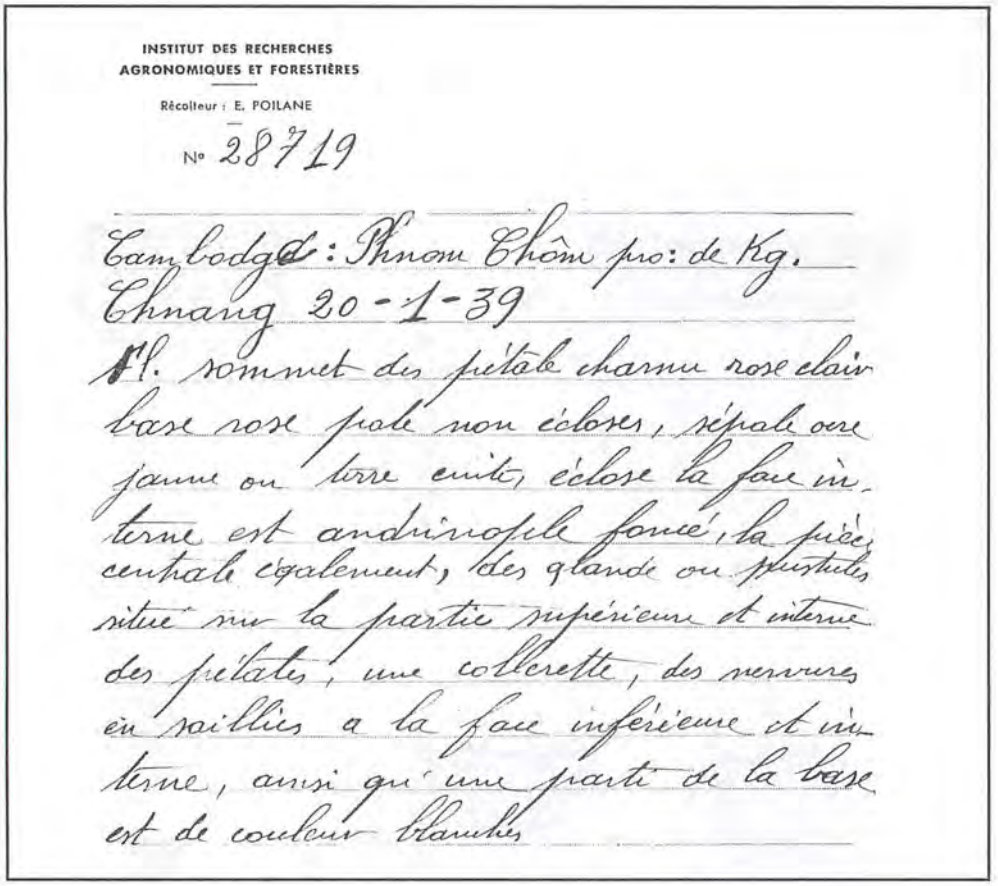



Figure 1. Cross-section of holotype of *Sapria ram,* with morphological terms. a=bract, b=lobe, c=diameter of flower, d=circumference of tube, e=width of lobe, f=length of lobe, g=wart, h=diameter of diaphragma, i=width of collar of diaphragma, ib=basal band of collar of diaphragma, im=median band of collar of diaphragma, id=distal band of collar of diaphragma, j=aperture of diaphragma, k=ramenta, l=tube, m=ridge of tube, n=flange of ridge, o=fusion area of ridges, p=ovary, q=column.




Figures 2–4. *Sapria ram:* Cross-section of female column (2), male column (3), and of tube ridge (4).
Figures 5–9. *Sapria poilanei:* Cross-section of female column (5, 6: variation) and of tube ridge variations (7–9). mh=height of ridge, nw=width of flange of ridge, q=central column, r=width of column stalk, s=height of disk, t=width of disk crest, u=depth of disk, v=calli, w=stigmatic fascia, x=maximum diameter of stigmatic circle, y=reduced anther, z=anther.



INSTITUT DES RECHERCHES
AGRONOMIQUES ET FORESTIÈRES

Récolteur : E. POILANE

N° 28719

Cambodge : Phnom Chôm pro: de Kg.
Chnang 20-1-39
Fl. sommet des pétale charnu rose clair
base rose pale non écloses, sépale ore
jaune ou terre cuite, éclose la face in-
terne est andrinople foncé, la pièce
centrale également, des glande ou pustules
situé sur la partie supérieure et interne
des pétales, une collerette, des nervures
en saillies a la face inférieure et in-
terne, ainsi qu'une parti de la base
est de couleur blanches

Figure 10. Poilane's field notes used by Gagnepain to describe *Sapria poilanei*.

and outer whorl of perigone lobes are inverted. However, the male column is correctly drawn.

Poilane's notes state (sometimes in not very grammatical French—but after all, they are field notes) that the perianth is pink in closed flowers (*'Fl.[eures]...non écloses'*), i.e. in buds, and hence externally. Internally the open flower is dark red (*'...éclose la face interne est andrinople foncé...'*), which colour refers to the lobes, the disk (*'la pièce centrale'*), and the tube, but logically not to the other structures mentioned later as being white. These include the warts positioned on the lobes (*'glande* [sic] *ou pustules situé* [sic] *sur la partie supérieure et interne des pétales'*), the diaphragma (*'collerette'*), the ridges (*'nervures en saillies'*), as well as part of the tube base (*'ainsi qu'une parti* [sic] *de la base'*) which are white (*'de couleur blanches'* [sic]).

