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A RECONSIDERATION OF *BRACHYCHILUM* PETERSEN (HEDYCHIEAE: ZINGIBERACEAE)

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The morphological difference between the monospecific genus *Brachychilum* and *Hedychium* is bridged by the recently described *Hedychium muluense* R. M. Smith. Cytological studies reported here show that at least one stock of *B. horsfieldii* (Wall.) O. Petersen shares the same basic chromosome number and morphology with *Hedychium*. The genus *Brachychilum* should therefore be placed in synonymy with *Hedychium*, and *B. horsfieldii* should revert to *Hedychium horsfieldii* [R. Brown ex] Wall.

INTRODUCTION

The genus *Brachychilum* currently contains one species, *B. horsfieldii* (Wall.) O. Petersen (Petersen, 1893), which is separated from *Hedychium* on one morphological character. The labellum of *B. horsfieldii* is very small, 2–4mm long, and much shorter than the corolla lobes which are c.20mm long (Fig. 1Ba) whilst the labellum of most species of *Hedychium* is approximately equal in length to the corolla lobes (see Figs 1Aa, 1Ca). Other than this *B. horsfieldii* is morphologically indistinguishable from *Hedychium*.

A morphological character which closely links *Brachychilum* with *Hedychium* is that the style is carried in a groove in the corolla tube in both genera (Smith, 1980a). While it is common to find the style held in a groove in the filament in the Zingiberaceae, the only genera in which it has so far been found in a groove in the corolla tube are *Brachychilum*, *Hedychium* (Hedychieae), *Zingiber* (Zingibereae), *Rhynchanthus* and *Stadiochilus* (Alpineae) (Smith, 1980a).

Cytological investigations appear to support the distinction between *Brachychilum* and *Hedychium*. Holzer (1952) published a count of $2n = 32$ for *B. horsfieldii*. Many species of *Hedychium* have been examined, most of them having the basic number $x = 17$ in at least one of the published counts (Newman, 1988: 26–27). While numbers not based directly on $x = 17$ have been reported, especially from polyploids and cultivated species, no report of a *Hedychium* with $2n = 32$ has been found.

When Smith (1982) published the description of a new species, *Hedychium muluense* she noted that it seemed to be intermediate between *B. horsfieldii* and other species of *Hedychium*. Figure 1Aa shows that the labellum is comparatively short; it is 10mm long, being the same length as the lateral staminodes, but 5–10mm shorter than the corolla lobes. In this character it is intermediate between many other species of *Hedychium* and *B. horsfieldii*. It also bears the style in a groove in the corolla tube (Fig. 1Ab).

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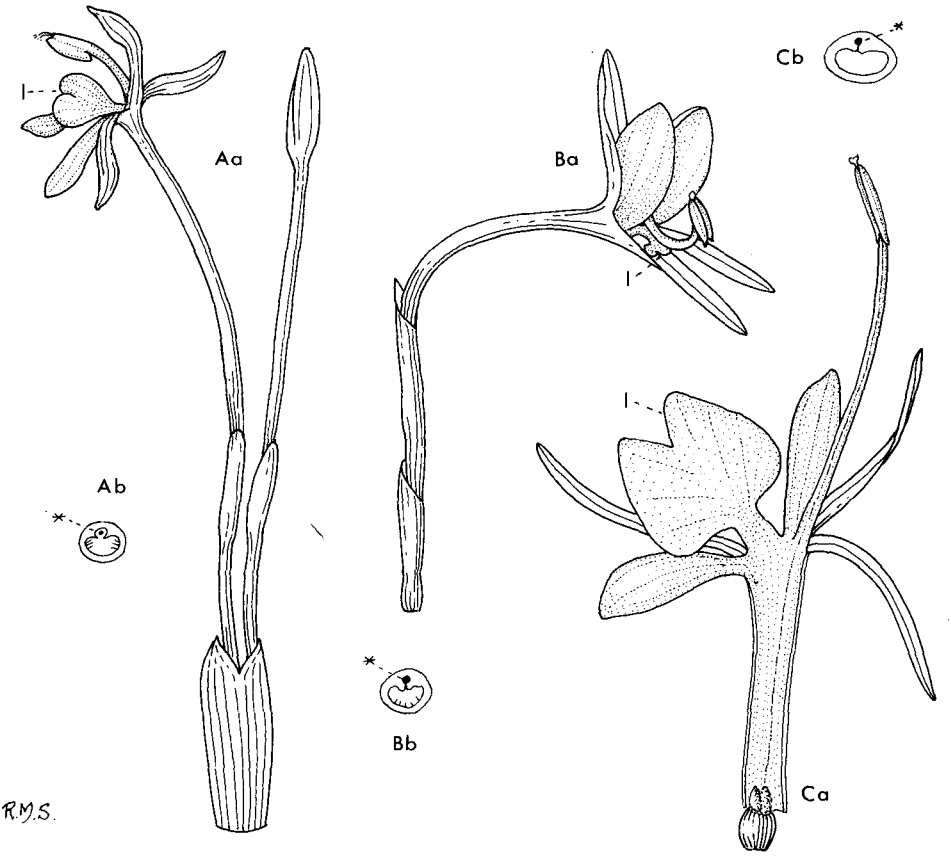

