

## On the morphological and systematic position of the genus *Moldenkeanthus* (*Eriocaulaceae*)

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**Abstract:** The genus *Moldenkeanthus* has to be rejected; its two species have to be placed in *Paepalanthus* KUNTH. The supposed differential character of fused filaments and petals as well as the fusions between petals and stigmas are due to erroneous observations. A revised and emended description of *Paepalanthus itremensis* (MORAT) STÜTZEL comb. nov. and *Paepalanthus bosseri* (MORAT) STÜTZEL comb. nov. is presented. Furthermore, it is shown that the genera *Paepalanthus* and *Leiothrix* also can be distinguished by characters of the gynoecium even when appendices are lacking.

The genus *Moldenkeanthus* was erected in 1976 by MORAT on the basis of two new species, endemic to Madagascar: *M. bosseri* and *M. itremensis*. The plants were collected ten years apart from the same locality. The differential characters of *Moldenkeanthus*, appeared doubtful and stimulated a thorough re-examination of the existing material.

### Materials and methods

For my investigations the three available specimens were used: *Moldenkeanthus bosseri* (BOSSER 19993, P; holotype and *M. itremensis* (BOSSER 19567, P; holotype and MORAT 4263, P). Single flowers were shortly boiled in 1 N KOH and subsequently prepared in water. For an accurate analysis it is necessary to examine the flowers shortly before anthesis; in older flowers artefacts are common and can easily lead to incorrect descriptions.

### Results

MORAT (1976) based his new genus on the type species *Moldenkeanthus itremensis* and referred especially two floral characters for separating it from *Paepalanthus* KUNTH and *Leiothrix* RUHL. Firstly, in the male flowers, the sessile dithecate anthers were supposed to be inserted directly on the lobes of the corolla tube ("3 petales soudés en entonnoir courtement trilobé au sommet et portant 3 étamines réduites à

des anthères bithèques rigoureusement sessiles, insérées aux extrémités des lobes corollins, ...”). Such corolla-anther tubes are in fact not known from any other genus in the *Eriocaulaceae*. Secondly, it was stated that the tips of the petals of the female flowers are fused with the style branches (“... 3 pétales libres jusqu’à la base mais dont les sommets sont légèrement recourvant leurs marges et adhérent fortement à chacune des 3 branches respectives du style; ...”). Investigations of other genera (*Paepalanthus*, *Syngonanthus* and *Leiostrix*) have revealed that the flowers of the *Eriocaulaceae* often have a very pronounced nectar production (STÜTZEL 1984). This aroused the suspicion that the above described peculiarities in *Moldenkeanthus* flowers can be attributed to artefacts produced by the sticky nectar. This assumption is supported by the fact that in older herbarium material of *Paepalanthus tatei*, the filaments also appear to be fused with the corolla, whereas fresh material clearly shows that they are free as in all *Paepalanthoideae*. Incurving of the petals as described and illustrated by MORAT also occurs in other *Paepalanthoideae*. HERZOG (1931: 208) noticed this in female flowers and also mentioned that “fused” flower parts, after drying could hardly ever be separated again. Similar phenomena in wilting male flowers have been described by STÜTZEL (1981).

Investigations of flowers of *M. itremensis* have shown that the connection of the stigmata and petals in the female flowers also is secondary and always separable; it does not represent a permanent attachment, as described. In male flowers, shortly boiled in 1 N KOH, similarly, the filaments are completely free down to the base. The tips of the petals, however, are pressed between the thecas of the basifixed anthers in such a way that they can hardly ever be separated from one another without tearing the corolla. Under such conditions, and considering the extremely small size of the flowers, erroneous observations are understandable. Also in the second species of the genus, *M. bosseri* MORAT, the filaments, when examined closely, were similarly found to be free and the connection of the stigmata and appendices to the corolla was seen to be due to stickiness, and thus of no systematic importance. Therefore it is necessary to point out that the only two supposed differential characters of the genus *Moldenkeanthus* are based on incorrect analyses.