This is a perfect match with our own observations from SE Thailand. The wide discrepancy with Gagnepain's original description, and the finding of many new characters, make a redescription of *S. poilanei* inevitable. Also, the female was hitherto unknown.

**Redescription** (Figs. 5–9, 17–21; morphological terms also in Fig. 1). Buds smaller than about 10 cm in circumference are completely enclosed in bracts (a) which are pink with more or less clear paler margins. In larger buds the two whorls of perigone lobes (b), which externally are wine-red, wart-less and undotted, start to become exposed inside the triangular-obtuse bracts.

Diameter (c) of open flower is 65–120 mm, height 49–70 mm, tube circumference (d) 126–159 mm. Width (e) and length (f) of perigone lobes are 22–34 x 27–38 mm in the outer whorl and 14–24 x 22–32 mm in the inner whorl. The lobes are triangular-obtuse and wine-red except for the white-dotted warts (g). These are distributed mainly on the basal and central part of the lobes though occasionally a dot can reach the rim; in some cases this may also be pale on some sections. The warts measure 1–3 mm in width but can be longer when merged with adjacent ones; towards the margin they are increasingly smaller.

The diameter (h) of the diaphragma is 39–48 mm, with a collar (i) width of 9–15 mm and an aperture (j) of 15–25 mm. When fresh it is throughout pure white to pale creamy, sometimes very slightly yellowish towards the aperture. The basal band (ib) is 1–4 mm wide, the median (im) 3–8 mm and the distal (id) 2–5.5 mm.

The ramenta (k) are filiform, more or less sinuous, without or with only slightly enlarged apices, and a more or less papillose surface. They are up to 5 mm long and 0.5 mm wide but mostly 1–3 mm long, especially those of the basal and sometimes of the distal rows, and tend to be merged tangentially to the diaphragma for a good part of their length. They are completely or only basally white; the distal part can be pale yellow to pale brown.

The central column (comprising stalk and disk) (q) is very different in the two sexes. In females it is 17–21 mm high and 10–13 mm wide at its narrowest point (r). The female disk is 11.5–15 mm high (s), 9–18 mm wide at the crest (t) (where the disk is not at its widest), and 7–11 mm deep (u). The ratio width of disk crest:disk height is 0.5–1.5. The disk is bowl-shaped with convex outer walls tending to converge rather than diverge (as in *S. ram*) towards the crest; around the centre of the disk bottom are irregularly shaped and positioned calli (v). Above the disk is very pale pinkish, the calli and the crest slightly darker. Dense, up to 1.5 mm long, cinnamon coloured hairs cover the whole upper part of the disk, including the crest and the adjacent outer part of its wall for a width of up to 3 mm. Below this is the stigmatic fascia (w) 8–9 mm wide; the maximum diameter of the circle (x) encompassed by the stigma is 17–20 mm which is more than the width of the disk crest. The stigma is shiny white due to its texture of white papillae soaked in stigmatic fluid. The 20 reduced anthers (y) on the stalk of the column, about 2 mm below the disk, are about 1 mm in size.

In males the column is 13–16 mm high and 5–6 mm wide at the narrowest point. The disk, cup-shaped with more or less vertical walls and with or without a more or less deep V-like depression near the bottom's center, is 4.5–6 mm high (without the anthers), 12–15.5 mm wide at the crest and 4–6 mm deep. Above the disk is wine-red, sometimes with a white dot at the center (probably on top of a callus), and is dorsally densely covered throughout by cinnamon hairs up to 1.5 mm long, including the crest and the outer wall down to the anthers where the hairs are up to 3 mm long.

The 20 anthers (z) are set in a ring 3.5–4 mm wide along the lower edge of the disk.

Each anther has two superimposed duct-like chambers which merge distally into a slit-like dehiscence pore. The pollen is exuded as a yellow mush.

The wall of the tube (l) has a granular surface. The granuli are mainly wine-red but some are whitish to pinkish, resulting in an irregular faint speckling of the tube. The radial ridges are low and topped by a flange which is transversally curved or roof-shaped (Figs. 1, 7–9); the ridges are 1–2 mm high (mh) in females and 0.5 mm in males at the maximum where the flange is maximally 2–3 mm wide (nw) in females and 2 mm wide in males. The ridge:flange ratio is about 1/2 in males and 1/2–2/3 in females. In males the ridges fuse with each other at the base of the tube while in females they are fused for 1–4 mm above the base, the surface of this fusion area (o) being rib-like. The flange is white throughout its length, including the fusion surface and the base.

The ovary (p) is inferior and consists of irregular cavities bearing great numbers of ovules.

**Distribution.** So far known only from Cambodia's Cardamom range and its outlayers in SE Thailand, at 1200–1400 m.

**Biology.** The three clusters of *S. poilanei* found in SE Thailand parasitized *Tetrastigma laoticum* Gagnepain (Vitaceae) (BÄNZIGER in prep.). This is also one of the main hosts of *S. himalayana* (ELLIOTT, 1990; BÄNZIGER, pers. obs.). Pollination is carried out by Calliphoridae (BÄNZIGER, in prep.).

