GERMINATION, SEEDLING, AND CHROMOSOME NUMBER OF SCYPHOSTEGIA BORNEENSIS STAPF (SCYPHOSTEGIACEAE)

DING HOU

Rijksherbarium, Leiden

SUMMARY

1. Germination of *Scyphostegia borneensis* is epigeal (or phanerocotylar).
2. The chromosome number has been found to be n = 9 and 2n = 18.
3. The somatic chromosomes are almost V-shaped, relatively symmetrical, each having a median or sub-median centromere.
4. Chromosomal information of *Scyphostegia* gives additional evidence for excluding this genus from the *Monimiaceae*.

INTRODUCTION

Ever since the remarkable Bornean genus *Scyphostegia* was described and placed in the *Monimiaceae* by Stapf (1894) and later a monotypic family *Scyphostegiaceae* was established by Hutchinson (1926), it has drawn much attention to its floral morphology and its taxonomical position or affinity. It has been extensively studied and widely discussed. For a detailed, historical review on its taxonomy and morphology, reference should be made to the papers by Van Steenis (1957), Van Heel (1967), and Croizat (1968).

The result of the comprehensive anatomical and ontogenetic investigations on the morphology of its flower and fruit, recently published by Van Heel (l.c.), throws light on the controversial subjects. He concluded that 'the *Scyphostegiaceae* must be placed in the *Parietales*. Of all the families in that order they must be nearest to the *Flacourtiaceae*, as judged from external characters'.

Croizat (1968) stated that '*Scyphostegiaceae* cannot belong to either "*Celastrales*" or "*Flacourtiales*", but may belong—on opinion—to different orders in turn'. He placed that family in a new order; this means that *Scyphostegia* is under a family and order of its own.

In the delimitation of the 'order' *Celastrales* based on pollen morphology, Lobreau (1969) found that *Scyphostegia* possesses some characters which have never been encountered among the '*Celastrales*'. She stated that according to pollen characters this genus is possibly allied to *Flacourtiaceae* or *Violaceae*, thus corroborating the anatomical study by Van Heel (cf. also Thorne, 1968).

Prof. Dr. C. G. G. J. van Steenis' great interest in this marvellous genus *Scyphostegia* has stimulated studies to contribute to our understanding of it. So far there has been nothing published concerning its seed germination, seedling, and chromosomes. It is appropriate to present information on these topics in a special publication dedicated to him.

