Karyomorphology of Rhoiptelea (Rhoipteleaceae)

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Abstract. Karyomorphology of Rhoiptelea chiliantha, the only species of Rhoipteleaceae, was studied for the first time. Rhoiptelea has the simple chromocenter type at interphase and 2n = 32. Of the 32 chromosomes at metaphase, the first and the second longest pair of chromosomes have a secondary constriction at median-submedian position; eight pairs have centromeres at median position, three pairs at median-submedian position, and three pairs at subterminal position. Despite its clear distinctness, Rhoiptelea best resembles Juglandaceae karyomorphologically within the higher Hamamelididae. Like Juglandaceae, Rhoiptelea have x = 16 and the secondary constriction in two pairs of the longest chromosomes. It is further discussed that Juglandales (Juglandaceae and Rhoipteleaceae) (x = 16) are probably of tetraploid origin from a common ancestor with Myricaceae (with x = 8)

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Rhoiptelea, comprising R. chiliantha Diels & Hand.-Mazz. which rarely occurs in northern Vietnam and southern China, is the only genus of the family Rhoipteleaceae. Because of shared pinnately compound leaves that are unique in Hamamelididae, Rhoipteleaceae are nearly always placed together with Juglandaceae in Juglandales (Cronquist, 1988; Dahlgren, 1989) or Juglandineae (Thorne, 1992). In a previous paper, Oginuma and Tobe (1992) discussed, on the basis of the karyomorphological information on seven of eight constituting genera, that Juglandaceae (predominantly x = 16) resemble Myricaceae (x = 8) and are probably of tetraploid origin from a common ancestor with Myricaceae.

In the present paper we present the karyomorphology of Rhoiptelea for the first time and discuss its evolutionary position on the basis of chromosome features.

Materials and Methods

Somatic chromosomes of Rhoiptelea chiliantha cultivated at the Kunming Institute of Botany, Academia Sinica, People’s Republic of China (voucher: Oginuma 9209, KYO) were examined on the basis of at least three cells of young leaves. Methods for pretreatment, fixation and staining followed those described by Oginuma et al. (1992). Categories of
chromosomes on the basis of the position of a centromere basically follow Levan et al. (1964).

**Observations**

*Rhoiptelea chiliantha* has chromatin threads and many chromomeric granules in interphase nuclei. About 15 to 20 darkly staining, round or ellipsoid, condensed blocks appear in an interphase nucleus (Fig. 1). The interphase nucleus is thus of the simple chromocenter type (for typification

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**Figs. 1-6.** Somatic chromosomes of *Rhoiptelea chiliantha* \((2n = 32)\). 1, 2, 3, and 4: Chromosomes at interphase, prophase, metaphase, and metaphase, respectively. 5 and 6: Drawings of chromosomes in Fig. 4 as they are (5) and arranged according to their size (6). Arrows indicate chromosomes with centromeres at subterminal position, and arrowheads indicate chromosomes with the secondary constriction. Scale bar = 2 \(\mu\)m.
see Tanaka, 1971, 1980). Chromosomes at prophase contain early and late condensing segments. The early condensing segments are confined to the proximal regions of two arms in most chromosomes, indicating a clear transition state into late condensing segments (Fig. 2).

Chromosomes at metaphase are counted $2n = 32$ (Figs. 3, 4). Their length varies gradually from about 0.6-$\mu$m to about 1.6-$\mu$m. Of 32 chromosomes, the first and the second longest pair of chromosomes (numbered 1–4) have a secondary constriction at median-submedian position. In the remaining 28 chromosomes, 16 have centromeres at median position (with arm ratio 1.0–1.6), six (numbered 5–6, 19–22) at median-submedian position (with arm ratio 1.7–2.2), and six (numbered 25–28, 31–32) at subterminal position (with arm ratio 3.1–3.7) (Figs. 5, 6).

**Discussion**

When compared to Juglandaceae as well as to other related families such as Myricaceae, Betulaceae, Casuarinaceae and Fagaceae of the `higher' Hamamelididae (for the delimitation of the 'higher' Hamamelididae see Hufford and Crane, 1989; for possible relationships between Juglandales and those four families see recent molecular studies of Chase et al. [1993] and Manos et al. [1993]), Rhoiptelea obviously best resembles Juglandaceae karyomorphologically (for karyomorphological data of Juglandaceae, Myricaceae, and the other families see Oginuma and Tobe [1992], Oginuma and Tanaka [1987], Morawetz and Samuel [1989], respectively). In fact, the basic chromosome number $x = 16$ is restricted to *Rhoiptelea* and Juglandaceae and is likely to be a synapomorphy supporting their mutual close affinities. In addition, both *Rhoiptelea* and Juglandaceae have two pairs of the longest chromosomes with the secondary constriction. They further agree with each other in having the simple chromocenter type of nucleus at interphase and both early and late condensing chromosome segments at prophase, although these are not necessarily restricted to *Rhoiptelea* and Juglandaceae.

However, *Rhoiptelea* is clearly distinguished from Juglandaceae in having three pairs of chromosomes with centromeres at subterminal position. Juglandaceae have only one pair of such chromosomes (as in *Platycarya, Carya, Juglans, and Pterocarya* [Oginuma and Tobe, 1992]) or even lack them (as in *Engelhardia* [unpublished data]). The difference in chromosome morphology therefore may support a distinctness of *Rhoiptelea* as a separate family within Juglandales.

Some evidence supports close relationships between Juglandales (Juglandaceae and Rhoipteleaceae) and Myricaceae (for example see Zavada and Dilcher [1986: pollen morphology] and Friis [1983: fossil record]). Myricaceae have one pair of the longest chromosomes with the secondary constriction and $2n = 16$ ($x = 8$) with no chromosomes having centromeres at subterminal position (Oginuma and Tanaka, 1987). We have the impression that the basic chromosome number of $x = 16$ in the Juglandales contains a double fold of the $x = 8$ of the Myricaceae-type of chromo-
somes. Therefore, the whole Juglandales \((x = 16)\), rather than only Juglandaceae (Oginuma and Tobe, 1992), are probably of tetraploid origin from an ancestral stock common with Myricaceae \((x = 8)\).

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References


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摘 要

荻沼一男・顧 志建・岳 中枢：ロイプテレア属（ロイプテレア科）の核形態

クルミ目（Juglandales）はクルミ科（Juglandaceae）とロイプテレア科（Rhoipteleaceae）からなっているが、ロイプテレア科の核形態についてはこれまで観察されていない。ロイプテレア科唯一の種 R. chiliantha の間期核、分裂期前期及び中期染色体の形態を初めて報告する。間期核が単純染色中央粒型、染色体数が 2n = 32 及び中期の 32 本の染色体中、最長の 4 本の染色体が二次狭帯を持つことはクルミ科に類似していることが分かった。しかしながら、32 本の染色体中、次端部型染色体を 6 本持つことは、2 本 (成いは持たない) を持つクルミ科とは相違していることが分かった。また、クルミ科と同様にロイプテレア科 (x = 16) は、2n = 16 (x = 8) の染色体組中、2 本の染色体が二次狭帯を持つヤマモモ科と共通の祖先から派生した四倍体と推察された。

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