**Vernacular name.** กระโถนนางสีดา (*krathon Nang Sida*) or Sida's spittoon.

**Comments.** It is interesting to note that, unlike *S. ram*, the female column of *S. poilanei* resembles somewhat that of *Rhizanthes zippelii* (Blume) Spach (cf. Fig. 5 in BÄNZIGER, 1995). Main differences between *S. poilanei* and *S. ram* are mentioned in the keys; additional differences are: tube wall faintly speckled (concolorous in *S. ram*); radial ridges fused for a shorter length (max. 4 mm; in *S. ram* up to 10 mm) and fusion area rib-like (in *S. ram* even); ramenta slightly shorter and thicker and often tangentially fused with diaphragma. Female disk narrower and higher when compared to the flatter and broader disk of *S.ram.* Male disk tends to have a V-like depression instead of a callus; outer wall of disk hairy throughout (in *S. ram* there is a median, generally hairless band 2–3 mm wide); outer wall of disk lower than in *S. ram*, ratio wall:anther height 1.1–2 (in *S. ram* the ratio is 2–2.7); column lower.

**Material studied.** CAMBODIA: Kompong-chnang Prov., Phnom-chom, alt. 1200 m, 20.1.1939, Poilane 28719, lectotype selected 22.3.1971 by Bertel Hansen, P (=Paris). 3 paratypes, idem, Poilane 28740; loc. cit. but alt. 1300–1400 m, 22.1.1939, Poilane 28758; Kompong-chnang Prov., Phnom-san-kos, Pursat, 17.11.1938, Müller 509, all P. THAILAND: Chanthaburi Prov., Khao Soi Dao Wildlife Sanctuary, 5 males, 5 females (coll. as 1–5 days old flowers), and 8 flowers coll. dead, from 3 different clusters at 1255 and 1260 m, 11., 14. and 16.3.97, Bänziger 1490–1507, to be deposited at BKF (= Forest Herbarium, Bangkok) (1490, 1491, and 2 flowers coll. dead (1503, 1505) on loan to C (= University Herbarium, Copenhagen).

***Sapria ram* sp. n.**
(Figs. 1–4, 11–16)

*A specie Sapria himalayana Griff. floribus minoribus, 55–110 mm diametro; perigonii segmentis verrucis albis vel subroseis basim versus densis instructis, non uniformis dispersis; vinosis, non sanguineis; diaphragmate ramentis cylindraceis, apicem versus non dilatatis, instructo differt. A specie Sapria poilanei Gagnep. diaphragmate taeniis tribus dissimilis coloris, nec albidis, neque flavidis ornato; hypanthio porcis prominentibus radialibus 2.5–5 mm altis, non 0.5–2 mm altis ornato; porcae in transectione T-formes, protectis applanatis vel sulcatis, non curvatis vel transverse triangularibus instructae; floribus femineis disco patelliforme late cristato, non crateriformi anguste cristato ornatis, (ratio cristae latitudinis et disci altitudinis: 2–2.5, non 0.5–1.5) differt.*

Buds smaller than about 10 cm in circumference are completely enclosed in bracts which are pink with more or less clear paler margins. In larger buds the two whorls of perigone lobes, which externally are wine-red, wartless and undotted, start to become exposed inside the triangular-obtuse bracts.

Diameter of open flower is 55–110 mm, height 61–80 mm, tube circumference 132–181 mm. Width and length of perigone lobes are 17–34 x 21–41 mm in the outer whorl, 15–29 x 20–41 mm in the inner whorl. The lobes are triangular-obtuse and wine-red in colour (sometimes slightly paler near the base which can be pinkish) except the white-dotted (sometimes pink to faint purplish dotted) warts. These are distributed mainly at the basal and central part of the lobes though occasionally a dot can reach the rim; in some cases this may also be pale on some sections. The warts are 1–3 mm wide, longer when merged with adjacent ones (generally radially), but increasingly smaller towards the margin.

Diameter of the diaphragma is 37–53 mm, with a collar width of 8–18 mm and an aperture of 13–29 mm. The basal band is 1–7 mm wide, of the same colour as the lobes or pinkish or even white (when it tends to have faint, pinkish radial stripes); it may also be rimmed, mostly on the distal side but occasionally also on the basal side, by a very narrow dark red to purplish ring. The median band is 3–5 mm wide and yellowish to brownish to dark red in colour. The distal band generally measures 4.2–8 mm but in some northern specimens it is only 2–4 mm wide; the colour ranges from wine-red to very dark red, often with greyish or brownish tinge, to nearly black (even in fresh specimens), often somewhat shiny. In one specimen (photograph generously loaned by Dr. T. Santisuk) the basal band, white, is unusually broad and the distal band paler than normally.

The ramenta are filiform, sinuous, without or with only slightly enlarged apices, and have short papillae; the largest ramenta are 5–5.5 mm long and 0.25–0.4 mm thick. They are generally yellowish in colour but can be brownish to reddish, especially those transgressing into the distal band.

The central column is very different in the two sexes. In females it is 19–23 mm high and 9–12 mm wide at the narrowest point. The disk is 8.5–12 mm high, 22–28 mm wide at the crest (where the disk is widest), and 6.5–8.5 mm deep. The ratio width of disk crest:disk height is more than 2 to more than 2.5. The disk is flatly pan-shaped with more or less sinuous walls tending to diverge towards the crest, and with irregularly shaped and

positioned calli around the center. Above the disk is whitish or very pale pink, with a slightly darker pink central area (calli) and distal area towards the crest. Dense, up to 2 mm long, cinnamon coloured hairs cover the whole upper part of the disk including the crest and down the outer wall of the disk for a width of up to 3 mm (hair cover results in the disk appearing darker). Below this is the stigmatic fascia 7–10 mm wide; the maximum diameter of the circle encompassed by the stigma is 20–24 mm which is narrower than the width of the disk crest. The stigma is shiny white due to its texture of white papillae soaked in stigmatic fluid.