Another systematic difficulty originates from the fact that the “appendices” are supposedly absent in *M. itremensis*. These “appendices” are nectaries on the gynoecium, occur in a median position on the respective carpels and are homologous with the stigmas of the *Eriocauloideae*. In all *Paepalanthoideae* the stigmas occur in the form of commissure-stigmata which are either simple and thread-like (stigmata simplicia) or distinctly branched at the top (stigmata bifida). According to our investigations of other *Paepalanthoideae*, it appears unlikely that the appendices are in fact ever completely absent, as during the ontogeny of the gynoecium they are the first structures to be formed. In *Syngonanthus chrysanthus* (BONG.) RUHL., where the appendices are also absent according to KOERNICKE (1863), rudiments could easily be found in fresh material, but disappear during drying. Even if rudiments of appendices could be seen in fresh material of *M. itremensis*, it would be more practical in such cases to continue to state “appendices nullae” in the diagnoses.

MORAT (1976) quite correctly criticized the fact that in RUHLAND’s (1903) key to the genera, the place of insertion of the appendices is used as a key characteristic and is thus inappropriate for keying out those few species without appendices belonging

to the genera *Paepalanthus*, *Syngonanthus* and *Leiothrix*\*. However, in such cases a distinction between *Leiothrix* and *Paepalanthus* is surely not impossible ("On est en droit de se demander sur quoi l'auteur se fondait réellement pour différencier ces deux genres?" MORAT 1976). But even in the absence of appendices, the difference in the ratio of style to stigma length allows a clear distinction between *Paepalanthus* and *Leiothrix*: In *Paepalanthus*, the style is at most as long as the stigmas; in *Leiothrix* it is more than double the length.

From the facts presented above it becomes necessary to place the two species of *Moldenkeanthus* in the genus *Paepalanthus* and in prove their descriptions:

***Paepalanthus itremensis* (P. MORAT) STÜTZEL, comb. nov.**

Basionym: *Moldenkeanthus itremensis* P. MORAT, *Adansonia* **15** (4): 466.

Typus: J. BOSSER 19567 (holo-P!).

Planta minima, rosulata. Folia subulata, 4–15 mm longa, in medio 0,5 mm lata, cum pilis adpressis malpighiaceis longitudine 0,2–0,5 mm, ad basem cum pilis simplicibus pluricellularibus. Pili malpighiacei granulosi usque ad verucosi, ceteri sine structura.

Vagina ad orem prolata, exeunda in laminam longitudinis 0,2–0,4 mm et reclinatam. Vagina intus glabra, extra pilis adpressis malpighiacei et pilis glanduliferis cum 3, raro 4 cellulis ferulae longis et una cellula basilare breve. Vagina sine nervis distinctis, longitudine circa similem foliis. Pedunculi longitudinis usque ad 2 cm.

Capitulum 2–5 mm diametro cum 5–10 flores. Receptaculum pilosum, pili floribus vix breviores. Bractee involucantes ovatae cum paucis pilis simplicibus acutis vel glabrae. Bractee interiores pilosiores. Flores masculini trimeri, pedicellatae perspicuae. Sepala libera, medium lateralibus minus et pilosius. Petala connata, membranacea, glabra. Stamina 3, dithecati, filamenta libera petalibus aequae longitudinis. Gynoeceum reductum ad 3 glandulas parvas, cylindriformes. Flores feminei trimeri sessiles vel brevissime pedicellatae. Sepala libera, lanceolata, aliquid longiora quam sepala florum masculinarum, omnia aequa, maxime in margine etiam in dorso cum pilis acutis sine structura. Petala libera, lanceolata in dorso valde pilosa cum pilis acutis sine structura, sed apex petalorum glabrus. Gynoeceum tricoccum. Stigmata 3, simplicia, commissuralia. Glandulae (appendices) nullae. Stylus brevior quam stigmata.