FIG. 1. A, *Hedychium muluense* R. M. Smith: a, cincinnus, showing open flower and first bracteole × 1; b, corolla tube in T.S. showing position of style × 2. B, *Brachychilum horsfieldii* (R. Br. ex Wall.) O. Peters.: a, flower with bracteole × 1; b, corolla tube in T.S. showing position of style × 2. C, *Hedychium coccineum* Buch.-Ham.: a, corolla, dissected × 1; b, corolla tube in T.S. × 2. (* = position of style; l = labellum).

MATERIALS AND METHODS

Both of the species examined were available as living plants at the Royal Botanic Garden Edinburgh. The plants of *B. horsfieldii* were of garden origin (RBG accession number 750167), while those of *H. muluense* (RBG accession number 773490, the type plant) came from Gunung Mulu in Sarawak.

Plants of these two species were grown in pots in the tropical glasshouse of the Department of Plant and Soil Science, University of Aberdeen. Root tips were collected just before midday and, in the early stages of the study, were pre-treated in 1-monobromonaphthalene or para-dichlorobenzene solution for 2–6 hours at 18–20°C. These pre-treatments produced unsatisfactory and inconsistent results. Later it was found that improved contraction of the chromosomes could be achieved by using the

method applied to other plants (e.g. palms) by Johnson (1985). The root tips were pre-treated for 24 hours at 4–5°C in 1-monobromonaphthalene. Following fixation in 3:1 ethanol and acetic acid or Carnoy's 6:3:1 (6 parts ethanol, 3 parts acetic acid and 1 part chloroform) the root tips could be stored in a refrigerator until required.

Two staining schedules were tested. In the first the root tips were softened for 10–15 minutes in 1M HCl at 60°C, rinsed and then left in Snow's (1963) alcoholic-hydrochloric acid-carmine for 24 hours.

The second schedule involved hydrolysis of the root tips in 5M HCl at room temperature (c.20°C) for 45–60 minutes followed by rinsing in distilled water and staining in Feulgen reagent for c.2 hours. After further rinsing the root tips were softened for about 1 hour in a 1:1 mixture of 5% cellulase and 5% pectinase at 35°C.

'Squashing' was done in 45% acetic acid using No. 1 coverslips.

Most slides were used as temporary preparations but voucher slides of both species were made. Those of *B. horsfieldii* (preparded earlier in the study) were made permanent by a modification of the freeze-drying method of Conger & Fairchild (1953). The slides were frozen on an aluminium block cooled in liquid nitrogen rather than on dry ice (Jong, pers. comm.). Those of *H. muluense* were made permanent by the vapour exchange method of Bradley (1948).

Results and Discussion

The second staining schedule was found to be a great improvement on the first. After softening the root tips in enzyme solution the tissues could be squashed very flat making it easier to photograph well-spread metaphases.

The diploid number of the plants of *B. horsfieldii* examined here is $2n = 34$. Most of the chromosomes appear to be metacentric, although it is rarely possible to see all the centromeres equally clearly in any one cell. All the chromosomes are small, ranging from 1.4–2.4μm in length (Fig. 2A).