In males the column is 14–21 mm high and 4.5–5 mm wide at the narrowest point. The disk, cup-shaped with more or less vertical walls and an irregular central callus (sometimes small calli), is 6–8 mm high (without the anthers), 14–18 mm wide at the crest and 4.5–7 mm deep. Above, the disk is wine-red with darker walls; in some individuals (even in the same cluster) there may be a more or less conspicuous white dot at the center. Dense, cinnamon hairs up to 2 mm long cover the whole dorsal part of the disk, including the crest and down the outer wall for a width of 1–2 mm; 2–4 mm long hairs are also found along a belt 3–5 mm wide set at the lower edge of the outer wall just above the anthers (hence there is a median generally hairless belt 2–3 mm wide on the outer wall of the disk).

The 20 anthers are set in a ring 2.5–3.5 mm wide; they are dark red. Each anther has two superimposed duct-like chambers which merge distally into a slit-like dehiscence pore. The pollen is exuded as a yellow mush.

The inner wall of the tube is wine-red or slightly darker and may have a brownish tinge. The surface is granular. The 20 radial ridges are high and topped by a flange which is flat, often slightly grooved longitudinally; the ridges are 3–4 mm high in females and 2.5–5 mm in males at the maximum where the flange is maximally 1–2 mm wide in both sexes. The ridge:flange ratio is about 2–3 in females and 2–4 in males. In males the ridges are fused for 1–5 mm above the base of the tube and in females for 6–10 mm; the fusion area is even. The flange is wine-red near the diaphragma but becomes increasingly paler towards the base where it is yellowish-orange, as is the fusion area and the base.

The ovary is inferior and consists of irregular cavities bearing great numbers of ovules.

**Distribution.** Found at (100) 200–750 m along the Dawna-Bilauktaung and contiguous southernly ranges, with confirmed records from Tak, Kanchanaburi, Ranong, Phangnga and Suratthani Provinces.

**Biology.** *S. ram* was found to parasitize *Tetrastigma harmandii* Planchon (Vitaceae) and *Tetrastigma* sp. 1, a closely related species (sterile material, identification uncertain). Pollination is carried out by at least six species of flesh flies (Sarcophagidae) (Bänziger, in prep.).

**Etymology.** Refers to Rama, consort of Sita (in Thai *Sida*), the main characters in the epic Ramakian, the Thai version of the Indian epic Ramayana. Sida appears in the vernacular Thai name for *S. poilanei*, viz. กระโถนนางสีดา (*krathon Nang Sida*) or Sida's spittoon. The species name *ram* is the shortened Thai version of Rama, viz. พระราม (*Phra Ram*) and is used in apposition to the generic name. The reason for not following recommendation No. 60 C.1. of the International Code of Botanical Nomenclature is that a change of the epithet (declination to *ramiae*) would have made its meaning unrecognizable to the Thai people

Figure 11. Male *Sapria ram*, paratype 1396. Note the brownish ridges in the tube.

Figure 12. Female *Sapria ram*, paratype 1393.

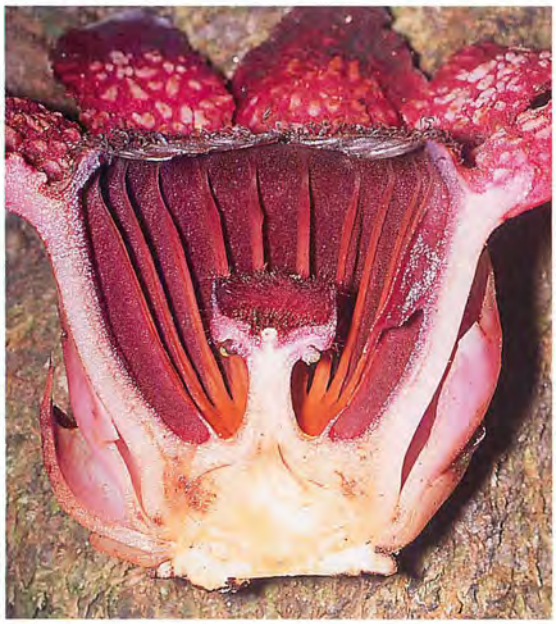


Figure 13. Cross-section of male *Sapria ram*, paratype 1396.

Figure 15. Collar of diaphragma with multicoloured bands of *Sapria ram*.

Figure 14. Cross-section of female *Sapria ram*, paratype 1393.

Figure 16. Ramenta of *Sapria ram* (apices point towards the warts, to the left).

Figure 17. Male *Sapria poilanei*. Note the white ridges in the tube.

Figure 18. Female *Sapria poilanei*. Note the white ridges in the tube.

Figure 19. Cross-section of male *Sapria poilanei*. Warts and ridges partly discoloured/darkened as flower 3–5 days old.

Figure 20. Cross-section of female *Sapria poilanei*. Warts and ridges partly discoloured/darkened as flower 3–5 days old.

Figure 21. White collar of diaphragma of *Sapria poilanei* with ramenta.

whose language is completely uninflected.

The only local name for *S. ram* H.B. has been able to find is ดอกบัวผุด (*dok bua phud*) which is also used for *Rafflesia kerrii* Meijer. In order to avoid confusion, it is proposed to use กระโถนพระราม (*krathon Phra Ram*), viz. Rama's spittoon, as the most appropriate Thai name for the new species.

**Comments.** *S. ram* is readily distinguished from *S. himalayana* and the more closely related *S. poilanei* as mentioned in the keys (additional characters cf. those mentioned for *S. poilanei*).