Plants very small, rosette-like. Leaves 4–15 mm long, 0.15 mm wide in the middle, linear, with 0.2–0.5 mm long Malpighian hairs, and with single multicellular unbranched hairs at the base. Malpighian hairs granular-warted outside, other hairs smooth. Sheath broadened at the aperture, extended into a 0.2–0.4 mm long projecting blade. Sheath glabrous inside, outside with Malpighian hairs and capitate hairs with a unicellular capitulum, three or more rarely four stalk cells and a single bladder-like basal cell. Sheath without pronounced nerves,  $\pm$  as long as the leaves. Scape to 20 mm long, round, with capitate and Malpighian hairs as on the sheath. Capitula 2–2.5 mm in diam. with 5–10 flowers. Receptacle hairy. Hairs only slightly shorter than the flowers. Involucre bracts broadly lanceolate with a few smooth

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\* The only species in the genus *Leiothrix* without appendices (*L. arechavaletae*) has since been transferred to *Syngonanthus* by GIULIETTI (1984) on the basis of other characters.

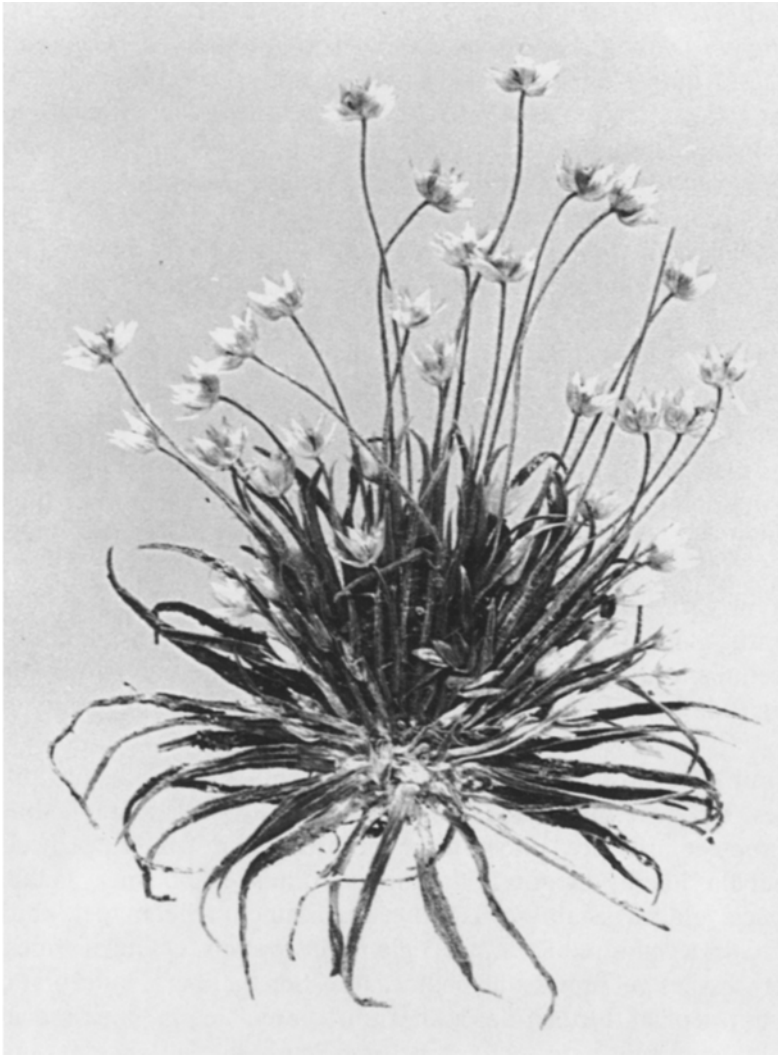


Fig. 1. *Paepalanthus itremensis*, habit

acute hairs or glabrous, ca. 1 mm long. Inner bracts more hairy. Male flowers trimerous, distinctly pedicellate. Sepals free, the middle one smaller and more densely hairy than the two lateral ones. Petals fused, tapering into a sharp point, glabrous. Stamens 3, ditheous, filaments free, exactly as long as the petals. Gynoecium reduced to 3 small, shortly stalked flash-shaped glands. Female flowers trimerous, sessile or very shortly pedicellate. Sepals free, lanceolate, slightly longer than those of the male flowers, all equal in shape, mainly on the margin but also dorsally with smooth acute hairs. Petals lanceolate, free, dorsally densely hairy with smooth acute hairs, though tips glabrous. Gynoecium trilocular. Stigmas three, simple, inserted on the commissure. Glands (appendices) absent (in dried material). Styles shorter than the stigmas. Seeds 1.5 times longer than wide, with ca. 14 longitudinal ribs (Figs. 1, 2).