The diploid number of *H. muluense* is also $2n = 34$ (Fig. 2B). Again the chromosomes are very small and appear to be mostly metacentric. This is the first report of a chromosome number in this species.

The finding that *B. horsfieldii* has $2n = 34$ chromosomes does not agree with that of Holzer (1952). His drawings show chromosomes of roughly the same size as are found here but there are only 32 of them. *B. horsfieldii* is a very characteristic species so misidentification is unlikely to have occurred. Furthermore, Holzer made counts from two cell types in his plants so his results seem to be consistent. Accordingly this anomaly should be borne in mind when further work is done on a wider sample of natural populations.

Until recently *Brachychilum* was held to be different from *Hedychium* on the basis of its short labellum, and this seemed to be supported by Holzer's chromosome count. With the discovery of *H. muluense*, however (for further details see Smith, 1982), the small labellum begins to look like the extreme of a range of labellum size. Furthermore, it has been demonstrated above that at least some plants of *B. horsfieldii* have the same chromosome number and morphology as *Hedychium*.

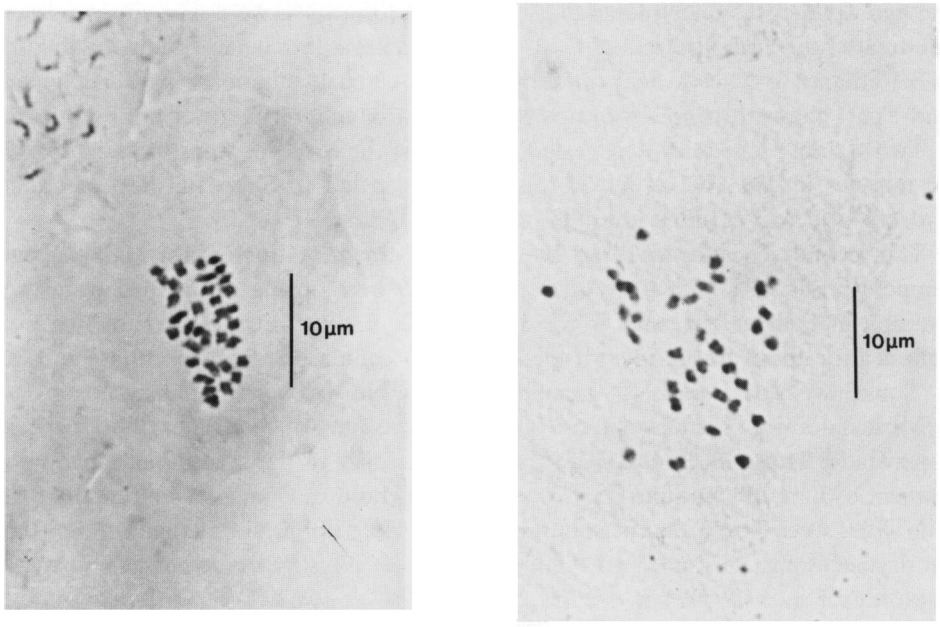

FIG. 2. A, *Brachychilum horsfieldii*: root tip metaphase, 2n = 34; B, *Hedychium muluense*: root tip metaphase, 2n = 34.

B. horsfieldii cannot now be distinguished from other species of *Hedychium*, either on morphological or cytological grounds and, what is more, it shares with *Hedychium* the character of a groove in the corolla tube holding the style. *B. horsfieldii* should, therefore, be returned to its original position in *Hedychium* (Wallich, 1853).

Hedychium horsfieldii [R. Brown ex] Wall. in Hooker's J. Bot. Kew Gard. Misc. 5: 376 (1853).

Syn.: *Brachychilum horsfieldii* (Wall.) O. Petersen in Bot. Tidsskr. 18: 262-263 (1893).

Type: Java, Mount Prahu, *Horsfield* (BM—hb Banks) n.v.

Note: Brachychilum tenellum K. Schum. has already been transferred to *Hedychium* as *H. tenellum* (K. Schum.) R. M. Smith (Smith, 1980b).

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