Reasons for considering *S. ram* distinct from *S. poilanei* and giving it species rank are: (i) The main characters of the two species are clearly distinct and without graduation into each other. (ii) The variation along *S. ram*'s 750 km distributional range is small when compared to the variation between individuals of the same cluster, and that seen within species of other Rafflesiaceae. (iii) The geographical distribution of the two taxa is disjunct. (iv) The altitudinal range is different. (v) The hosts infected are not the same. (vi) The pollinators of *S. ram* are sarcophagid flies, not calliphorids which pollinate the other two *Sapria* species, as well as *Rafflesia* and *Rhizanthes* species (BEAMAN ET AL., 1988; BÄNZIGER, 1991, 1996, and in prep.).

It is interesting to note that, while morphologically *S. ram* is closely allied to *S. poilanei,* it is very different in many biological aspects from *S. poilanei* as well as from *S. himalayana,* which are more similar to each other than either is to *S. ram* in their biology. Both share, essentially, the same hosts, the same family of pollinators and the same altitudinal range.

**Material studied.** Holotype. Female, THAILAND, Ranong Prov., Khlong Naka Wildlife Sanctuary, western cluster, 460 m, 10.1.97, Bänziger 1484, to be deposited in BKF. Paratypes. 7 males, 2 females (coll. as 1–7 days old flowers), 5 coll. as dead, black flowers, and 2 as buds, loc. cit. but 8., 10., 12.–14.1.96, 20.3.96, Bänziger 1393–1402, 1424–1428, 1485, 1486; 2 males (one coll. as dead, black flower), Phangnga Prov., Sriphangnga National Park, 330 and 455 m, 18.3.96 and 15.1.97, Bänziger 1423, 1487, all to be deposited in BKF; 1393, 1398, and 2 coll. as dead flowers (1425, 1427) on loan to C.

**Non-type material.** Kanchanaburi Prov., Huay Bankao, 750 m, 12.11.1971, Beusekom et al. 3715, L(=Leiden), C. Ranong Prov., Hot Springs, 200 m, 23.12.1976, Santisuk 842, C. 1 male, 1 female, Tak Prov., S of Umphang, 680 m, 19.3.97, Bänziger 1488 and 1489, to be deposited at BKF.

## IDENTIFICATION KEY TO KNOWN *SAPRIA* SPECIES

The colours mentioned below refer to freshly opened flowers. Some thin, pale structures (ramenta, rim of diaphragma and of lobe) can start to darken by the end of the first flowering day, but most colours will keep for a few days.

1a. Flowers large (95–200 mm), yellow- (rarely white-) dotted warts distributed more or less evenly over the blood-red lobes. The up to 10 mm long ramenta have conspicuously

expanded apices (bi- or multilobed or crateriform) and are distributed in a wide band (7–14 mm) over much of the diaphragma. Its aperture of 18–37 mm is always quite smaller than the disk of 33–51 mm which is a more or less flat, wall-less pan; dorsal hairs mainly around the bottom of the disk, none reaching the margin. From NE India (Assam) to Burma, SW China and Thailand (where confirmed as far south as about the 16th parallel), probably also Laos and Vietnam but not W Cambodia ..... *S. himalayana*

1b. Flowers small (55–120 mm), white- (sometimes pale pink-) dotted warts distributed mainly basally on wine-red lobes. The up to 5.5 mm long ramenta lack conspicuous expansion at apices and are found mainly in a narrow band (3–8 mm) mostly some distance (2–7.5 mm) from the aperture of the diaphragma. Its aperture of 13–29 mm is always much to just wider than the male disk of 12–18 mm, or slightly wider to slightly smaller than the female disk of 17–28 mm. The disk is clearly walled, in males cup-shaped, in females pan- to bowl-shaped, dorsally with conspicuous hairs all over including the crest in both sexes. Thailand and Cambodia below the 16th parallel ..... 2

2a. Diaphragma pure white to pale creamy, without differently coloured concentric bands. Ramenta of the same colour or pale yellow, may be darker distally. Radial ridges in the tube also white, not so prominent (0.5–2 mm high) and topped by a curved or roof-shaped flange (ratio ridge:flange 1/2–2/3). Female disk bowl-shaped with convex outer wall, crest diameter 9–18 mm (narrower than the expanse of the stigmatic circle of 17–20 mm); ratio crest diameter:disk height 0.5–1.5. Male disk cup-shaped, crest diameter 12–15.5 mm, wall height 4.5–6 mm, ratio wall:anther height 1.1–2.0. A montane species (1200–1400 m) of the Cardamom Ranges (W Cambodia) and its outlayers in SE Thailand .... *S. poilanei*

2b. Diaphragma with differently coloured concentric bands: basal one generally pink to red, sometimes whitish, median and distal ones variably yellow to brown to dark red, but the distal one can also be grey to nearly black. Ramenta yellow to brown to red. Radial ridges wine red distally, paler towards the base where they are orange-red, very prominent (2.5–5 mm high) and topped by a flat or slightly grooved flange (ratio ridge:flange 2–4). Female disk pan-shaped with sinuous wall, crest diameter 22–28 mm (wider than the stigmatic circle of 20–24 mm), ratio crest diameter:disk height 2–2.5. Male disk cup-shaped, crest diameter 14–18 mm, wall height 6-8 mm, ratio wall:anther height 2.0–2.7. A pedemontane species ((100) 200–750 m) of the Dawna-Bilauktaung Ranges from S Tak to Phangnga Provinces ..... *S. ram*

## IDENTIFICATION KEY FOR DRY/WILTED *SAPRIA* SPP.

This will work, in most cases, with herbarium dried material, even when partly broken. The key should also be a valuable tool for the field ecologist since black, more or less shrivelled flowers found dry or partly rotten on the forest floor should be identifiable even when they have been dead for many weeks.