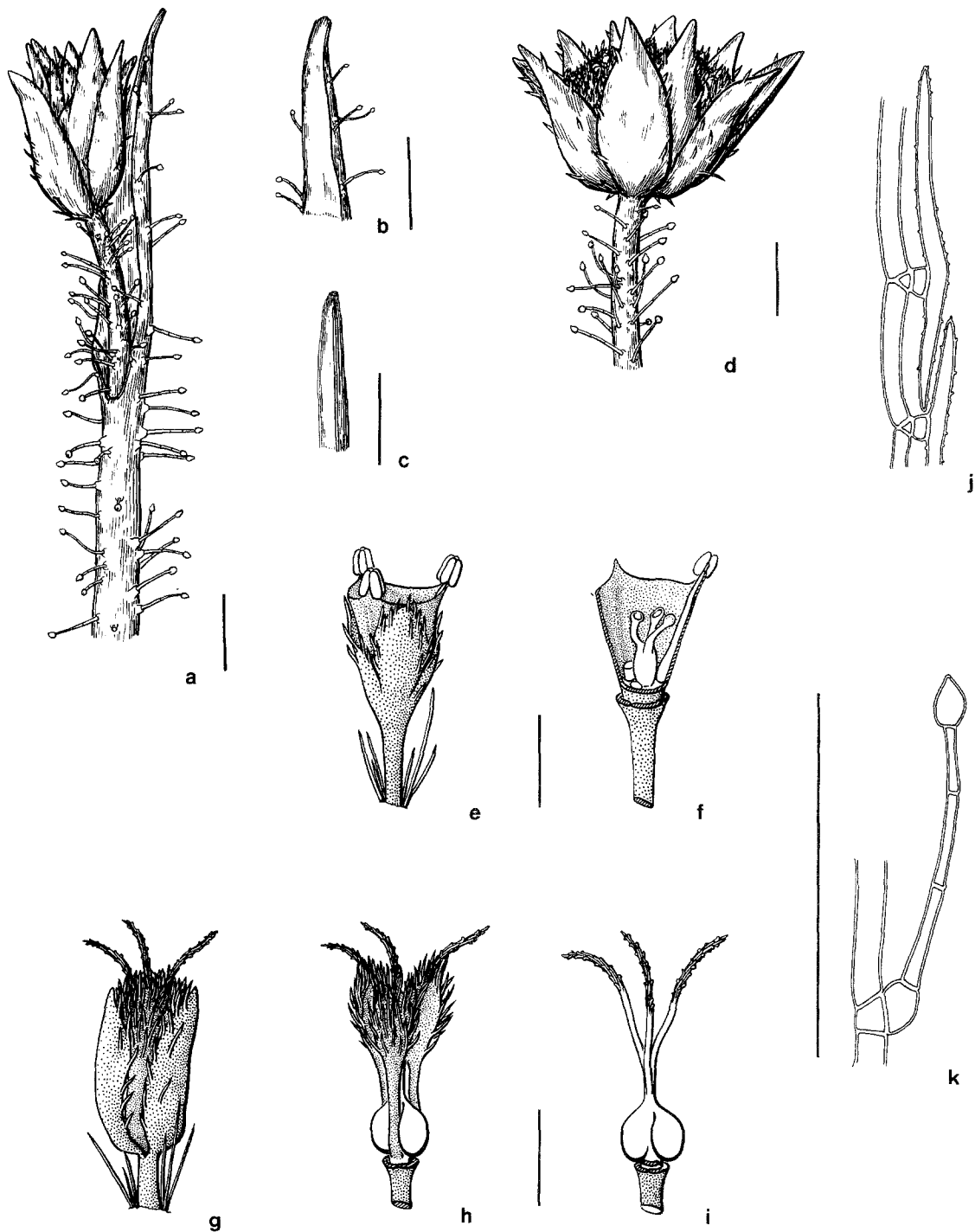


Fig. 2. *Paepalanthus itremensis*, a capitulum with sheath; b apex of sheath; c leaf apex; d capitulum; e male flower; f male flower after removal of the calyx and part of the corolla; g female flower; h female flower after removal of the calyx; i female flower after the removal of calyx and corolla; k Malpighian hair; l capitulate hair. Scales 0.5 mm

In the investigated capitula the female flowers were situated on the periphery and the male flowers in the centre. Although this observation agrees with the description given by MORAT (1976), it was not included in the diagnosis, because it is known from other *Eriocaulaceae* that the distribution of male and female flowers can be strongly influenced by changes in season or habitat, and even can lead to purely monoecious capitula. Whether the bracts of the inner-most flowers are completely absent or only much smaller than the flowers and thus not visible between the long hairs of the receptacle could not be determined.

***Paepalanthus bosseri* (P. MORAT) STÜTZEL comb. nov.**

Basionym: *Moldenkeanthus bosseri* P. MORAT, *Adansonia* **15** (4): 468.

Typus: J. BOSSER 19993 (holo-P!).