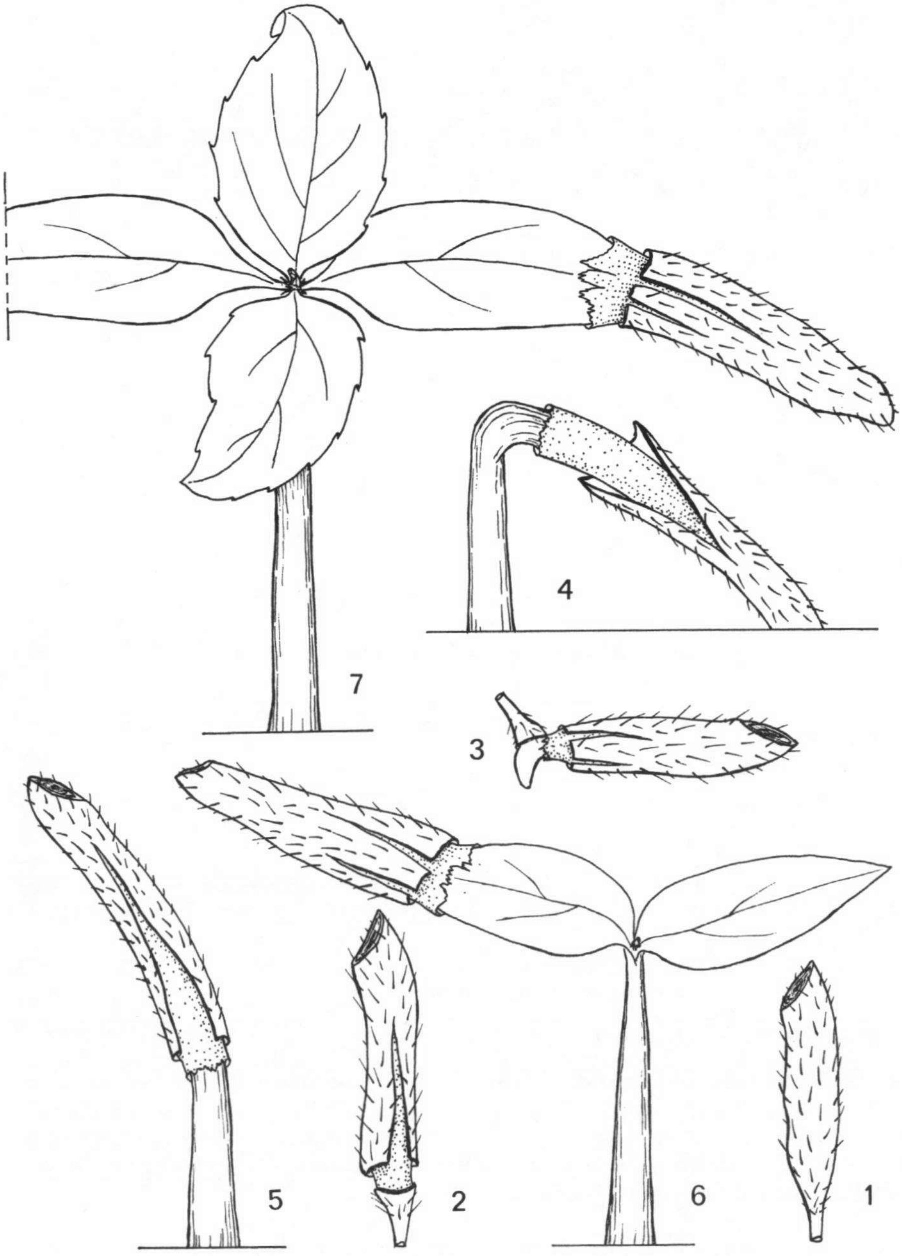

Fig. 1—7. Seed and early growth of seedling of *Scyphostegia borneensis* Stapf — 1. Seed in natural position. — 2—7. Seedling at successive stages of growth; 2 & 5. from seeds in natural position; 3—4. from horizontally placed seeds. (all × 5; *Nooteboom & Aban 1600*).

MATERIAL AND METHOD

In the Botanical Garden, Penang, Malaya, there are several cultivated (small) trees of *Scyphostegia borneensis*, which grew from cuttings sent from Mt Kinabalu by Mrs M. S. Clemens in about 1932 (oral comm. Prof. R. E. Holttum, Kew). Mr Cheang Kok Choy, Superintendent of the Garden, told me, when I visited the Garden in 1966, that they are all males, growing vigorously in the shade and flowering all year around. From those trees I collected and fixed flower-buds (voucher: *Ding Hou 851*, L) in Carnoy's solution in an early evening. In 1969 through my friend Dr H. Keng, University of Singapore, I received additional flowering material collected from the same source as mine but fixed in Carnoy's solution at daytime.

In 1970, Mr H. P. Nooteboom collected and sent me flower-buds, fixed in Carnoy's solution (voucher: Penibukan, secondary forest, alt. 1000 m, March 10, 1970, *Nooteboom & Aban 1539*, L) and dried fruits and seeds (voucher: Kampon Kiau I, behind rest house, in forest, alt. 950 m, March 12, 1970, *Nooteboom & Aban 1600*, L), from the native habitat of this species, Mt Kinabalu. As soon as the material arrived at Leiden by air on March 18, 1970, the seeds were prepared for germination in my office. Some seeds were laid horizontally on cotton in a Petri dish and some in compost in a pot. In order to keep relatively high humidity, the dish and pot were placed on a support (*c.* 5 cm high) in a glass tank (22 × 25 × 18 cm) containing water (*c.* 3 cm deep). A piece of glass plate was placed on supports over the tank leaving (about 2 mm) space for ventilation.

The procedure and technique for storage of fixed material and for squash preparations with aceto-carmine and/or -orcein used here are similar to those applied for material of *Trigonobalanus verticillata* Forman (Hou, 1971).

OBSERVATION AND DISCUSSION

Germination and seedling. The germination of *Scyphostegia borneensis* is epigeal (or phanerocotylar, see Duke, 1965). During germination, when the embryo grows, the testa starts to split near the proximal (funicle) end along the long axis. The radicle then pushes out of the testa and carries on its tip the apical, transversally broken, cap-like part of the coat (fig. 2). When the hypocotyl elongates its bent distal end, or the distal (chalazal) end of the seed, penetrates the soil surface (fig. 4 & 5). The cotyledons gradually expand into two ovate, green, entire blades above soil surface and one of them carries the remaining coat on its end (fig. 6).