1. Flowers large, about 80–110 mm diameter; most ramenta with expanded apices (bi- or multilobed or crateriform), 5–7 mm long, 0.2–0.6 mm wide; unless the diaphragma is warped, its aperture is narrower than the disk which is a large, more or less shallow, wall-

less pan about 24–38 mm in diameter with dorsal hairs only centrally ..... *S. himalayana*

1b. Flowers small, about 45–70 mm; ramenta not or only rarely slightly widened apically, 2–5 mm long, mostly 0.15–0.3 mm wide (if wider, then very flat). Aperture wider than disk which is clearly walled and hairy all over, including the crest (unless hairs fallen off); male disk cup-shaped (9–15 mm diameter), in females pan- or bowl-shaped, the walls more or less strongly 'collapsed' inwardly (size data incomplete but diameter less than 24 mm).....2

2a. Radial ridges low, often only curved flange visible, its width wider than ridge height. Wall of female disk collapses inwardly, more or less completely closing the bowl and exposing the stigmatic fascia. Ramenta mostly 2–3 mm long, 0.2–0.3 mm wide (if wider then very flat).....*S. poilanei*

2b. Radial ridges high, 2–3 mm, at their maximum clearly higher than width of flange which is flattish or grooved; if wall of female disk collapsed, then only part of interior concealed. Ramenta mostly 2–5 mm long, 0.15–0.2 mm wide.....*S. ram*

## ACKNOWLEDGMENTS

The authors thank Dr. W. Brockelman, Mahidol University, for criticizing and improving the manuscript. H.B. is very grateful to his colleague Mr. P. Sukumalanand for letting him use his computer facilities and giving unstinting support for this research, as did Dr. S. Ratanabhumma and the other colleagues of the Department. H.B. owes a very special thank to Mr. S. Nakul, Khlong Naka, for his years-long field assistance, and the help of his assistant, Mr. U. Khongsuwan, Dr. S. Elliott, Chiang Mai University, gave details about *S. himalayana* and criticized the manuscript. Dr. T. Santisuk, and the late Dr. T. Smitinand, both of the Forest Herbarium, Bangkok, gave much appreciated information on coll. No. 842, and on where *S. poilanei* was discovered, respectively. Mr. P. Chanin, Mr. P. Thongsuk and Mr. P. Yaopirom very kindly provided information on *Sapria.* Prof. A. Latiff, University Kebangsaan Malaysia, and Prof. Li Chaoluan, Academia Sinica, Chengdu, identified critical *Tetrastigma* spp. Prof. Li also translated parts of a Chinese publication on *S. himalayana*, as did Dr. P. Gianola, ETH Library, Zürich. Mr. K. Kreetiyutanont and Mr. S. Phopinit extended most welcome hospitality at Wildlife Sanctuaries. Dr. Thomas Pape, Swedish Museum of Natural History, and Dr. N. Wyatt, British Museum, identified Sarcophagidae and Calliphoridae. Mrs. S. Panthi discovered valuable reports in local magazines and helped with the table layout. H.B. is particularly grateful to the Royal Forest Department which extended permissions (No. 39/38 and 27861) for studies in National Parks and Wildlife Sanctuaries; the National Research Council gave research approval (No. 125/35). Both authors are indebted to the directors at K and P for lending important material for study, and to Cees Lut, Library of the Rijksherbarium, Leiden. We are grateful to Peter Wagner for correcting the Latin diagnosis of *S. ram.*

## REFERENCES

BÄNZIGER, H. 1988. How wildlife is helping to save Doi Suthep: Buddhist Sanctuary and National Park of Thailand. *In* I. Hedberg (ed.), Systematic Botany—a key science for tropical research and documentation. *Sym. Bot. Ups.* 28: 255–267.

BÄNZIGER, H. 1991. Stench and fragrance: unique pollination lure of Thailand's largest flower, *Rafflesia kerrii* Meijer. *Nat. Hist. Bull. Siam Soc.* 39: 19–52.

BÄNZIGER, H. 1995. Ecological, morphological and taxonomic studies on Thailand's fifth species of Rafflesiaceae: *Rhizanthes zippelii* (Blume) Spach. *Nat. Hist. Bull. Siam Soc.* 43: 337-365.

BÄNZIGER, H. 1996. Pollination of a flowering oddity: *Rhizanthes zippelii* (Blume) Spach (Rafflesiaceae). *Nat. Hist. Bull. Siam Soc.* 44: 113–142.

BAIN, J. R. AND S. R. HUMPHREY. 1980. A profile of the endangered species of Thailand. Rep. No. 4, Off. Ecol. Serv., Florida State Museum, 367 pp.

BEAMAN, R. S., P. J. DECKER AND J. H. BEAMAN. 1988. Pollination of *Rafflesia* (Rafflesiaceae). *Amer. J. Bot.* 75: 1148–1162.

ELLIOTT, S. 1990. The distribution, status and ecology of *Sapria himalayana* Griff. (Rafflesiaceae) in Thailand. *British Ecol. Soc. Bull.* 11: 246–249.

GAGNEPAIN, F. 1941. Une espèce nouvelle d'un genre monotype: *Sapria. Not. Syst.* (Paris) 9: 144–145.

HANSEN, B. 1972a. Notes on some parasitic Phanerogams from the Indo-Chinese Peninsula. *Bot. Tidsskr.* 67: 146–151.