Planta herbacea, rosulata vel subcaulecentia. Folia lanceolata 15 mm longa, in medio 0,6 mm lata, cum paucis pilis adpressis malpighiaceis vel glabra. Vagina ad orem prolata, exeunda in laminam reclinatam et acutam. Vagina intus glabra, extra cum pilis glanduliferis et pilis adpressis malpighiaceis.

Pedunculi longitudinis usque ad 15 cm, 3 costati. Costae glabrae, inter costibus cum pilis adpressis malpighiaceis et pilis glanduliferis. Pilis adpressis malpighiaceis 0,2–0,5 mm longis, granulosis. Pilis glanduliferis cum 3 cellulis ferulis longis et una cellula basilare breve.

Capitulum 4–5 mm diametro cum fere 30 flores. Bractee involucentes exteriores ovato-lanceolatae et glabrae, bractea involucentes interiores lanceolatae et ciliatae. Receptaculum pilosum, pilerum et florum longitudo aequalis.

Flores masculini trimeri, pedicellati. Sepala libera, lanceolata dorso piloso cum pili laevis et acutis. Petala glabra, connata in petalorum tubus lobis 3, acutis. Stamina 3, libera. Longitudine filamentibus petala aequalibus. Gynoeceum reductam ad 3 glandulae parvas cylindriformes.

Flores feminei trimeri, pedicellati. Sepala libera, dorso et marginalibus pilosa cum pilis laevis et acutis. Petala libera, lanceolata, dorso piloso vel glabra ad apicem. Gynoeceum tricocum, stigmata 3, commissuralia. Glandulae (appendices) 3, tenuiores quam stigmata. Longitudine stylorum et stigmatorum aequale.