The leaves of the first pair are opposite, stipulate, ovate, serrate, and alternate at right angles with the foliaceous cotyledons (fig. 7).

The only surviving seedling is growing very well into a small plant (Pl. 1: A) in the Botanic Garden, Leiden, under the care of Mr. Peter Bukhuizen.

Meiotic chromosomes. Many squash preparations of fixed flower-buds were made and examined. Finally, favourable stages of microsporogenesis with well spread chromosomes were observed. The haploid number was found to be n = 9 (Pl. 1 B), which is close to the original basic number of Angiosperms (x = 7) (cf. Ehrendorfer *et al.* 1968; Raven *et al.*, 1971).

Mitotic chromosomes. Squash preparations made from the flower-buds, radicles of germinating seeds, and roottips of the young plant mentioned above, were examined for the somatic chromosome number. Mitosis was observed in only a few cells of each preperation. As the material was fixed in the day it is possible that cell division mostly occurs at night. The somatic number was shown to be 2n = 18 (Pl. 1: C—F). There is little differentiation between the chromosomes. All are more or less V-shaped, relatively symmetrical, each having a median or sub-median centromere (Pl. I: C—F). Such chromosomes could be regarded as a primitive character (cf. Ehrendorfer *et al.*, 1968).

Scyphostegia was first included in the *Monimiaceae*. When more details became known, it was excluded from that family by later botanists and placed to one of its own. Van Heel (l.c.) recently also concluded that this genus 'cannot be related with the *Monimiaceae*'. I may add here that it has a haploid chromosome number n = 9, while representatives of *Monimiaceae* have much higher polyploid numbers, so far reported, n = 19, 22, 39, *c.* 43 (cf. Ehrendorfer *et al.*, 1968; Raven *et al.*, 1971). The chromosome information gives additional evidence for excluding *Scyphostegia* from that family.

So far, in the *Flacourtiaceae* the chromosome numbers are known only for three genera with n = 11, 12 (cf. Darlington & Wylie, 1955). As to the relationship between *Scyphostegiaceae* and that family, the chromosomal information available is insufficient for comparison.

ACKNOWLEDGEMENTS

The author is grateful to Mr H. P. Nooteboom and Dr H. Keng for the indispensable material, to Dr W. A. van Heel and Dr C. E. Ridsdale for critical reading of the manuscript, and to the Director of the Botanic Garden, Leiden, for providing facillities to grow the seedling.

REFERENCES

CROIZAT, L. 1968. The biogeograph of the tropical lands and islands east of Suez-Madagascar: with particular reference to the dispersal and form-making of Ficus L., and different other vegetal and animal groups. Atti VI, 4: 3—400.

DARLINGTON, C. D. & A. P. WYLIE. 1955. Chromosome atlas of flowering plants, 2nd ed.

DUKE, J. A. 1965. Keys for the identification of seedlings of some prominent woody species in eight forest types in Puerto Rico. Ann. Mo. Bot. Gard. 52: 314—350.

EHRENDORFER, E., F. KRENDL, E. HABELER and W. SAUER. 1968. Chromosome numbers and evolution in primitive Angiosperms. Taxon 17: 337—468.

HEEL, W. A. VAN. 1967. Anatomical and ontogenetic investigations on the morphology of the flowers and the fruit of Scyphostegia borneensis Stapf (Scyphostegiaceae). Blumea 15: 107—125.

HOU, D. 1971. Chromosome numbers of Trigonobalanus verticillata Forman (Fagaceae). Acta Bot. Neerl. 20: 543—549.

HUTCHINSON, J. 1926. Families of flowering plants, ed. 1.

LOBREAU, D. 1969. Les limites de l'"order" des Célastrales d'après le pollen. Pollen et Spores 11:499—555.

RAVEN, P. H., D. W. KYHOS and M. S. CAVE. 1971. Chromosome numbers and relationships in Annoniflorae. Taxon 20: 479—483.

STAPF, O. 1894. On the flora of Mount Kinabalu, in North Borneo. Trans. Linn. Soc. London. 2nd ser., Bot. 4: 69—263.

STEENIS, C. G. G. J. VAN. 1957. Scyphostegiaceae, in: Flora Malesiana I, 5: 297—299.

THORNE, R. F. 1968. Synopsis of a putatively phylogenetic classification of the flowering plants. Aliso 6: 57—66.