HANSEN, B. 1972b. Rafflesiaceae. In: *Flora of Thailand.* pp 182–184, T. Smitinand and K. Larsen, eds., Appl. Sci. Res. Corp. Thailand.

HANSEN, B. 1973. Rafflesiaceae. In: *Flore du Cambodge, du Laos et du Vietnam,* pp 59–64, A. Aubreville and J.-F. Leroy, eds., Muséum National d'Histoire Naturelle.

HOSSEUS, C. C. 1907. Eine neue Rafflesiaceengattung aus Siam. *Bot. Jahrb. Syst.* 41: 55–61.

SMITINAND, T. 1980. *Thai Plant Names.* Funny Publishing, Bangkok.

SOLMS-LAUBACH, H. GRAFEN ZU. 1914. *Sapria himalayana* Griff. und ihre Beziehungen zu *Richthofenia siamensis* Hosseus. *Bot. Jahrb. Syst.* 50. Beibl., 114: 34–37.

**Appendix 1.** Morphometric data of *S. poilanei* and *S. ram*

Table 1. Morphometric data of female *Sapria poilanei* (in mm)

| Flower code | 1491 | 1493 | 1501 | 1507 |
|---|---|---|---|---|
| Diameter of flower | 81x87 | 90x94 | [55] | [half open bud] |
| Lobe inclination | 45° | 30–45° | 90° | ——— |
| Height of flower | 70 | 70 | [65] | [72] |
| Circumference of tube at lobe base | 138 | 141 | 154 | 159 |
| Perigone lobe width /length (outer whorl) | 25–29 /36–38 | 25–32 /32–35 | 23–27 /27–32 | 26–28 /30–33 |
| Perigone lobe width /length (inner whorl) | 17–19 /28–31 | 15–17 /25–29 | 14–22 /25–29 | not measu-rable |
| Diameter of whole diaphragma | 40–45 | 42–43 | 42 | ditto |
| Width of diaphragma collar | 13–14 | 12 | 11 | ditto |
| Width of diaphragma aperture | 15x17 | 18 | 18x21 | ditto |
| Width of band of ramenta | 7–8 | 8 | 8 | 7 |
| Width of distal band of diaphragma | 3–4 | 2–4 | 2–4 | 2–4 |
| Height of column | 18–19 | 18 | 20–21 | 17 |
| Diameter of column where narrowest | 10 | 12 | 13 | 13 |
| Diameter of crest of disk | 13 | 15–16 | 9–12 | 15–18 |
| Diameter of disk where widest | 17 | 18 | 20 | 17.5–20 |
| Depth of disk | 8 | 7 | 10–11 | 9 |
| Height of disk | 12 | 11.5–12 | 14–15 | 12–13 |
| Width of stigmatic fascia | 8–9 | 8–9 | 9 | 8–9 |
| Maximum diameter of stigmatic circle | 17 | 18 | 20 | 17.5x20 |
| Maximum height of tube ridge:width of its flange at that point | >1:<2 | 1.5:3 | <2:<3 | <1.5:>2 |

Table 2. Morphometric data of male *Sapria poilanei* (in mm)

| Flower code | 1490 | 1492 | 1494 | 1499 | 1500 |
|---|---|---|---|---|---|
| Diameter of flower | 80x97 | 110 | 65x70 | 91x97 | 116x119 |
| Lobe inclination | 0–45° | 0–60° | 60–90° | 30–45° | 0–45° |
| Height of flower | 52 | 55 | 63 | 49 | 58 |
| Circumference of tube at lobe base | 126 | 143 | 140 | 132 | 148 |
| Perigone lobe width /length (outer whorl) | 23–28 /28–31 | 26–32 /31–38 | 22–28 /32–34 | 22–27 /27–35 | 27–34 /34–35 |
| Perigone lobe width /length (inner whorl) | 18–21 /25–27 | 20–24 /30–32 | 17–22 /28–30 | 15–19 /22–24 | 21–24 /29–32 |
| Diameter of whole diaphragma | 40–43 | 43–47 | 39–41 | 39–41 | 45–48 |
| Width of diaphragma collar | 9–10 | 10–12 | 10–11 | 10–12 | 14–15 |
| Width of diaphragma aperture | 21x24 | 23x25 | 20x22 | 17x18 | 18x20 |
| Width of band with ramenta | 4–5 | 3–4 | 3–4 | 5–6 | 8 |
| Width of distal band of diaphragma | 3–5 | 4–5.5 | 2.5–4 | 3–5 | 3 |
| Height of column | 14 | 15 | 13–14 | 14–15 | 15–16 |
| Diameter of column where narrowest | 5 | 5.5 | 5 | 6 | 5–5.5 |
| Diameter of crest of disk | 13 | 15 | 12x13 | 14 | 14x15.5 |
| Diameter of disk where widest | ditto, since disk is widest at crest | | | | |
| Depth of disk | 4 | 4 | 4 1/3 | 6 | 4.5 |
| Height of disk (without anthers) | 4.5 | 5.5 | 5 | 5–6 | 5.5–6 |
| Width of annular row of anthers | 3.5 | 3 | 3 | 3.5–4 | 4 |
| Maximum height of tube ridge:width of its flange at that point | <0.5:2 | <0.5:<2 | >0.5:<2 | 0.5:<2 | >0.5:>2 |