Plants herbaceous, to 5 cm tall. Leaves linear, 15 mm long, 0.6 mm wide in the middle, almost glabrous or with Malpighian hairs. Sheath broadened at the aperture tapering into a projecting pointed blade. Sheath glabrous inside, outside with single capitate and Malpighian hairs. Scape up to 15 cm long, with three distinct ribs. Ribs glabrous, areas between them with Malpighian and capitate hairs. Capitate hairs clustered densely under the capitula. Malpighian hairs 0.2–0.5 mm long, warted-granular, capitate hairs ca. 1 mm long with 3 stalk cells and one distinct bladderlike basal cell. Capitula 4–5 mm in diameter with ca. 30 flowers. Outer involucre bracts broadly lanceolate, glabrous, inner ones slightly smaller and with fringed margins. Receptacle hairy, hairs almost as long as the flowers. Male flowers pedicellate, trimerous, sepals free, lanceolate, dorsally with smooth acute hairs. Petals fused, extending into a sharp point, glabrous. Stamens three, with free filaments, dithecate. Filaments exactly as long as the petals. Rudimentary gynoeceum in the form of 3 free shortly stalked glands. Female flowers pedicellate, trimerous. Sepals lanceolate, free, dorsally and margin with smooth acute hairs, tips glabrous. Gynoeceum trilocular, stigmas three, inserted on the commissure. Glands (appendices) three,