Table 3. Morphometric data of 4 female and 2 male *Sapria ram* sp. n. (in mm)

| Flower code<br>Sex | 1393<br>female | 1484<br>female | 1485<br>female | 1489<br>female | 1487<br>male | 1488<br>male |
|---|---|---|---|---|---|---|
| Diameter of flower | [64x77] | 80x86 | [73x77] | [90] | 90x104 | 61x71 |
| Lobe inclination | 80–90° | 60–90° | 75–90° | (*) | 45–80° | 45–60° |
| Height of flower | [75] | 85 | [72] | [61] | 66 | 61 |
| Circumference of tube at lobe base | 165 | 181 | 170 | 163 | 160 | 132 |
| Perigone lobe width /length (outer whorl) | 25–27 /37–39 | 24–34 /33–41 | 20–28 /31–33 | 17–20 /21–27 | 27–33 /33–35 | 19–21 /25–28 |
| Perigone lobe width /length (inner whorl) | 16–23 /30–33 | 19–26 /33–40 | 17–29 /29–35 | 15–18 /20–25 | 19–23 /27–29 | 17–19 /22–27 |
| Diameter of whole diaphragma | 42–50 | 49–53 | 49–52 | 42 | 51–55 | 37–40 |
| Width of diaphragma collar | 9–12 | 15–18 | 15–17 | 9–11 | 12–13 | 10–11 |
| Width of diaphragma aperture | 25x29 | 19x21 | 16x18 | 27 | 24x26 | 17x18 |
| Width of band of ramenta | 4.2–5 | 3–5 | 3–4 | 4–5 | 3–4 | 3–4 |
| Width of distal band of diaphragma | 4.2–5.4 | 5–7 | 5–8 | 3–4 | 6 | 2–3.5 |
| Height of column | 19–20 | 21–23 | 20 | (*) | 14–16 | 15 |
| Diameter of column where narrowest | 9 | 10 | 9 | 12 | 5 | 4.5 |
| Diameter of crest of disk | 24 | 27–28 | 25 | 22 | 17 | 14 |
| Diameter of disk where widest | ditto, since disk is widest at crest | | | | | |
| Depth of disk | 6.5 | 8.5 | 7 | 7 | 5 | 4.5 |
| Height of disk (without anthers) | 9.5–11 | 12 | 10–11 | 8.5 | 7 | 6 |
| Width of stigmatic fascia/annular row of anthers | 8.5 | 10 | 9 | 7 | 3.5 | 2.5–3 |
| Maximum diameter of stigmatic circle | 21.5 | 24 | 23 | 20 | —— | —— |
| Maximum height of tube ridge:width of its flange at that point | <4:<2 | <4:<2 | <4:>2 | >3:>1 | 3:1.5 | 2.5:1 |

(*) Lobe spreading distorted by roots

Table 4. Morphometric data of male *Sapria ram* sp. n. (in mm)

| Flower code | 1394 | 1395 | 1396 | 1397 | 1398 | 1399 | 1400 |
|---|---|---|---|---|---|---|---|
| Diameter of flower | 78x93 | 55x79 | 105x110 | [55x67] | 78x93 | 63x65 | 70x75 |
| Lobe inclination | 30–80° | 45–90° | 30–45° | 80–90° | 45–60° | 60–90° | 60–80° |
| Height of flower | 80 | 68 | 75 | [65] | 69 | 66 | 76 |
| Circumference of tube at lobe base | 157 | 148 | 163 | 148 | 157 | 144 | 151 |
| Perigone lobe width /length (outer whorl) | 24–32 /38–39 | 18–27 /35–36 | 25–31 /40–41 | 19–27 /35–40 | 21–29 /36–37 | 21–29 /34–37 | 21–29 /35–40 |
| Perigone lobe width /length (inner whorl) | 20–24 /35–41 | 16–21 /32–35 | 21–24 /33–36 | 18–23 /33–35 | 19–26 /33–35 | 17–20 /28–31 | 18–24 /33–36 |
| Diameter of whole diaphragma | 42–49 | 38–47 | 46 | 43 | 43–50 | 39–41 | 41–46 |
| Width of diaphragma collar | 13–16 | 8–10 | 13–16 | 9–12 | 13–15 | 12–15 | 13–14 |
| Width of diaphragma aperture | 16x20 | 18x27 | 19x20 | 21x24 | 17x20 | 14x15 | 13x16 |
| Width of band of ramenta | 3.3–5 | 3.3–4.2 | 3.3–4.2 | 3.3–4.2 | 3.3–4.2 | 3.3–4.2 | 4.2–5 |
| Width of distal band of diaphragma | 5.8–6.6 | 4.6–5.4 | 5.8–6.6 | 4.6–5 | 5.8–6.6 | 5.8–7.1 | 6.2–7.5 |
| Height of column | 20 | 17 | 19–21 | 18–19 | 17–19 | 18 | 18 |
| Diameter of column where narrowest | 5 | 4.5 | 4.5 | 5 | 5 | 4.5 | 4.5 |
| Diameter of crest of disk | 17 | 14–15 | 17 | 15 | 17–18 | 17 | 16–17 |
| Diameter of disk where widest | ditto, since disk is widest at crest | | | | | | |
| Depth of disk | 6.5 | 6 | 7 | 5–6 | 7 | 5.5 | 5 |
| Height of disk (without anthers) | 7.5–8 | 6.5 | 8 | 7 | 7.5–8 | 6.5–7.5 | 7.5–8 |
| Width of annular row of anthers | 3 | 3 | 3.5 | 3 | 3 | 3 | 3 |
| Maximum height of tube ridge:width of its flange at that point | 5:>1.5 | 3.5:>1 | >4.5:>1 | 3.5:1 | >4:>1.5 | 3:>1 | 4:<2 |