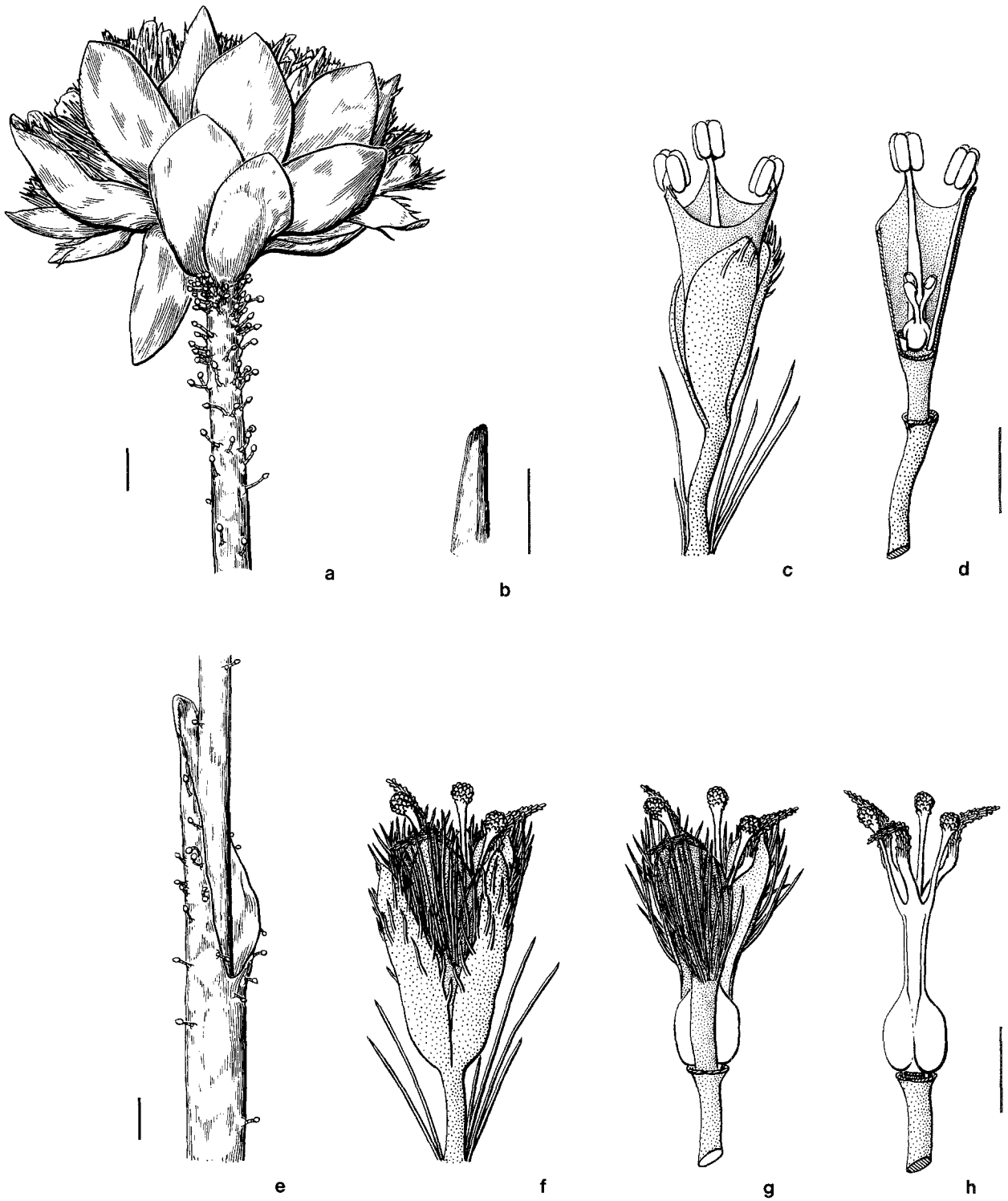


Fig. 3. *Paepalanthus bosseri*, a capitulum; b leaf apex; c male flower; d male flower after the removal of the calyx and part of the corolla; e sheath aperture; f female flower; g female flower after the removal of the calyx; h female flower after the removal of the calyx and corolla. Scales 0.5 mm

thinner than the stigmas. Style  $\pm$  as long as the stigmas. Seeds ovate, 1.5–2 times longer than wide with longitudinal ribs (Fig. 3).

Whether *Paepalanthus bosseri* is in fact perennial cannot be determined the available herbarium material. That it produces vegetative shoots after the formation of inflorescences does not necessarily indicate a perennial habit. As in *P. itremensis*, no informations on the distribution of male and female flowers and on the flower bracts are included. Furthermore, it was also not possible to confirm that sepals of the female flowers eventually fall off (“maturitata caducis”, MORAT 1976).

### Discussion

Both species of the genus *Moldenkeanthus* thus belong to the genus *Paepalanthus*, and the genus *Moldenkeanthus* must be reduced to synonymy. It still has to be determined whether the close relationship between the two species as suggested by MORAT still holds true. Because of their distinctly different flower size, the differences in the gynoeceum and the different scape diameters, it is quite clear that *P. bosseri* and *P. itremensis* are in fact two different species. The differences in habit and size may not be important, because investigations of *Syngonanthus chrysanthus* (BONG.) RUHL., *S. caulescens* (POIR.) RUHL. (STÜTZEL 1984) and *Paepalanthus tatei* MOLD. (STÜTZEL, 1985 a, b in press) have shown that even greater differences can occur within the variation range of a single species. Also, the number of flowers can range from 50 to more than 500 in cultivated plants of *P. tatei*.

The most important indication that *P. itremensis* and *P. bosseri* are closely related is found in the form of the stigmas and appendices in the two species. Usually in the other *Paepalanthoideae* and *Syngonanthoideae*, the appendices are thicker than the stigmas. The fact that they are thinner in *P. bosseri* may be interpreted as being the first step towards the (almost?) complete reduction of the appendices in *P. itremensis*. This trend becomes even more significant considering that such reductions are very rare in the family. Furthermore, the same hair types occur with the same distribution on the various organs in the two species.

In RUHLAND's (1903) taxonomic division of the genus *Paepalanthus*, *P. itremensis* and *P. bosseri* would have to be placed in the subsect. *Eupaepalanthus*, sect. *Eriocaulopsis* of the subg. *Paepalocephalus*. However, as the division of subg. *Paepalocephalus* according to RUHLAND's criteria has led to unsatisfactory and unhomogeneous groups a revision of this subgenus is urgently needed before relationships with other species in the genus can be suggested.

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